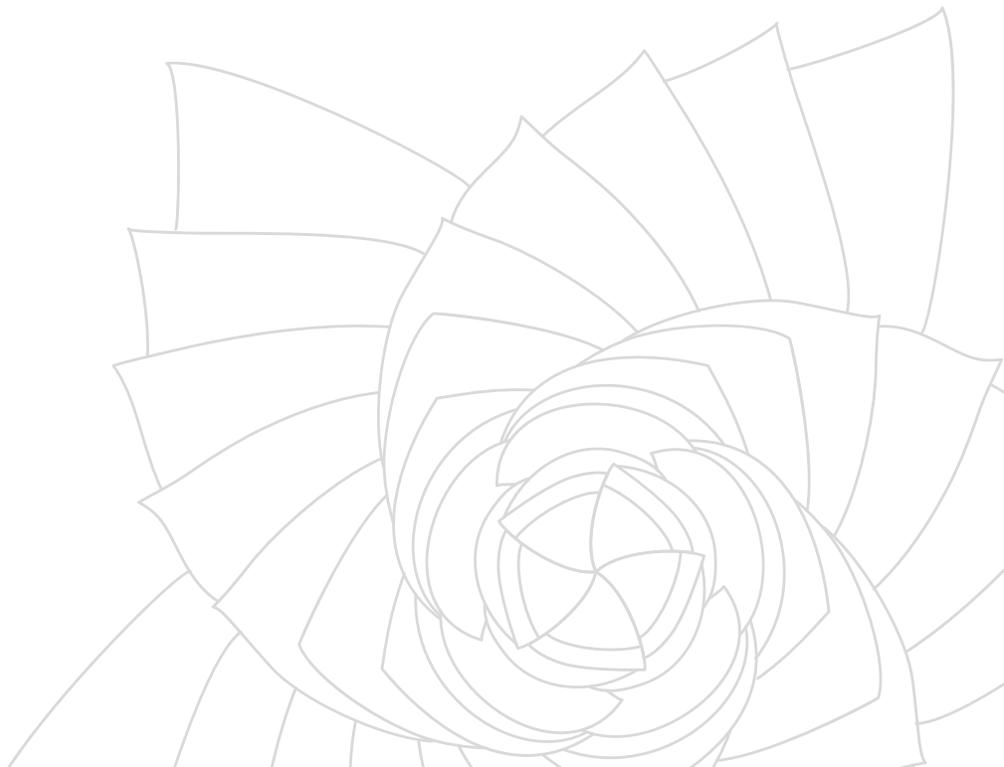




Annex 2.2  
Design Study: Proposed Outputs

31 May 2023



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## 1. ABOUT THE ANNEX

This annex is part of the wider Annex 2 on design study of the Community Resilience Partnership Program (CRPP).<sup>1</sup> Based on the climate risks faced by the seven countries selected under CRPP Investment Fund (IF), and national climate priorities, this annex presents the justification for proposed outputs 4, 5, and 6, to be financed by the Green Climate Fund (GCF) and introduces the tentative activities under each of the outputs. Projects to be financed by the CRPP IF, will cover either one or more of these outputs. For each project to be financed by the CRPP, the proposed output/s will be analyzed in the context of project specific climate risk assessments and as per the eligibility criteria set for the CRPP IF and described in Annex 2.4.

## 2. INTRODUCTION

The CRPP is a regional partnership program of the Asian Development Bank (ADB) which aims to help countries and communities in Asia and the Pacific region scale up investments in climate adaptation, especially investments at the community level, that explicitly target the nexus between climate change, poverty, and gender. The CRPP aims to contribute to transformational change by; (i) mobilizing large-scale public investments that support community level adaptation of poor and vulnerable people; (ii) developing national and local policies, plans, and programs that promote financing for community-led adaptation; and (iii) increasing the meaningful participation of poor women and men in resilience related decision-making. In doing so, the CRPP will address the points of procedural and distributive justice so that the people most vulnerable to the impacts of climate change can engage in a fair process and receive a fair share of the benefits of adaptation efforts.

The CRPP will support countries to meet their commitments to the Paris Agreement, the Sendai Framework for Disaster Risk Reduction, and the Sustainable Development Goals. The program responds to the COP26 goal of scaling up adaptation to protect communities and natural habitats, and mobilizing finance for climate adaptation measures that meet the needs of the poor and vulnerable communities. It is also identified as flagship program under the locally led action track of the Global Commission on Adaptation, which aims to spur financing for adaptation measures at the local level, and to help create structures that support appropriate subsidiarity and give local actors greater influence for adaptation-related decision-making. The CRPP is directly aligned with the core recommendations of the recently released Intergovernmental Panel on Climate Change's (IPCC) Working Group 2 Report "Climate Change 2022: Impacts, Adaptation and Vulnerability", which highlights that for adaptation efforts to be effective, they must be concentrated on promoting climate justice and supporting the most economically and socially marginalized populations, and calls for integrated, multi-sectoral solutions that address social inequalities and cut across systems.

The CRPP is operationalized through the Community Resilience Financing Partnership Facility (CRFPF) which was established by ADB in August 2021 and comprises two separate but interlinked components; the **CRPP Trust Fund (TF)** focusing on upstream support to strengthen the enabling environment required for implementing local adaptation measures at scale; and the

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<sup>1</sup> The other annexes under 2 includes (i) annex 2.1 country climate risk profile; (ii) annex 2.3 description of project concepts; and (iii) annex 2.4 eligibility criteria for CRPP IF projects.

**CRPP Investment Fund (IF)** focusing on the efficient roll-out of local adaptation measures through downstream investments.

The TF will provide technical assistance and grant resources financed by development partners and administered by ADB, to selected developing member countries (DMC) of the ADB to implement the following three outputs: (1) Knowledge and action research on climate risk informed pro-poor community-level solutions strengthened; (2) Institutional and community capacity to develop and deliver climate adaptation investments at community-level strengthened; and (3) Inclusive and pro-poor adaptation investment projects identified and prepared. The TF will include a dedicated Gender Window with funds earmarked specifically for providing technical assistance and grants for identifying, developing, and implementing investments that explicitly strengthen the resilience of women, particularly poor women, and/or adaptation investments led by women that have a specific focus on supporting women to build their resilience. The TF will have a budget of US\$75 million with roughly 15% earmarked for the Gender Window. To date, Government of United Kingdom, the Nordic Development Fund, and the French Development Agency has confirmed financial support for the TF, amounting to a total of ~ US\$68 million. The TF will **not** be funded by GCF.

The IF will provide grant and loan financing to seven selected DMCs, namely, Cambodia, Indonesia, Lao PDR, Pakistan, PNG, Timor-Leste, and Vanuatu, to implement local adaptation measures as part of ADB financed sub-projects that are targeted at the poor and vulnerable population. The IF will deliver three climate related **outputs** that are the focus of this annex (4) **information and systems** for delivering applied climate-risk informed local investments at scale improved; (5) climate resilient pro-poor **livelihoods** investments implemented; and (6) pro-poor climate adaptation **infrastructure** investments implemented. All sub-projects financed by the IF will be implemented by the respective governments following ADB's procedures. The GCF is requested to provide US\$100 million as grants and US\$20 million as loan for the seven countries identified above (with each country receiving between USD 12 to 25 million) in support of the IF of this program, while the ADB will provide USD 555 million of grant and loan financing. The program will utilize GCF grant resources to co-finance at least 15 sub-projects implemented under the IF only, for outputs 4, 5 and 6. The IF will be part of an ADB administered trust fund set up for GCF financed projects under the umbrella of the CRFPF.

The following sections present a summary of the climate change rationale and national climate priorities of the seven countries selected under CRPP Investment Fund (IF) which have guided the selection of the proposed outputs 4, 5, and 6, to be financed by the Green Climate Fund (GCF) and introduces the tentative activities under each of the outputs.

### 3. SUMMARY OF CLIMATE CHANGE RATIONALE GUIDING THE SELECTION OF OUTPUTS

The Asia and Pacific region is one of the most diverse regions, home to 4,180 million people (2019) accounting for 55% of global population and 34.9% of global gross domestic product (GDP).<sup>2</sup> The region is also one of the most disaster-prone regions in the world. Between 2000-2019, the region has experienced 3,068 disaster events accounting 42% of global events. Among those, rapid onset events such as floods accounted for 41% of the events impacting 1.5 billion people or 93% of affected global population, followed by tropical cyclones accounting 79% of total

<sup>2</sup> Asian Development Bank (ADB). 2019. *Key Indicators for Asia and the Pacific Region 50<sup>th</sup> edition*. Manila, Philippines. <https://www.adb.org/sites/default/files/publication/521981/ki2019.pdf>.

people affected and 90% of deaths globally.<sup>3</sup> Slow onset event such as drought is widespread and their impacts on agriculture, environment, health and water resources sector is very high. Moreover, extreme weather and climate events have resulted in disproportionate impacts on poor and vulnerable communities in rural and urban areas and causing widespread damage to livelihoods, infrastructure and environment. The average annual loss (AAL) for multi-hazard risk in Asia and the Pacific is estimated around US\$ 675,415 million, which is around 2.4% of regional GDP. Agricultural drought related AAL is estimated to be approximately 60% of the total AAL.<sup>4</sup> The AAL for countries in the region varies substantively depending on the exposure and vulnerabilities to various types of hazards. Overall occurrences of extreme weather and climate events are on a rise and its impacts are increasing due to high exposure and vulnerability of settlements in coastal zones and flood plains and the risk is reconfigured by drivers such as rapid and unplanned urbanization, provision of weak and inadequate infrastructure and basic services, and environmental degradation.

While impacts of climate change are already being felt in some of the sectors in the region, in the future, climate change can result in changes in frequency, intensity, spatial extent, duration, occurrence and timing of extreme weather and climate events, thereby resulting in unprecedented extreme weather and climate events, and sea level rise will pose significant threat to coastal communities and small island developing states (SIDS) in the region.<sup>5</sup> Projected key risks with high confidence includes (i) risk of death, injury, disrupted livelihoods in low-lying coastal zones and SIDS due to storm surges, coastal flooding and sea level rise; (ii) risk of severe ill-health and disrupted livelihoods for urban population due to inland flooding; (iii) risk of food insecurity and breakdown of food systems linked to warming, drought, flooding, precipitation vulnerability and extremes particularly for poorer population in urban and rural settings; (iv) risk of loss of rural livelihoods and income due to insufficient access to drinking and irrigation water and reduced agricultural productivity particularly for farmers; and (v) risk of loss of marine and coastal ecosystems, biodiversity and the ecosystem goods, functions and services they provide for coastal livelihoods.

According to Notre-Dame GAIN Index 2020, the rank of the selected seven countries range between 97 and 152 out of 192 countries [Cambodia 140, Indonesia 97, Lao PDR 142, Pakistan 152, PNG 149, Timor Leste 111, and Vanuatu 142]. Higher the country score, higher the vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. Estimates for the Asia-Pacific region show that growth will be significantly impacted in a warmer climate. Without climate action, the GDP in the region could decrease by as much as 3.3 per cent by 2050 and 10 per cent by 2100, relative to the base case; and South Asia, Southeast Asia, and the Pacific are projected to experience higher income losses arising from higher temperature.<sup>6</sup> Estimates suggest that climate change could push more than 100 million people in developing countries below the poverty line by 2030, with Asia and the Pacific being one of the main hotspots.<sup>7</sup> Detailed review of climate risks (discussed below) shows significant risk faced by the urban and rural communities of the region, with disproportionate impact on women, poor and vulnerable communities, and highlights the importance adopting

<sup>3</sup> Center for Research on Epidemiology of Disasters (CRED) and United Nations Office for Disaster Risk Reduction (UNDRR). 2020. *The Human Cost of Disasters: An Overview of the Last 20 years (2000-2019)*. Switzerland.

<sup>4</sup> United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP). 2019. *The Disaster Riskscape Across Asia-Pacific Pathways for Resilience, Inclusion and Empowerment*. Asia Pacific Disaster Report 2019. Bangkok, Thailand. Note the geographic coverage is slightly different of ADB member countries.

<sup>5</sup> Intergovernmental Panel on Climate Change (IPCC). 2012. *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*.

<sup>6</sup> Lee M, Villaruel M, and Gasper R. 2016. *Effects of Temperature Shocks on Economic Growth and Welfare in Asia*. ADB Economics Working Paper Series. Manila, Philippines.

<sup>7</sup> Hallegatte, Stephane, et.al. 2016. *Shock Waves: Managing the Impacts of Climate Change on Poverty*. Climate Change and Development Series. Washington, DC: World Bank.

climate risk informed decision-making, pursuing resilient livelihoods, and investing in adaptive infrastructure. Moreover, the adverse impacts of climate change are manifested largely at the local level due to the local socioeconomic, ecological, institutional and governance characteristics. Hence, the need for local adaptation solutions that are tailored to the specific physical and socioeconomic characteristics of local contexts.

**Rainfall.** Rainfall associated with monsoon plays an important role in supply of fresh water across vast part of the region. Freshwater resources are particularly important for countries in Asia and the Pacific because of its large population and heavy economic dependence on agriculture and associated activities. In Timor-Leste, agriculture accounts for more than 90 percent of freshwater withdrawals.<sup>8</sup> Trends in rainfall including extreme events in the region are characterized by strong variability, with both increasing and decreasing trends in different parts and seasons.<sup>9</sup> In Lao PDR the rainfall has been erratic, intensity of sub-daily extreme rainfall events and monthly rainfall with an intensity of more than 600mm has increased; in PNG intensive rainfall events in the highland areas have resulted in landslides and decreased rainfall has led to droughts, and in Timor-Leste, rainfall analysis indicates a reduction in mean annual rainfall and more pronounced during December–February.<sup>10,11</sup> In the future, climate change is likely to affect water resources through reduced renewable surface water and ground water resources.<sup>12</sup> Projected impacts of climate change on future fresh water availability differ substantially among river basins and seasons and there will be an increase in water demand leading to significant water stress. In Indonesia climate change projections show a varied pattern of rainfall changes both spatially and temporally; in Timor-Leste, annual rainfall is expected to increase, with significant inter-annual variability in rainfall, potential changes in the seasonality and intensity of rainfall; in PNG intensive rainfall events can increase to 20-30% by 2090; and in Lao PDR due to increased rainfall in sub-basins of Mekong will have higher discharge leading to increased floods. There is a need for adaptive water management practices that adopts flexible and low regret options to deal with variable rainfall and uncertain climate and hydrological changes in the region. It is also important that such practices are selected based on a robust understanding of how existing forms of socioeconomic vulnerabilities of the poor and marginalized population may be compounded by climate change, in order to ensure the selected adaptive water management practices support building of adaptive capacity of poor households and communities in the short and long run.

**Temperature.** Warming trends and increasing temperature extremes has been observed across most of the region during the past century, including increase in numbers of warm days and decrease in numbers of cold days. Increase in temperature has also resulted in increase in heat wave frequency across large parts of Asia since the middle of 20<sup>th</sup> century. In Pakistan, many regions experience temperatures of 38°C and above on an annual basis, when weather patterns

<sup>8</sup> United States Agency for International Development (USAID). 2017. *Climate Risk Profile*.

<sup>9</sup> Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan. *Asia. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y. O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P. R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370. 2014. [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24_FINAL.pdf).

<sup>10</sup> Westra, S., Fowler, H. J., Evans, J. P., Alexander, L. V., Berg, P., Johnson, F., Kendon, E. J., Lenderink, G., Roberts, N. 2014. *Future changes to the intensity and frequency of short-duration extreme rainfall*. *Reviews of Geophysics*, 52, 522–555. URL: <https://agupubs.onlinelibrary.wiley.com/doi/epdf/10.1002/2014RG000464>

<sup>11</sup> The World Bank Group Climate Change Knowledge Portal (CCKP). 2018. *Climate country overview*. <https://climate.knowledgeportal.worldbank.org/country/timor-leste/climate-data-historical>

<sup>12</sup> Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan. *Asia. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y. O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P. R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370. 2014. [https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24_FINAL.pdf).

converge to deliver prolonged periods of heat wave, they result in serious human health impacts. A study estimates that Pakistan experienced 126 heat waves between 1997–2015, around 7 per year, and detected an increasing trend.<sup>13</sup> In Timor -Leste, climate projections shows increase in intensity and frequency of days of extreme heat and in Lao PDR, increase in temperatures, along with a decrease in rainfall during the dry season, leading to longer and severe droughts.<sup>14</sup> Changes in temperature and rainfall patterns and the occurrence of extreme weather events, among others in the region have direct repercussions on the productivity and sustainability of rural livelihoods, food and nutrition security.<sup>15</sup> There are needs for interventions to deal with heat stress, especially in urban areas, targeted at the urban informal settlements and workers. Such investments could include a range of measures, including improved climate services for local preparedness planning, low-cost climate resilient housing, improvement of public health infrastructure, and outdoor infrastructure for informal workers (such as street vendors).

**Flooding.** Large number of people are exposed to riverine, coastal and urban flooding in Asia and the Pacific. There has been increase in such flooding events leading to widespread damage to settlements, infrastructure and livelihoods in Asia.<sup>16</sup> In Pakistan, between 2006 and 2016, almost two-thirds of all damage and loss to crops were caused by floods. The unusually large rainfall from the 2010 monsoon caused the most catastrophic flooding in Pakistan's history flooding one-fifth of the country, affecting 20 million people, and claiming over 2,000 lives and agriculture sector alone accounted for US\$ 4.5 billion worth of damage. In Lao PDR, extreme flooding in 2013 affected over 350,000 people, killed thousands of livestock, and damaged 15,000 ha of rice crop as well as core national infrastructure including bridges and schools.<sup>17</sup> Flooding poses a major risk for PNG, on an average, at least 22,000 people are affected by river flooding, causing damages of over US\$ 8 million and around 8,000 people are affected by coastal flooding every year, causing over US\$ 10 million in damages. In Vanuatu over 10,000 people and several thousand infrastructure assets are exposed to riverine flooding and several hundred people and infrastructure assets are exposed to coastal flooding. An ADB study highlighted that many households in Lao PDR have a high probability of falling into extreme poverty even when exposed to relatively high frequency flood and drought events.<sup>18</sup> In Timor-Leste, an event occurring once in every five years has approximately a 50% chance of pushing a household into extreme poverty. Riverine and flash flooding due to extreme rainfall were experienced in 2001, 2003, 2006, 2013, 2019 and in 2020. La Niña events are frequently associated with heavy rainfall and increased flooding in Timor Leste. The global flood risk ranking by World Research Institute's reveals Pakistan and Indonesia ranks among top 15 countries globally, and also account for 80 percent of population affected in an average year.<sup>19</sup> Considering 2010 as baseline year, for a 1 in 25-

<sup>13</sup> Nasim, W., Amin, A., Fahad, S., Awais, M., Khan, N., Mubeen, M., . . . Jamal, Y. *Future risk assessment by estimating historical heat wave trends with projected heat accumulation using SimCLIM climate model in Pakistan*. 2018. *Atmospheric Research*: 205: 118–13

<sup>14</sup> The World Bank. *Climate Risk and Adaptation Country Profile*. Washington D.C. 2014. [https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb\\_gfdr\\_climate\\_change\\_country\\_profile\\_for\\_LAO\\_0.pdf](https://climateknowledgeportal.worldbank.org/sites/default/files/2018-10/wb_gfdr_climate_change_country_profile_for_LAO_0.pdf).

<sup>15</sup> Klein, R. J. T., et al. 2014. *Climate change 2014: impacts, adaptation and vulnerability*. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK.

<sup>16</sup> Hijioka, Y., E. Lin, J.J. Pereira, R.T. Corlett, X. Cui, G.E. Insarov, R.D. Lasco, E. Lindgren, and A. Surjan. *Asia. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y. O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P. R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1327-1370. 2014. "[https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24\\_FINAL.pdf](https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap24_FINAL.pdf).

<sup>17</sup> United Nations Office for the Coordination of Humanitarian Affairs (UNOCHA). *Lao People's Democratic Republic Overview*. Reliefweb report. 2013. URL: <https://reliefweb.int/country/lao>.

<sup>18</sup> Asian Development Bank (ADB). 2017 *Risk financing for rural climate resilience in the greater Mekong subregion*. Greater Mekong Subregion Core Environment Program. Manila, Philippines.

<sup>19</sup> World Resources Institute (WRI). *Aqueduct Global Flood Risk Country Rankings*. <https://www.wri.org/resources/data-sets/aqueduct-global-flood-risk-country-rankings>

year flood event in Indonesia, about 1.5 million can be affected annually and resulting in urban damage of US\$ 1.4 billion; in Pakistan, 1.5 million people can be affected, resulting in urban damage estimated at US\$1.4 billion; and in Lao PDR about 48,000 people can be affected and the expected annual damages is around US\$159 million. Risk due to flooding will continue to rise, due to changes in precipitation patterns, sea level rise and storm surges, along with increased economic development in high risk areas. Even under lower emissions pathways consistent with the Paris Climate Agreement, almost all Asian countries face an increase in the frequency of extreme river flows.<sup>20</sup> What would historically have been a 1-in-100-year flow, could become a 1-in-50 year or 1-in-25-year event in most of South, Southeast, and East Asia. (footnote 17) While there is uncertainty around climate change impacts, climate change could amplify coastal flood risk by 19-37% of expected annual damage by 2030 in Indonesia.<sup>21</sup> This calls for increased investments in flood risk management which adopts a combination of structural (grey and green) and nonstructural measures, identified based on local conditions and needs, and offer robust performance under a variety of future scenarios. Expected increase in floods also calls for improved systems early warning systems, disaster preparedness and response targeted at the poor and vulnerable population through national social protection programs.

**Tropical Cyclone.** Tropical cyclone or typhoons associated strong winds, heavy to extreme rainfall, storm surges also result in coastal erosion, saltwater intrusion and affect the coastal and island communities. Cyclone can result in extensive damage to urban and rural settlements, infrastructure, water supply, eco-systems and disrupt food production. Due to its large coastal population, countries in Asia and the Pacific region, especially the SIDS are highly vulnerable. Vanuatu experiences around 20-30 cyclones each decade. In 2015 Cyclone Pam, a category 5 tropical cyclone, struck Vanuatu killing 11 people, destroying or damaging over 17,000 buildings and displacing 65,000 people. The economic damages associated with the event were estimated to be equivalent to around 64% of GDP. Cyclone Pam, caused severe damage to marine and coastal ecosystems such as coral reefs and mangroves, and to tropical forests which are an important ecosystem services for water regulation, nursery services for fisheries, and protection against natural hazards.<sup>22</sup> On an average, around 15 tropical cyclones pass through PNG's exclusive economic zone, around a quarter of which is category 3 or stronger (severe events). Flooding and inundations have been experienced in low lying islands even cyclone passing a long way from PNG can result of elevated water levels. A 1-in-100-year cyclone landfall is estimated to cost around 8.4% of GDP as of 2011.<sup>23</sup> While there has been substantial reduction of mortality over the past few decades due to improved early warning systems and disaster preparedness, the damages and disruptions caused by cyclones are on rise, concurrently with increased development and investments in the coastal areas. Climate change and associated sea level rise is expected to interact with cyclone hazard in complex ways that are currently poorly understood. While there is uncertainty on increase or decrease in global frequency of cyclones, mean windspeed and rainfall rates are likely to increase globally. With the current observed upward trends in mean sea level together with projected increases for 2100 and beyond, indicate that coastal systems and low-lying areas will increasingly experience extreme sea levels and their adverse impacts during storm surges. Recognizing the large impacts faced by the poor and vulnerable community, including communities with livelihoods dependent on coastal resources, it

<sup>20</sup> Paltan, H., Allen, M., Hausteine, K., Fuldauer, L., & Dadson, S. 2018. *Global implications of 1.5°C and 2°C warmer worlds on extreme river flows* *Global implications of 1.5°C and 2°C warmer worlds on extreme river flows*. Environmental Research Letters, 13. <https://doi.org/10.1088/1748-9326/aad985>

<sup>21</sup> Muis, Sanne & Aerts, Jeroen & Ward, Philip. 2018. *Flood risk and adaptation strategies under climate change and urban expansion: A probabilistic analysis using global data*.

<sup>22</sup> Government of Vanuatu. 2015. *Second National Communication*.

<sup>23</sup> Paltan, H., Allen, M., Hausteine, K., Fuldauer, L., & Dadson, S. 2018. *Global implications of 1.5°C and 2°C warmer worlds on extreme river flows* *Global implications of 1.5°C and 2°C warmer worlds on extreme river flows*. Environmental Research Letters, 13. <https://doi.org/10.1088/1748-9326/aad985>

is important to scale up adaptation measures that will protect lives and livelihoods from cyclone risk. This includes measures, such as green infrastructure in form of coastal defenses, multipurpose emergency shelters, and improved early warning to help roll out social protection programs.

**Drought.** Unlike rapid onset hazards, drought is an insidious hazard, characterized by lower-than-normal rainfall extended over a season or longer period. Drought can result in cascading impacts such as food insecurity, famine, epidemics and also migration for alternative livelihoods. On an average, severe drought events occur every five years in South East Asia. In PNG, small-scale farming in upland, rainfed areas are impacted by seasonal drought due to limited water storage facilities and lack of rainfall. In Indonesia, prolonged droughts associated El Niño Southern Oscillation (ENSO), triggered intense fire events in 1997 and 2015.<sup>24</sup> Lao PDR is exposed to frequent droughts, and severe drought occurred in 1996, 1998, 2003 and 2007. Drought occurrences can be intensified further by hydropower development on the Mekong river and alterations in the hydrology of the region. The SE Asia region faced one of the most severe droughts during 2015-2020. Over 210 million people were exposed to severe drought conditions and around 325 million at some point. The spatial coverage and intensity of droughts were highest since the major El Niño of 1997-1998.<sup>25</sup> Climate change will be a stress multiplier, and its effects will be most pronounced among groups which are already poor and marginalized. In Indonesia, climate change projections point to more frequent and severe droughts and subsequently more forest fires. Some studies show that increased fire risk is not only associated with drought years, but also temperature rise in non-drought years.<sup>26,27</sup> Rural communities which are relatively isolated and reliant on rain-fed, subsistence agriculture have limited access to resources and have limited capacity to cope with, and recover from, climate-related hazards. Although there remains uncertainty over how the ENSO cycle will change under climate change, current understanding suggests that severe El Niño events will become more common during the course of the century, and there may also be an increase in the frequency of El Niño events, with the result that the likelihood of severe drought can also increase.<sup>28,29</sup> Targeted investments will be needed to support poor communities deal with drought risk through diversification of livelihoods, water harvesting infrastructure, and improved early warning systems. Critical will be to ensure that decisions for such interventions are closer to the ground, in order to reflect local priorities and needs, especially of women's needs.

**Sea level rise.** Sea level rise will impact large population, assets and infrastructure along the coastal communities and ecosystems with irreversible changes across the Asia and Pacific. Some of the low-lying areas and SIDS in the region are expected to face significant impacts and need significant investments to maintain and restore coastal infrastructure and eco-systems. Indonesia is in particularly exposed to sea-level rise, with nearly 40 million living in areas less than 10 m

<sup>24</sup> Field, R.D., Van Der Werf, G.R., Fanin, T., Fetzer, E.J., Fuller, R., Jethva, H., Levy, R., Livesey, N.J., Luo, M., Torres, O. and Worden, H.M., 2016. Indonesian fire activity and smoke pollution in 2015 show persistent nonlinear sensitivity to El Niño-induced drought. *Proceedings of the National Academy of Sciences*, 113(33), pp.9204-9209.

<sup>25</sup> UNESCAP. 2020. *Ready for the Dry Years Building resilience to drought in South-East Asia With a focus on Cambodia, Lao People's Democratic Republic, Myanmar and Viet Nam: 2020 Update*. Bangkok, Thailand.

<sup>26</sup> Lestari, R.K., Watanabe, M., Imada, Y., Shioyama, H., Field, R.D., Takemura, T. and Kimoto, M., 2014. *Increasing potential of biomass burning over Sumatra, Indonesia induced by anthropogenic tropical warming*. *Environmental Research Letters*, 9(10), p.104010.

<sup>27</sup> Fernandes, K., Verchot, L., Baethgen, W., Gutierrez-Velez, V., Pinedo-Vasquez, M. and Martius, C.2017. *Heightened fire probability in Indonesia in non-drought conditions: the effect of increasing temperatures*. *Environmental Research Letters*, 12(5), p.054002.

<sup>28</sup> McPhaden, M. J., A. Santoso, and W. Cai. 2019. *Understanding ENSO in a changing climate*. *Eos*, 100. DOI: <https://doi.org/10.1029/2019EO124159>. Published on 23 May 2019.

<sup>29</sup> Wang, B. et al.2019. *Historical change of El Niño properties sheds light on future changes of extreme El Niño*. *Proceedings of the National Academy of Sciences* 116 (45) 22512-22517

above sea level and of which 30% in urban areas.<sup>30</sup> Rising sea-levels and strong wave action can lead to significant coastal erosion leading to permanent inundation, higher tides and land subsidence, affecting urban and informal settlements, agricultural lands, ponds and harbours / airports.<sup>31</sup> Similarly, Pakistan's coastline holds considerable vulnerability to sea-level rise and its associated impacts. Large tracts, around 4,750 km<sup>2</sup> of Indus Delta lies below 2m above sea-level.<sup>32</sup> Salinity intrusion continues to be a major challenge in the coastal zone, degrading land quality and agricultural yields. Sea levels in the Pacific have generally been rising faster than global averages although there are variations across PNG. In line with the increasing trends, by 2090 sea level can increase by 89 cm and about 2m by 2100 if high-end Antarctic ice-sheet loss is included in the calculations. In the case of Vanuatu, sea level rise has been at a rate of around 6 mm per year, slightly faster than the global average between 1990 and 2010.<sup>33</sup> Subsidence of land due to tectonic movement can significantly threaten the coastal areas and result in permanent inundation. Adaptation measures to tackle sea level risk will be critical, especially for SIDS countries and should include rehabilitation of green infrastructure, coastal infrastructure, resilient livelihoods, and adaptive water management infrastructure.

#### 4. NATIONAL CLIMATE CHANGE PRIORITIES AND ACTIONS

Following paragraphs summarizes the key national priorities and actions identified by the countries in response to extreme weather and climate events and future climate change related risks.

##### Cambodia

Cambodia with an estimated population of 16 million (2018) graduated to lower-middle income in 2015. It is undergoing transition from agriculture, into a narrow industrial base and low value added productions in garment and agriculture sector.<sup>34</sup> Over 80% of its population live in rural areas and agriculture sector plays an important role in rural livelihoods, food security and poverty reduction. Agriculture remains mostly subsistence while contributing to 24.9% of GDP (2018), while it has been experiencing slower growth in the recent years.<sup>35</sup> Much of the farming is rain-fed and many irrigational schemes are not functional.<sup>36</sup> While there is high potential for growth in agriculture sector, productivity remains low with limited agricultural services and high production cost. Country receives 90% of rainfall between May to early October while also experiences recurrent floods affecting central plains and coastal areas affecting agriculture, fisheries, tourism, transportation sectors. Drought impacts are wide spread across the country. Impacts of the floods and drought are widely felt as approximately 52% of the population live in the central plains, 30% around the Tonle Sap Lake areas. While the country is protected from tropical cyclones originating in South China Sea and the Pacific by long mountain ranges, Typhoon Ketsana in 2009 exposed the vulnerability of agriculture and infrastructure sectors. In addition, storms and lightning strikes also pose significant threat. According to estimates in 2010, annual flooding along Mekong River

<sup>30</sup> Neumann et al. 2015. "Future Coastal Population Growth and Exposure to Sea-Level Rise and Coastal Flooding". PLOS ONE. doi:10.1371/journal.pone.0118571.

<sup>31</sup> Ministry of Environment. 2015. *Cambodia's Second National Communication under the United Nations Framework Convention on Climate Change*. General Secretariat, National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh. <https://unfccc.int/resource/docs/natc/khmn2.pdf>

<sup>32</sup> Syvitski, J. P. M., Kettner, A. J., Overeem, I., Hutton, E. W. H., Hannon, M. T., Brakenridge, G. R., . . . Nicholls, R. J. 2009. *Sinking deltas due to human activities*. *Nature Geoscience*, 2(10), 681–686

<sup>33</sup> Second National Communication

<sup>34</sup> United Nations Development Programme (UNDP). 2019. *Draft Country Programme Document*.

<sup>35</sup> ADB. 2017. *Report and Recommendation of the President to the Board of Directors: Proposed Loan, Grant, and Administration of Grant Kingdom of Cambodia: Irrigated Agriculture Improvement Project*. Manila, Philippines.

<sup>36</sup> ADB. 2017. *Report and Recommendation of the President to the Board of Directors: Proposed Loan and Administration of Loan and Grant Kingdom of Cambodia: Climate-Friendly Agribusiness Value Chains Sector Project*. Manila, Philippines

and Tonle Sap basins results in \$100170 million each year and in 2015, climate related disasters resulted in losses of \$ 1.5 billion or 10% of its GDP.<sup>37,38</sup>

The country is highly vulnerable to impacts of climate variability and change, and impacts will be felt in increased frequency of disaster events disproportionately affecting the poor who are dependent on climate sensitive livelihoods. Increase in rainfall would vary across location and time and it is projected that low land areas will be affected more than the high land areas. Sea level rise along the coastal areas can permanently inundate around 25,000 ha for a 1 meter rise and increase to 38,000 ha for 2 meter. In addition sea level rise also will impact coastal ecosystems, erosion, salt water intrusion etc. Vulnerability Index developed as part of SNC, shows that much of the communities are categorized as vulnerable to extremely vulnerable and Phnom Penh, capital city falls into extremely vulnerable. Climate change impacts on rice yield can have substantive impacts due to shorter rainy seasons and longer and drier dry seasons. Lack of adaptation to changing climate can result in as much as 10% losses in rice yield in wet season and 8% in dry seasons by 2050. Similar, inland fisheries is expected to have significant impacts (USAID, 2019).<sup>39</sup> Despite high risk, farmers adaptation to climate change and delivery of agricultural marketing information is not comprehensive yet.

The **Cambodia Climate Change Strategic Plan for 2014–2023** lists the priority and actions of the government towards a low carbon, resilient, equitable and sustainable society. The plan also recognizes the importance of engaging the wider stakeholders such as public, civil societies, private sector and other development organizations. The **National Strategic Development Plan (2019-2023)** recognizes climate change as one of the four mega threats that can affect Cambodia and the challenges related to slow economic growth and constraints due to diversification and promotion of agriculture sector, and need to manage environment and natural resources and climate change impacts for sustainability and stability of its growth. The SNC has identified the need to strengthen technical and institutional capacity of ministries in climate change impact assessments and mainstreaming adaptation in sector and sub-sector development plans. **The Rectangular Strategy Phase IV (RS-IV)** of the Government has also identified the need to strengthen the capacity and governance of public institutions, at both national and sub-national levels, to ensure effectiveness and efficiency of public services delivery as one of its four goals. The ongoing decentralization reform process through delegation of power, transfer of functions, resources and techniques from national to sub- national administration will be an important opportunity to address climate change related risks in Cambodia.

## Indonesia

Indonesia, with a population of 270 million is the largest archipelago nation in the world. It is prone to range of recurrent climate related disasters such as floods, droughts, heat waves, rainfall induced landslides and other geological hazards. The country ranks 12th out of 35 countries that face high mortality rates due to multiple hazards such as tsunamis, earthquakes, fires, landslides, floods, and droughts.<sup>40</sup> Coastal areas and cities are densely populated and are undergoing rapid urbanization. Approximately 150 million Indonesians are living in urban areas, with a projection of

<sup>37</sup> Ministry of Environment. 2015. *Cambodia's Second National Communication under the United Nations Framework Convention on Climate Change*. General Secretariat, National Council for Sustainable Development/Ministry of Environment, Kingdom of Cambodia, Phnom Penh. <https://unfccc.int/resource/docs/natc/khmnc2.pdf>

<sup>38</sup> USAID. 2019. *Climate Risk in Cambodia: Country Risk Profile*. [https://reliefweb.int/sites/reliefweb.int/files/resources/2019\\_USAID\\_Cambodia%20CRP.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/2019_USAID_Cambodia%20CRP.pdf)

<sup>39</sup> Ibid

<sup>40</sup> Ministry of Foreign Affairs of the Netherlands. 2018. *Climate Change Profile Indonesia*. <https://www.government.nl/ministries/ministry-of-foreign-affairs/documents/publications/2019/02/05/climate-change-profiles>.

200 million by 2035, or roughly 67 percent of the total population.<sup>41</sup> The high population density in these coastal cities further increases Indonesia's exposure to natural hazards. Approximately 40 percent of Indonesia's population (over 100 million) are at risk, and more are expected to be as climate change exacerbates these hazards. While the climate change related impacts are already being felt, in the future the impacts can lead to increased frequency of extreme climate events and extended dry seasons, while sea level rise, increase temperature and changes in rainfall patterns poses significant threat to the country. Climate change is expected to disproportionately affect the urban poor as they depend on land and water resources for their livelihoods living in high-risk areas with inadequate urban infrastructure and housing, and have few alternative livelihood options and social safety nets. Of Indonesia's 150 million urban residents, approximately 10 million are poor; 46 million live in slums 30 million do not have access to clean water and sanitation; and 6 million practice open defecation.<sup>42,43,44,45.</sup>

The Government considers climate change mitigation and adaptation as an integrated concept to build resilience in safeguarding food, water and energy resources.<sup>46</sup> Natural and built environmental degradation has been identified as a cross-cutting issue of national importance due to interconnected impacts of climate change.<sup>47</sup>

Over the past decade, the government has enacted Indonesia Adaptation Strategy (2011), National Action Plan for Adaptation to Climate Change (DNPI, 2011), Indonesia Climate Change Sectoral Road Map (2010), and sectoral adaptation plans. Indonesia's **National Action Plan for Adaptation to Climate Change (RAN-API)** prioritizes four sectors for adaptation, namely, agriculture, water, marine and coastal and health, each of which is critical for strengthening resilience of the urban and rural poor population. It further identifies infrastructure, governance, technology and capacity building measures for adaptation. In infrastructure, green infrastructure is recognized as a key priority, especially for the low-income people and vulnerable groups. In governance, the RAN-API prioritizes strengthening of institutions and information systems in order to ensure benefits of adaptation are reaching the poor and vulnerable population. The RAN-API recognizes the need for resilience of special areas such as urban, coastal and small islands while promoting economic, livelihood and environmental resilience.

Strategy to achieve the above includes improving the quality of urban, coastal and small island environment, adjustment and increasing the quality of urban infrastructure, adaptation structures (structural and non-structural) measures in coastal and small island. Strengthening resilience is a priority identified in the national development plan - **Rencana Pembangunan Jangka Menengah Nasional (RPJMN) 2020-2024**. It recognizes the role of social protection in resilience building and the government has initiated a process to develop an Adaptive Social Protection Roadmap. The Government's slum upgradation programs have adopted inclusive community-driven approaches to provide basic services. Moving forward, such programs have identified the importance of nature-based solutions for reducing flood risk in urban informal settlements. Pilot project on Revitalizing Informal Settlements and their Environment, currently being implemented

<sup>41</sup> Government of Indonesia. 2014. *Statistics Indonesia (BPS)*. <https://www.bps.go.id/statictable/2014/02/18/1274/proyeksi-penduduk-menurut-provinsi-2010---2035.html>. Accessed 12 November 2020.

<sup>42</sup> Based on the national poverty line. As Indonesia's national poverty line is set low relative to its GDP per capita, this figure is likely higher.

<sup>43</sup> Calculated using 2018 data from World Development Indicators. <https://data.worldbank.org/indicator/EN.POP.SLUM.UR.ZS?locations=ID>. Accessed 12 November 2020.

<sup>44</sup> Government of Indonesia. 2019. *Statistics Indonesia (BPS)*. Accessed 12 November 2020.

<sup>45</sup> World Bank. 2017. *World Development Indicators*. Accessed 16 November 2020.

<sup>46</sup> Indonesia. 2016. *First Nationally Determined Contribution*.

<sup>47</sup> Bappenas. 2009. Indonesia Climate Change Sectoral Roadmap (ICCSR) Synthesis Report.

in Makassar City, has demonstrated the importance of water-sensitive approach for building resilience.

### Lao People's Democratic Republic

Lao PDR, a landlocked, least developed country (LDC) in main land South East Asia is endowed with natural resources such as forest, water and minerals. Over 65% of the population live in rural areas, where the poverty rate is 23.8% compared to 7.0% in urban areas.<sup>48</sup> Agriculture accounts for 16% of GDP, employing over 65% of the population (of which more than half are women) while also dependent upon natural resources for their livelihoods. According to the World Health Organization, around 33% of children under five years of age are stunted, while the ethnic groups living in the upland areas have levels reaching over 50%.<sup>49</sup> Lao PDR is highly vulnerable to extreme weather events with annual expected losses ranging from 2.8% to 3.6% of the GDP.<sup>50</sup> In 2018, two storm events caused floods with \$147 million of damages and a further \$225 million in economic losses, with 57% of the losses in the agriculture sector.

The Government is cognizant of the issue of recurrent flooding, drought and erratic rainfall episodes resulting in adverse impact on livelihoods of people and the environment. It is projected that in the future, climate change impacts in the form of increase in intensity and frequency of extreme climate events will result in increased floods and droughts that will significantly affect agriculture, water supply, household food security in the rural communities.

Mitigating the impact of floods and drought has been identified a priority of the government since its **6th Five-year Socio-Economic Development Plan (2006–2010)**, and the **NAPA (2009)** identified urgent needs for adaptation in agriculture, forestry, water and public health sectors. Priorities include promotion of tree plantation in high-risk areas from flooding or drought, agro-forestry systems for water shed protection and erosion reduction in steep areas, conservation and development of major water sheds, repair and rehabilitation of infrastructure and utilities damaged by floods in agricultural areas. Adaptation needs related to agriculture and water resources sector are a priority, and calls for promotion of climate resilience in farming systems, agriculture and water resource infrastructure, strengthen water resource information systems, managing water sheds and wetlands for climate resilience.<sup>51</sup> The assessment of hydro-meteorological services of Lao PDR notes the relatively limited technical, human and financial resources of the Department of Meteorology and Hydrology to carry out its mission, and its information production and dissemination is of average level while compared to most of the NMHSs in the Southeast Asian region.<sup>52</sup>

The **Government's Agricultural Development Strategy 2020**, recognize the importance of transition of agriculture from subsistence into commercial smallholder production through use of innovative technologies and science-based practices for systematic and continuous production of high value agri-food products and local- value added agro-processing for domestic, regional and global market while promoting resiliency to climate change. The Government has also prioritized protection of natural resources and environment and readiness to cope with disasters and effects

<sup>48</sup> Lao Statistic Bureau. 2020. *Poverty in Lao PDR: Key findings from the Lao Expenditure and Consumption Survey, 2018-2019*. Vientiane, Lao PDR.

<sup>49</sup> World Health Organization; Ministry of Health, Lao PDR. 2014. *Success Factors for Women's and Children's Health: Lao PDR*. Geneva.

<sup>50</sup> World Bank Group and Asian Development Bank. 2020. *Climate Risk Country Profiles: Lao PDR (draft report)*.

<sup>51</sup> Lao PDR. 2015. *Intended Nationally Determined Contribution*.

<sup>52</sup> United Nations Office for Disaster Risk Reduction (UNISDR). 2013. *Country Assessment Report*. Strengthening of Hydrometeorological Services in Southeast Asia. [https://www.unisdr.org/files/33988\\_countryassessmentreportlaopdr%5B1%5D.pdf](https://www.unisdr.org/files/33988_countryassessmentreportlaopdr%5B1%5D.pdf)

of climate change as an outcome to achieve the objectives of **8th National Socio-Economic Development Plan (2016-2020)**.

## Pakistan

Pakistan is a lower middle-income, and the world's sixth most populous, country. It is prone to droughts, floods, landslides, cyclone, recession of glaciers, glacial lake outburst flooding and heatwaves. Due to its subtropical geographic location, Pakistan's climate regions namely marine tropical coastlands, subtropical continental lowlands, subtropical continental highlands and subtropical continental plateau faces distinct climate risks. Coastal areas are impacted by cyclones, severe storms, floods, shoreline erosion and sea level rise causing loss of life, damage to livelihoods, environment, human settlements and infrastructure.

Rural communities along the coastal areas are predominantly poor, and the community livelihoods and economy are closely tied to the immediate environment such as (i) mangrove swamps and creeks at the outer fringe of the Indus Delta, and the associated fisheries; and (ii) land above the high tide level, where subsistence agriculture, livestock and fish farming, are practiced. Communities reliant on agriculture and fisheries are exposed to the natural hazards associated with climate change and man-made environmental impacts. With few alternatives, communities are increasingly using saline groundwater for human consumption and agriculture, which has detrimental impact on their health and degrades the soil. Coastal areas have seen cultivated land decrease by up to 60% between 1998 to 2018.<sup>53</sup> Water pollution, loss of mangrove habitats, and poor fishing practices have depleted fish stocks. Resource and service scarcity has greatest effect on women and children.<sup>54</sup> Increased migration is underway from rural to urban areas as the environmental conditions become less tenable for development.<sup>55</sup> In the future, climate change related risks along the coastal area can result in saline water intrusion in the Indus delta affecting coastal agriculture, mangroves and breeding grounds of fish species and sea level rise and increased cyclonic activity due to higher surface temperatures.<sup>56</sup> Increased sea level rise can result in salinization of ground and surface water sources and intrusion along the deltas of Indus river. While there has been decline in natural habitats and biodiversity, it is anticipated that the climate change will accelerate and worsen the situation.

The **National Climate Change Policy (2012)** spells out the policy measures for adaptation in vulnerable ecosystems including coastal and marine ecosystems and the framework for implementation of climate change policy (2014-2030) provides a detailed list of actions with timeframe for implementation which includes building natural plantation barriers along coastal areas to control sand and soil erosion and to minimize the disastrous impacts of cyclones and tsunamis.

## Papua New Guinea

Papua New Guinea (PNG) located in the tropical West Pacific is one of most culturally diverse and underdeveloped regions in the world. As of 2017, 87% of PNG's population lives in rural areas. Agriculture, fishing, community forestry, and small-scale mining are the primary livelihood activities in rural areas. Due to poor or non-existent infrastructure, transportation of goods and

<sup>53</sup> Mahar and Zaigham. 2019. *Spatio-temporal assessment of agriculture & mangroves and its impact on socio-economy of people in Indus delta*. Pakistan Journal of Botany 51 (1): 377-383.

<sup>54</sup> ADB. 2014. Pakistan: *Sindh Coastal Community Development Project*.

<sup>55</sup> Salik, K.M. et al. 2015. *Climate change vulnerability and adaptation options for the coastal communities of Pakistan*. Ocean & Coastal Management. 112: 61-73.

<sup>56</sup> Ministry of Climate Change. 2012. *National Climate Change Policy*. Islamabad, Pakistan.

services is a major challenge while also undermining economic and social opportunities. The country is exposed to riverine, flash and coastal flooding, landslides, coastal erosion, droughts, heatwaves, etc. due to which the communities are facing food insecurity and health related issues.

The Intended Nationally Determined Contribution notes that gradual shifts in climatic conditions disrupt daily life, cause damage to assets and infrastructure, destroy livelihoods, endanger cultural and ecological treasures, and kill or injure people. Rural population are highly dependent on natural resources with limited educational opportunities, economic alternatives, access to market, information. Basic infrastructure services such as electricity and clean water, are extremely limited for much of the population. Due to the limited infrastructure, connectivity and access to services, vulnerability varies greatly across the country and within most provinces. The increased pressure on the country's resource have also exacerbated the risks to hazards leading to extensive internal human movement.<sup>57</sup>

Between 2008 and 2013, around 151,000 people were displaced of which two thirds were due to disasters and rest due to conflict and violence which are partly linked to environmental degradation. The livelihood of resource dependent rural population is highly sensitive to climate risks, with declining environment, soil degradation and fishing, making it difficult for the communities to switch to new crops and farming practices and methods, adopt effective irrigation methods, acquire cultivable land for continued farming and adopt better fishing methods. Agriculture sector is the main source of employment for majority of people, and women are highly dependent on it. As of 2018, PNG ranked 175 out of 176 ranked countries of the UN's Gender Inequality Index. Adaptation to climate change is considered a high priority. Rural to urban migration is a widely used adaptation strategy by vulnerable communities. Access to financial resources such as microfinance, education, knowledge and skills transfers and access to labor markets are some policy measures recommended for high-risk communities.

## Timor-Leste

Timor-Leste, a SIDS with 80% of population depending on agriculture sector is highly vulnerable to changes in rainfall and temperature patterns, floods, cyclones, droughts, forest fires, landslides, extreme climate events such as ENSO as well as future climate change. Agriculture, including forestry and fisheries, provides a source of livelihoods for 80% of the population with two-thirds of all households having agricultural holdings.<sup>58</sup> Almost 50% of the country's total cereal consumption needs are met through imports, raising concerns about securing food supplies in the event of adverse external circumstances. Floods in 2013 displaced around 20,000 people and led to school closures and the contamination of drinking water supply. Flood risk is expected to increase in the future as extreme rainfall events become more common, and the increasing population means that more people live in flood-prone areas. Droughts occur regularly and drought conditions can be made more extreme or extended under El Niño conditions, with major decreases in the yield of major agricultural crops. The country experienced a major drought from 2015–2017. Landslides are a major hazard triggered either by heavy rainfall, or seismic activity. Deforestation and unsustainable land practices have destabilised many slopes, and increased soil erosion, thus increasing landslide risk. The majority of agriculture in the country is rainfed and vulnerable to changes in the timing and amount of rainfall and increasing variability. Agricultural systems will be affected both by increases in extreme events, as well as changes in temperature

<sup>57</sup> International Organization for Migration (IOM). 2014. *Assessing the Evidence: Migration, Environment and Climate Change in Papua New Guinea*. Geneva, Switzerland.  
[https://sustainabledevelopment.un.org/content/documents/2185\(IOM,%202014\)%20Assessing%20the%20Evidence%20Migration,%20Env,%20and%20CC%20-%20PNG.pdf](https://sustainabledevelopment.un.org/content/documents/2185(IOM,%202014)%20Assessing%20the%20Evidence%20Migration,%20Env,%20and%20CC%20-%20PNG.pdf)

<sup>58</sup> Ministry of Agriculture. 2020. 2019 Summary of Indicators *Timor-Leste 1st Agricultural Census Highlights*. Dili, Timor Leste-

and rainfall. Available water resources are likely to come under increased stress as a result of changes in rainfall patterns and temperatures, as well as rapid population growth and an associated increase in demand.<sup>59</sup>

Women in Timor-Leste face a range of economic, social, and cultural barriers to realize their potential as smallholder farmers with decision making power and personal autonomy. Not only are women in agriculture estimated to produce 15% less per hectare than men, they also experience unequal access to farm labor opportunities and farming tools, lower literacy, and have limited involvement in cash crop production and farmers' groups.<sup>60</sup>

The **Strategic Development Plan 2011-2030** recognizes extreme weather events, climate change, and sea level rise as a serious environmental challenge for Timor-Leste. Different agroecological zones will experience different impacts due to climate change. With a relatively high population density, the dry rainfed areas near the capital face a particular challenge from the effects of increased demand for land accompanied by hotter temperatures with less predictable rainfall. Too little or too much rain and associated disasters leading to food insecurity are a major concern for local communities.

The **NAPA** has identified floods and drought as primary risks facing agriculture and water sector—two key priority sectors. Among others priority adaptation measures identified in the two sectors includes development of integrated agroforestry and watershed management, construction of environmentally sustainable infrastructure to protect water sources, water harvesting (capture and storage). The **NDC** identifies food security as a key adaptation priority in order to reduce vulnerability of farmers to drought and flood by improving their capacity to plan for and respond to future climate conditions. In particular, the NDC identifies agroforestry and water shed management as key measures for strengthening food security. Priorities related to water resources management includes enhancing government and community strategies to respond to drought exacerbated by climate change; and enhancing water harvesting model, water distribution system and management system at all levels to avoid water shortages due to climate change. Promoting subnational capacity development for improved adaptation planning and implementation.

## Vanuatu

Vanuatu is an archipelago nation and SIDS of 80 islands in the Pacific. Majority of the population, about 60%, are involved in farming and fishing activities. As small islands, all population's economic activities and infrastructure development take place within or close to coastal zones and so are directly exposed to all coastal hazards. Vanuatu is prone to both rapid and slow onset disaster events such as cyclones, storm surges, riverine and coastal flooding, coastal erosion, landslides, hailstorms and droughts. The climate is also significantly influenced by ENSO.

Key economic sectors—agriculture, fishing, tourism—are all impacted by the above hazards. Several factors lead to Vanuatu society and economy having low adaptive capacity and therefore high vulnerability. These are notably linked to the remoteness of the country, the long distances between islands, the dispersed population, the low-capacity pool, the non-diversified nature of the economy and high costs of almost all actions. In particular, poor and marginalized groups are far more vulnerable than the average. Notable vulnerable groups (these are not mutually exclusive) are women, women-headed house-holds, the disabled, the landless and the growing

<sup>59</sup> Government of Timor Leste. 2014. *Initial National Communication to the UNFCCC*.

<sup>60</sup> World Bank. 2018. *Women Farmers in Timor-Leste: Bridging the Productivity Gap*. Washington, DC.

population living in informal settlements (many of who are landless). In general, these groups have few assets, face barriers accessing formal employment, have limited access to education, and limited access to health and other public services (water supply, sanitation, health care, etc). Recurrent disaster events have resulted in loss of income and capacity of the households in particular those of vulnerable groups and population living in informal settlements.<sup>61</sup>

In April 2020, Tropical Cyclone Harold struck the northern and central islands of Vanuatu with sustained winds up to 270km/hour (just after the declaration of the COVID Pandemic). The Post Disaster Needs Assessment estimated the cost of losses and damages associated with Harold to be approximately \$500mn. As the hazards become more intense and or frequent with climate change, this exposure will increase. Climate change and sea level rise are likely to impact water supply, coastal infrastructures and key livelihood sectors including tourism and fisheries that are important for sustainable development of the island nation. The Vanuatu approach for adaptation to climate variability, change and sea level rise calls for pro-active, no-regrets approach with measures and strategies that can be implemented to deal with current climate risks with the aim of reducing the vulnerability to future risks. While the ongoing risk reduction measures are contributing to resilience of the island, they are not able to meet the needs of climate vulnerable population to current and future risk. Globally, there is also growing awareness on use of social protection measures to reduce vulnerability and the Government is yet to establish a comprehensive social protection program. A comprehensive adaptive social protection system can support the loss of income and resultant economic downturn due to impact of disasters.<sup>62</sup>

## 5. PROPOSED OUTPUTS AND ACTIVITIES IN RESPONSE TO NATIONAL CLIMATE PRIORITIES

Based on climate risk context and national climate priorities targeted at the poor and vulnerable population, the CRPP proposes the following outputs for financing from GCF.

- **Output 4: Improved information and systems for delivering applied climate risk informed investments at scale.**
  - 4.1 Climate information services for priority sectors to meet local adaptation needs
  - 4.2 Climate risk informed social protection systems
  - 4.3 Climate risk information systems for decentralization policies
- **Output 5: Climate resilient pro-poor livelihoods investments implemented.**
  - 5.1 Climate resilient agroecological systems.
  - 5.2 Information technology and risk management services for climate resilient livelihoods.
  - 5.3 Climate resilient agriculture supply chains.
- **Output 6: Climate adaption pro-poor infrastructure**
  - 6.1 Ecosystem based infrastructure
  - 6.2 Flood and landslide protection infrastructure
  - 6.3 Multi-purpose emergency shelter

In addition to climate risk context and national climate priorities, the sub-outputs and activities presented in this section have been identified based on current research and literature and existing frameworks and guidelines widely used by practitioners in the adaptation and resilience field. This includes adaptation options identified by the IPCC as feasible and likely to contribute

<sup>61</sup> ADB. 2012. *Vanuatu: Updating and Improving the Social Protection Index. Consultant's report*. Manila, Philippines. (TA 7601-REG).

<sup>62</sup> Ibid.

to transitions in key systems that are necessary processes for large-scale transformations (see Box 1 below).

### **Box 1 – The CRPP’s contribution to systems transitions and climate resilient development**

The IPCC’s 6<sup>th</sup> Assessment Report identifies climate resilient development (CRD) as a core requirement to pursue sustainable development and one of the guiding principles for climate policy. CRD requires the adoption of adaptation measures to meet basic needs for each human being, eliminate poverty and enable equitable, just and sustainable development. The CRPP’s proposed approach towards implementing adaptation solutions through large-scale investment projects targeted at the poor directly responds to the IPCC’s call for integrated, multi-sectoral solutions that address social inequities, differentiate responses based on climate risk and cut across systems. The IPCC states that there is **high confidence** that such approaches increase the feasibility and effectiveness of adaptation in multiple sectors. There is also **high confidence** from the IPCC that climate resilient development is enabled when governments, civil society and the private sector make inclusive development choices that prioritize risk reduction, equity and justice, and when decision-making processes, finance and actions are integrated across governance levels, sectors and timeframes<sup>63</sup>. This is something that is fundamental to the CRPP’s proposed approach.

System transitions have been highlighted as necessary processes for large-scale transformations and a core enabler of CRD, requiring social, institutional and technological change within societal sub-systems. The CRPP has been designed to contribute to progress in core system transitions that catalyze broader societal transformations that steer development in a climate resilient direction. By including adaptation options that are targeted at the poor and vulnerable population, and have been identified by the IPCC as offering the potential for change within the key systems as part of investments in new or existing large-scale government poverty reduction programs, the CRPP can support faster transitions that contribute to more fundamental system transformations.

### **Output 4: Improved information and systems for delivering applied climate risk informed investments at scale.**

**The Solution.** Enhanced climate information services that provide reliable, tailored information based on the past, present and potential future climate, will be critical for better understanding of potential risks over various timescales, and to manage current and future climate risks across sectors and targeted at the poorest population. While there has been improvement in weather and climate forecasting and provision of downscaled climate change projections, existing climate information services are not well focused on the user needs (sectors and at various levels) and also do not reach “the last mile”. Often the poor and vulnerable communities whose livelihoods are climate sensitive does not have access to usable and timely information. Global analysis on climate information services reveal that capacities to deliver climate-risk and reliable early warning information services varies across countries and the functional capacities on monitoring and

<sup>63</sup> IPCC, 2022: Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Lösche, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösche, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

evaluation of results and benefits of the use of climate services remain weak (WMO, 2019).<sup>64</sup> There are major gaps, especially, at the local level, as the information available are coarse with limited details and capacities are limited among local government and communities to interpret climate risk information for decision-making purposes. Slow progress in improvements and weak capacities to adapt such practices will can be a major barrier to deal with dynamic climate risks. The State of Climate Services, 2019 report notes that “while investments have substantially increased over the past decade, more and better investments are still needed to ensure the provision of high-quality climate information and services for climate-resilient action”. Moreover, there has been renewed call for investment in improving climate information services to support from policy making to the end users such as farmers.<sup>65</sup>

This output will support countries in developing, utilizing and maintaining climate risk information services that will support climate risk informed local planning, budgeting and prioritization of investments. In particular, the focus will be on provision of climate-risk information to support of decentralized planning and decision-making related to poverty reduction, such as, climate sensitive sectors (agriculture and water resources) which provides livelihoods to poor and vulnerable population; in strengthening adaptive and shock-responsive features of social protection programs so that such programs can better respond to climate shocks and stresses; and decentralization programs that will allow risk-informed local planning, budgeting and prioritization of adaptation investments Use of innovative tools, such as forecast-based financing will also be promoted.

#### **Activity Area 4.1: Improved climate information services for key sectors to meet local adaptation needs**

Improvement in climate information services have multiple benefits and undertaking transformative adaptation practices requires robust climate evidence and information on climate risks and vulnerabilities impacting different livelihoods at community level.<sup>66</sup> It has been estimated that upgrading all hydrometeorological information and early warning capacity in developing countries would save an average of 23,000 lives annually and would provide between US\$ 3 billion and US\$ 30 billion per year in additional economic benefits related to disaster risk reduction.<sup>67</sup> Improved operational climate advisory services in India resulted in decreased cultivation cost of up to 25% and increased net returns of 83% for farmers growing paddy, wheat, pearl millet, and fruits and vegetables, with an estimated benefit of USD 7.575 billion per year. Furthermore, investments in climate services has an overall cost benefit ratio of 1 to 10.<sup>68</sup> Therefore, seamless provision of climate information across various timescale can enable the key climate sensitive sectors and vulnerable communities to improve their risk management practices dealing with extreme weather and climate events, climate variability and change. However, the challenge is bridging the gap between the information provider and sectoral users and reaching the last mile including poor and the vulnerable groups. As of 2019, countries report on climate services capacity reveals, 25 out of 59 countries under WMO’s Asia and the South-West Pacific

<sup>64</sup> World Meteorological Organization (WMO). 2019. *United in Science: High-level synthesis report of latest climate science information convened by the Science Advisory Group of the UN Climate Action Summit 2019*. URL: [public.wmo.int/en/resources/united\\_in\\_science](https://public.wmo.int/en/resources/united_in_science)

<sup>65</sup> Ibid [https://library.wmo.int/doc\\_num.php?explnum\\_id=9937](https://library.wmo.int/doc_num.php?explnum_id=9937)

<sup>66</sup> World Meteorological Organization. 2019. *State of Climate Services Agriculture and Food Security*. Geneva, Switzerland. [https://library.wmo.int/doc\\_num.php?explnum\\_id=10089](https://library.wmo.int/doc_num.php?explnum_id=10089)

<sup>67</sup> World Meteorological Organization. 2016. *Climate Services for Supporting Climate Change Adaptation Supplement to the Technical Guidelines for The National Adaptation Plan Process*. Geneva, Switzerland. [https://library.wmo.int/doc\\_num.php?explnum\\_id=7936](https://library.wmo.int/doc_num.php?explnum_id=7936). (Rogers and Tsirkunov, 2013, as cited in the report)

<sup>68</sup> World Meteorological Organization. 2019. *Benefits of Investments in climate services for agriculture and food security outweigh costs*. Geneva, Switzerland. URL: <https://public.wmo.int/en/media/press-release/benefits-of-investments-climate-services-agriculture-and-food-security-outweigh>. Last accessed 16 December 2020.

region, only two countries has national framework for climate services (NFCSS) and climate services capacity level as follows, advanced (4), full (3), essential (12), basic (3) and less than basic (2). In addition, the WMO has identified that there is a need to invest specifically in enhancing countries' capacities when it comes to impact-based forecasting. Alerts need to go beyond producing accurate forecasts and timely warnings, to better understand and anticipate the likely human and economic impacts due to severe weather and explain what a forecast means for each given location, specifically the types of impacts associated with the forecast to more effectively trigger early action based on the warnings.<sup>69</sup> Through this activity, support will be provided to improve climate information services and impact based early warning for better management climate risks and further support the activities under Output 4, 5, and 6.

### Proposed interventions under Activity Area 4.1

**Support national governments in the development of national frameworks for climate services.** The CRPP will invest in National Meteorological and Hydrological Services (NMHSs) and their partner institutions at a national level, to establish or improve National Frameworks for Climate Services (NFCS) that will coordinate institutions and enable them to work together to co-design, co-produce, communicate, deliver and use climate services for decision-making in climate-sensitive socio-economic sectors. The NFCS will serve as a key coordination mechanism to bring together the local, national and regional stakeholders needed for successful generation and delivery of co-designed and co-produced climate services with and for users, effectively linking climate knowledge with action on the ground at national and local levels.<sup>70</sup> Assistance will be guided by the five pillars of the Global Framework for Climate Services (GFCS)<sup>71</sup>, and be initiated through a comprehensive analysis of the current status of climate services in selected CRPP countries. Climate services have also been identified by the IPCC as a core overarching adaptation option for supporting adaptation transitions.<sup>72</sup> All subsequent activities under this intervention will closely follow the three Fundamental Guidelines of the GFCS;

- i. **Know the user and understand what is needed:** Understand the climatic elements that are relevant to the user; how the user wishes to receive information; how the user is likely to interpret the information; for what purpose the information will be used; the decision process of the user; and how the information might improve the decision-making processes.

<sup>69</sup> World Meteorological Organization. 2020. *State of Climate Services: Risk Information And Early Warning Systems*. Geneva, Switzerland. [Online] available at <https://public.wmo.int/en/resources/library/2020-state-of-climate-services-report>

<sup>70</sup> World Meteorological Organization. 2018. *Step-by-step Guidelines for Establishing a National Framework for Climate Services* [online] available at [https://library.wmo.int/?lvl=notice\\_display&id=20216#.YECdcZNKgWo](https://library.wmo.int/?lvl=notice_display&id=20216#.YECdcZNKgWo)

<sup>71</sup> The five pillars of the GFCS are; **User interface platform (UIP)** - A structured means for users, climate researchers and climate information providers to interact at all levels; **Climate services information system** - The mechanism through which information about climate (past, present and future) is routinely collected, stored and processed to generate products and services; **Observations and monitoring** - climate observations and other data necessary to meet the needs of end users are collected, managed and disseminated and are supported by relevant metadata; **Research, modelling and prediction:** research towards continually improving the scientific quality of climate information, providing an evidence base for the impacts of climate change and variability and for the cost-effectiveness of using climate information; and **Capacity development** - the basic requirements for enabling any GFCS-related activities to occur.

<sup>72</sup> de Coninck, H., A. Revi, M. Babiker, P. Bertoldi, M. Buckeridge, A. Cartwright, W. Dong, J. Ford, S. Fuss, J.-C. Hourcade, D. Ley, R. Mechler, P. Newman, A. Revokatova, S. Schultz, L. Steg, and T. Sugiyama, 2018: Strengthening and Implementing the Global Response. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson- Delmotte, V., P. Zhai, H.-O. P. rtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. P. an, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

- ii. **Make the information service simple, accessible and timely:** Provide products that can be understood and readily applied by the user, along with easy access to follow-up professional advice.
- iii. **Ensure quality:** Provide products that have been developed with skill and with an understanding of possible applications and analytical techniques, complete with proper documentation and backed by thorough knowledge of up-to-date data availability and characteristics.

**Improve Multi-Hazard Early Warning Systems (MHEWS) to support Impact Based Forecasting (IBF):** The fundamental distinction between a general weather warning and an impact-based warning is the inclusion of vulnerability of people, livelihood and property with consideration of the hydrometeorological hazards. That is, the impact of the weather drives the messaging, rather than the weather itself<sup>73</sup>. To this end, activities under Activity Area 4.1 will have a specific focus on supporting the improvement of IBF in selected CRPP countries. These activities will be structured around the key elements identified by the WMO on Multi-hazard Impact-based Forecast and Warning Services, and will include;

**Partnerships:** Developing partnerships between NMHS, disaster management authorities and local communities to link the expertise and capacity to deal with hydrometeorological forecasting and warnings with information on vulnerabilities, exposure and emergency disaster management.

**Development of Information and Services:** Develop a holistic approach to observing, modelling and predicting severe weather and the consequent natural hazards, through to their impacts through promoting a multidisciplinary and highly integrated scientific platform to translate natural hazard risk into impact services, and a validation process to assess service benefits and performance bespoke to users. Develop services to meet user requirements considering requirements such as timeliness, clarity of message, and update schedules.

**Functional Requirements:** Introduce the technical and functional features required in the development of the collaborative system supporting forecasts and warnings that focus on impacts. This will include the implementation of relevant technical tools (databases, models, information), dissemination platforms, protocols and formats such as XML/CAP, color-coded graphics, and GIS layers; dissemination processes, communication and interaction with media and post-event assessment protocols.

**Capacity development:** Support the development of the required set of skills and competencies, as well as the knowledge of how partners mutually use information to deliver on their mandates. A professional competency framework will be determined with respect to both functional and behavior competencies, cross-training on specific requirements and procedures including simulation exercises and collaborative workshops and educating users on how to use impact forecast information.

**Validation:** Develop impact-based monitoring tools, capabilities and networks to verify impact-based forecasts and warnings and build capacity for systematic evaluations for significant events.

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<sup>73</sup> World Meteorological Organization. 2015. *Guidelines on Multi-hazard Impact-based Forecast and Warning Services*. [Online] available at [https://library.wmo.int/index.php?lvl=notice\\_display&id=17257#.YECfIJNKgWo](https://library.wmo.int/index.php?lvl=notice_display&id=17257#.YECfIJNKgWo)

## Activity Area 4.2: Climate risk informed social protection systems

Current social protection programs supporting poor households are not flexible and adaptive to deal with dynamic nature of future climate risks and vulnerabilities.<sup>74</sup> This is critical because projected increase in the intensity and frequency of extreme weather events will require governments to increasingly call upon social protection programs, such as social assistance (e.g., conditional and unconditional cash transfer), labor market programs and social insurance programs to support poor and vulnerable households to better cope with climate shocks while building their capacity to engage in climate-resilient livelihoods. Integrating such dynamic climate-risk information of various timescale has the potential to inform the design, targeting and scale up or out of social protection mechanisms. Experience from Sahel Region in Africa shows that a) challenge in identifying clear entry points for climate information to inform social protection, b) limited understanding on impacts of weather on livelihoods and food security, while seasonal forecasts were relevant for forecast based early action including social protection, c) limited understanding of adaptive social protection by climate information service providers and of the value of using weather and climate information by social protection stakeholders.<sup>75</sup> Climate risk-informed social protection systems can strengthen linkages between early warning systems, sustainable livelihood programs and financial inclusion programs. This will allow design and implementation of social protection programs (such as cash transfer programs) to be adaptive and shock responsive, including improving climate risk-informed geographical and beneficiary targeting; and designing of adaptive features that allows horizontal and/or vertical scaling up of social protection programs in the event of climate shocks. It can also enable linkages between social protection programs and disaster risk financing instruments in order to ensure adequate, and predictable and timely finances are available for social protection programs to respond to shocks. This activity will focus on the integration of climate risk information in national social protection systems and building capacity of national agencies, local government and civil society organizations. Interventions will build on innovative initiatives such as forecast-based financing, pioneered by the Red Cross and Red Crescent Societies and adaptive social protection programme (ASSP) of the World Bank and ASPIRE project in Sahel by using robust climate information and forecasting to create the necessary mechanisms for using climate forecasting information and early warning to trigger support to existing or new beneficiaries in response to climate-related shocks.

### Proposed Interventions under Activity Area 4.2:

The World Bank has identified four key building blocks for the development of adaptive social protection based on a review of relate programs, they are; (i) programs, (ii) data and information systems, (iii) finance, and (iv) institutional arrangements and partnerships.<sup>76</sup> These four pillars will provide the framework under which the CRPP will invest in social protection interventions under output 4. Indicative sub-activities under this investment priority are outlined below.

**Programs:** Appraise and adjust the design parameters of existing social protection programs within the system such as; (i) adjusting targeting approaches to integrate risk and household vulnerability into eligibility criteria and beneficiary selection, as well as fine-

<sup>74</sup> Asian Development Bank (ADB). 2018. *Strengthening Resilience through Social Protection Programs, Guidance Note*. Manila, Philippines. <https://www.adb.org/documents/strengthening-resilience-social-protection-guidance-note>.

<sup>75</sup> Ward, N. and D. Conway. 2020. *Applications of interannual-to-decadal climate prediction: An exploratory discussion on rainfall in the Sahel region of Africa*. Climate Services. Volume 18.

<sup>76</sup> Bowen, T., del Ninno, C., Andrews, C., Coll-Black, S., Gentilini, U., Johnson, K., Kawasoe, Y., Kryeziu, A., Maher, B., and Williams, A. 2020. *Adaptive Social Protection: Building Resilience to Shocks* (English). International Development in Focus Washington, D.C. : World Bank Group. <http://documents.worldbank.org/curated/en/579641590038388922/Adaptive-Social-Protection-Building-Resilience-to-Shocks>

tuning benefit parameters to enhance resilience-building outcomes among those households; (ii) design features to support adaptation that promote more productive and resilient livelihoods including through asset and livelihood diversification; and (iii) providing trainings for social protection field workers to build their capacity on disaster preparedness measures and awareness raising for social protection program beneficiaries, especially women, on climate-resilient livelihoods.

**Data and information:** These activities will be closely linked to 4.1 and include (i) Integrating poverty and vulnerability data with disaster risk assessments for a spatial understanding of household vulnerability to shocks, including through the provision of hardware and software that allows acquisition, analysis, storage and visualization of hazard, exposure and vulnerability data which can be integrated in national social protection data systems; (ii) link social protection responses to early warning information and develop index-based triggers for response. Triggers for rapid response can be built using the data generated by existing early warning systems and climate forecasts (iii) invest in the capacity to conduct post-shock assessments, to ensure an up-to-date understanding of household needs (iv) creation of frameworks to facilitate the exchange of data between social protection and relevant line ministries, including DRM, as well as nongovernment partners. Finally, a key activity will be to expand social registry coverage within high-risk areas, enabling more frequent updating and ensuring the data contained in registries are useful in the assessment of household vulnerability to shocks.

**Finance:** Undertake cost estimation analysis of shock response using historical shock data to analyze the predicted cost of future responses with social protection. Support the government to preposition financial instruments to cover those costs, layering different instruments for different risks and ensuring timelier responses. Strengthen disbursement mechanisms and payment platforms so that they are prepared to efficiently disburse available funds to beneficiaries once released investing in the provision of ICT infrastructure to support this where necessary. Secure long-term national financing for the expansion of long-term programs that support household resilience.

**Institutional arrangements and partnerships:** Support the sustainable implementation of adaptive social protection through building policy coherence and institutional coordination mechanisms that bring together the sectors of social protection, DRM and climate change adaptation under a common framework, investing in human capacity building, and promoting government leadership through high-level engagement.

### Activity Area 4.3: Climate risk information systems for decentralization policies

The adverse impacts of climate shocks and stresses are largely manifested at the local level, where they interact with existing social norms, power relationships, and use of resources. Adaptation measures therefore need to be planned and implemented at the local level, where information and data on historic and observed changes in weather patterns and their impacts on people, assets, and livelihoods can be captured at the granular level that is required to design effective adaptation measures that respond to the specific needs of communities. Local governments are well-positioned to coordinate and develop effective local responses and pursue procedural justice in ensuring community engagement and enabling more participative adaptation decision-making<sup>77</sup>. In order to combat the challenges that climate change presents, local-level authorities

<sup>77</sup> de Coninck, H., A. Revi, M. Babiker, P. Bertoldi, M. Buckneridge, A. Cartwright, W. Dong, J. Ford, S. Fuss, J.-C. Hourcade, D. Ley, R. Mechler, P. Newman, A. Revokatova, S. Schultz, L. Steg, and T. Sugiyama, 2018: Strengthening and Implementing the Global

will therefore need to step up actions and move beyond business-as-usual delivery of services to steer local development in a resilient direction.

However, climate information services in many CRPP countries are not adequately developed to provide necessary information to support decision-making of planners and technical experts who are involved in settlement planning, infrastructure and basic service delivery at the local level. The connections between climate information users and providers is often weak or non-existent and climate information providers often do not fully understand the contexts in which decisions are being made<sup>78</sup>. The 2019 Global Assessment Report highlights the need for the provision of climate – risk information services that are decision-friendly and can support people to better understand the nature of their own risk and how to deal with it.<sup>79</sup> While some success using disseminated climate information services to better inform local government decision-making has been observed, there remains a large gap in informing the design of local investments to make them ‘climate-smart’ or responsive to climate projections.<sup>80</sup> The delivery of climate services in general requires further innovation and development so as to be fully effective and to ensure continuation of efforts to fully integrate them into decision-making processes, especially at the local level.

There is an opportunity to capitalize on on-going decentralization processes to support governments build robust, science-based local climate assessment frameworks that can inform planning processes, equipping decision-makers with the data, tools, guidance, and information needed to inform local planning and investment and, where necessary, provide incentives for implementing adaptation to changing climate. Climate- risk information service frameworks to be developed under the CRPP will move away from the traditional top-down approach (driven by climate models) as this can only support adaptation to a certain point. The provision of climate information services for local adaptation planning under the CRPP will instead support an iterative risk management process and co-produce information to meet specific sector needs and decentralized decision-making and investment processes, with gender-differentiated vulnerability analysis for the identification and implementation of local adaptation options. This bottom-up approach will involve close interaction between all stakeholders, including the providers and the users of climate information services, moving away from the one-way exchange of information from the scientific community to decision-makers, as the latter has significant limitations in promoting effective decision-making. An iterative co-design framework that promotes user and provider engagement and collaboration in communicating and disseminating risk information will ensure two-way communication channels, where information providers and users can interact equally. Most importantly, embedding such approach within local governments planning and budgeting processes will ensure longer-term sustainability.

### Proposed interventions under activity 4.3

Recognising the need for standardised processes and co-ordination across programs, the CRPP’s activities under this activity area will be closely linked to the UNCDF’s Local Climate Adaptive Living Facility (LoCAL) initiative’s performance-based climate resilience grant (PBCRG) mechanism and approach. As such, the CRPP can draw on lessons learned and build on

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Response. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [MassonDelmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

<sup>78</sup> Vaughan, C., and S. Dessai. 2014. Climate Services for Society: Origins, Institutional Arrangements, and Design Elements for an Evaluation Framework. *Wiley Interdisciplinary Reviews: Climate Change*. 5. pp. 587–603

<sup>79</sup> UNDRR. 2019. *Global Assessment Report on Disaster Risk Reduction 2019*. Geneva, Switzerland.

<sup>80</sup> DCF Alliance. 2019. *The Devolved Climate Finance mechanisms: Principles, implementations and lessons from four semi-arid countries*. The DCF Alliance, working paper.

experience from LoCAL, which has supported 293 local governments across 14 countries, and has been found to work extremely well for promoting inclusive adaptation investments at the local level, and more importantly, in building national and local capacity for scaling up adaptation with domestic (public and private) resources.

With the shared goals of increasing awareness of and capacities to respond to climate change at the local level, mainstreaming climate change adaptation into local government planning and budgeting systems and investments, and increasing the amount of finance available for local adaptation to climate change adaptation, the CRPP provides a significant opportunity to replicate and scale-up some of the key activities implemented under LoCAL. In countries where LoCAL is already being implemented, the CRPP will add value through providing the extra capacity and resources required to scale up the interventions. The CRPP also provides an opportunity to initiate similar activities in countries where the LoCAL initiative is currently not being implemented. In this regard, the type of activities implemented under output 4.3 are likely to be;

**Conduct/review climate risk assessment:** Local governments will receive support to develop tailor-made, country-based methodologies and systems to support them in the collection and analysis of climate data at the local level (down-scaled climate models) and undertake climate risk and vulnerability assessments that incorporate the local dimension (indicators of climate and non-climate drivers of risks and vulnerabilities at the local level), as well as capacity-building support to increase capacity to respond to climate change adaptation needs locally. Additionally, communities will be sensitized on climate change issues and risks and encouraged to participate in the local decision-making process.

**Integrate adaptation into local development planning and budgeting:** Support local governments to embed climate change adaptation in their development plans and budgets through strengthening existing methodologies or guidelines for local planning and budgeting by making use of climate and vulnerability data to identify adaptation investments and justify investment decisions and related costs. This will be supported by investments in capacity development for local government and institutional strengthening for fiscal decentralization. This activity will also support the set-up of public participation processes such as public hearings and social audits where local governments interacted with citizens, and communities can participate in the screening and validation of projects identified in the local development plans. There will be a particular focus on women's participation and empowerment.

**Support local authorities and communities to implement selected adaptation interventions:** The CRPP will channel small grants to top up national expenditures using the existing budgeting and fiscal transfer mechanisms, using the activity as an opportunity to formulate incentives to scale up adaptation, and strengthen fiscal transfer mechanisms and related monitoring systems. The menu of possible investments will be limited to the CRPP focus and will typically range from increasing the climate resilience of new or existing infrastructure to climate-adaptive infrastructure, ecosystem-based adaptation, awareness raising and capacity building, services to the local populations to help develop their resilience to climate change, and institutional strengthening for climate change adaptation. These activities will seek to strengthen local procurement practices, either by ensuring that the existing procedures are implemented to a high standard or, where necessary, supporting the introduction of improved procedures, including integration of climate-relevant measures in tender procedures and contract monitoring. Grassroots women's organizations will be prioritized as local service providers.

## Output 5: Climate resilient pro-poor livelihoods investments implemented

**The Solution.** Although rapidly urbanizing, many countries in Asia and the Pacific region still have a predominantly agrarian society, especially lower income countries. In Papua New Guinea for example 87% of the total population live in rural areas, and Cambodia (76%), Vanuatu (74%), Timor-Leste (69%), Lao PDR (64%) and Pakistan (63%) all have majority rural populations. Agriculture accounts for a significant proportion of GDP in many of these countries (Vanuatu 27%, Pakistan 23% and Cambodia 23%) and many rural households depend on subsistence agriculture for their livelihoods and food security<sup>81</sup>. In Lao PDR for example, 50% of rural households are subsistence farmers with incomes below \$300 per year and only about 30% are food secure.<sup>82</sup> Climate change impacts are already stressing agriculture, food security and the livelihoods of smallholder and subsistence farmers across Asia and the Pacific. Increasing temperatures are altering the distribution of cultivated species, and compromising crop yields and quality as well as harvest stability. The frequency of sudden agricultural production losses resulting from climate related extremes has also increased since the mid-20<sup>th</sup> century, with droughts and floods reducing food availability, and increased food prices threatening the livelihoods and food security of millions of people. Future climate change will make some current agricultural production systems unsuitable, or less viable, through changes in precipitation patterns and temperatures, changes in the distribution of pests, weeds and diseases, and increased climate extremes will increase losses. Exposure of outdoor workers and animals to heat stress, will also reduce labor capacity and animal health resulting in reduced productivity.<sup>83,84</sup> These changes will impact everybody, but it's vulnerable groups, such as low-income households, women and small-scale producers living in highly vulnerable regions that are at higher risk of livelihood loss. The impact of COVID-19 has further emphasized the fragile nature of rural livelihoods in Asia and the Pacific region. For example, the pandemic is expected to increase livelihood losses in Timor-Leste as 70 percent of the employed population are in the agriculture sector, which is directly hit by the measures imposed to control the spread of the virus.<sup>85</sup>

Autonomous responses by farmers to climate change are being observed, and Asia already hosts a high number of agricultural diversification strategies. There is robust evidence that a variety of these practices such as switching varieties/species, altered timing of planting, improved soil and water management and diversification into aquaculture that are already being employed are

<sup>81</sup> World Bank. 2019. World Bank Open Data Portal. Available at <https://data.worldbank.org/indicator>

<sup>82</sup> Vernooy, R. 2015. *Effective implementation of crop diversification strategies for Cambodia, Lao PDR and Vietnam: Insights from past experiences and ideas for new research.* [https://www.biodiversityinternational.org/fileadmin/\\_migrated/uploads/tx\\_news/Effective\\_implementation\\_of\\_crop\\_diversification\\_strategies\\_for\\_Cambodia\\_\\_Lao\\_PDR\\_and\\_Vietnam\\_1874.pdf](https://www.biodiversityinternational.org/fileadmin/_migrated/uploads/tx_news/Effective_implementation_of_crop_diversification_strategies_for_Cambodia__Lao_PDR_and_Vietnam_1874.pdf)

<sup>83</sup> Bezner Kerr, R., T. Hasegawa, R. Lasco, I. Bhatt, D. Deryng, A. Farrell, H. Gurney-Smith, H. Ju, S. Lluch-Cota, F. Meza, G. Nelson, H. Neufeldt, and P. Thornton, 2022: Food, Fibre, and Other Ecosystem Products. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösckke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

<sup>84</sup> Shaw, R., Y. Luo, T.S. Cheong, S. Abdul Halim, S. Chaturvedi, M. Hashizume, G.E. Insarov, Y. Ishikawa, M. Jafari, A. Kitoh, J. Pulhin, C. Singh, K. Vasant, and Z. Zhang, 2022: Asia. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösckke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

<sup>85</sup> United Nations Sustainable Development Group. 2020. UN Timor-Leste: COVID-19 Outbreak Multi-Sectoral Response Plan. April-September 2020. [https://reliefweb.int/sites/reliefweb.int/files/resources/TLS\\_Socioeconomic-Response-Plan\\_2020.pdf](https://reliefweb.int/sites/reliefweb.int/files/resources/TLS_Socioeconomic-Response-Plan_2020.pdf)

valuable in reducing negative effects of current climate anomalies.<sup>86,87</sup> However, these approaches often do not plan for the changing future climate, and due to limited adaptive capacity, are not likely to be adopted by the poorest and most vulnerable populations living in the most vulnerable regions. High levels of poverty, a lack of access to basic services, and significant wealth and gender inequalities present for low-income producers and vulnerable groups, means that many adaptation strategies are unlikely to take place on the scale that is required for them to respond to worsening climate change impacts<sup>88,89</sup>. The importance of scaling up adaptation in the livelihoods sector is being recognized in the region. In Timor-Leste, for example, NAPA consultations have identified vulnerability of the traditional rain fed rural livelihoods to increasing climate variability and building resilience of rural livelihoods to secure national food security was ranked number one as NAPA priority to manage climate change associated risks.

This output has been included in the CRPP to support poor and vulnerable communities to overcome the impacts of climate change by adopting adaptation measures that help to create climate resilient and sustainable livelihoods. The core activities to be implemented under this output have been identified based on three related frameworks, (i) the Sustainable Livelihoods Framework (SLF), (ii) the three Paradigm Shifting Investment Pathways, presented in GCF's sectoral guide on Agriculture and Food Security, and (iii) feasible adaptation options presented in the IPCC's 6<sup>th</sup> Assessment Report related to land, ocean, and ecosystems transitions.

The Sustainable Livelihoods Framework (SLF), first proposed by the UK Department for International Development, was developed for use by international agencies to guide programs for poverty alleviation, and posits that successful livelihoods are a prerequisite for poverty alleviation, as they transform a combined set of capabilities, assets and activities into income, dignity, and agency, to improve living conditions.<sup>90</sup> The SLF has more recently been effectively applied for exploring the many complex factors influencing household food security and climate resilience<sup>91,92,93</sup>, and thus provides a useful conceptual basis for the identification of the activities under this output.

<sup>86</sup> International Center for Tropical Agriculture (CIAT). *Climate-Smart Agriculture*. <https://ciat.cgiar.org/what-we-do/climate-smart-agriculture/>.

<sup>87</sup> Shaw, R., Y. Luo, T.S. Cheong, S. Abdul Halim, S. Chaturvedi, M. Hashizume, G.E. Insarov, Y. Ishikawa, M. Jafari, A. Kitoh, J. Pulhin, C. Singh, K. Vasant, and Z. Zhang, 2022: Asia. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegria, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

<sup>88</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf)

<sup>89</sup> Ibid. see no. 87 (Shaw *et al.* 2022)

<sup>90</sup> Sen, A. 2014. *Poverty and Famines: An Essay on Entitlement and Deprivation*. In IPCC AR5 Chapter 13. Livelihoods and Poverty livelihoods.

<sup>91</sup> Haider, M. 2009. Sustainable Livelihood Approaches: the Framework, Lessons Learnt from Practice and Policy Recommendations. Economic and Social Commission for Western Asia (ESCWA), UNDP. [Online] <http://css.escwa.org.lb/SDPD/1125/UNDP.pdf>

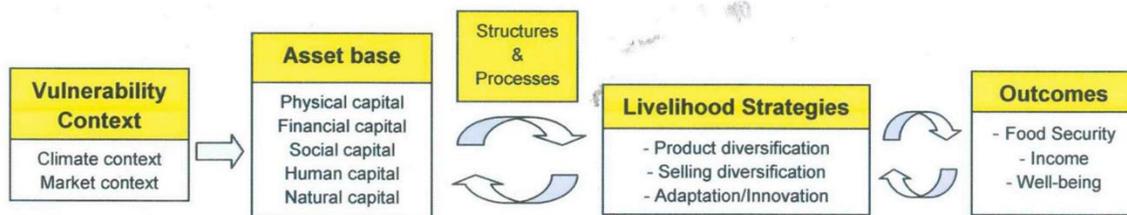
<sup>92</sup> IFAD. 2008. *IFAD's response to climate change through support to adaptation and related actions*. [online] available at <https://www.unclearn.org/wp-content/uploads/library/ifad71.pdf>

<sup>93</sup> Serfilippi, E. and Ramnath, G. (2018). Resilience Measurement and Concept Frameworks: A Review Of The Literature. *Annals of Public And Cooperative Economics*, Vol. 89, Issue 4, pp. 645-664

At its essence, the framework suggests that climate-related, economic and other ‘shocks’ will have impacts on households’ asset base and thus livelihood strategies pursued, as the different types of livelihood assets present form the basis for households’ choices of livelihood strategies, and the differentiated and shifting ways in which they compose their livelihoods in response to shocks. This in turn influences their food security status and level of well-being<sup>94</sup>. The five types of assets or capitals upon which livelihoods are built according to the SLF are: human (set of skills, knowledge, ability to work, and good health), socio-political (quantity and quality of social resources as networks and access to wider institutions in society), natural (fresh water, soil quality, forests, healthy ecosystems), physical (infrastructure, services, and productive assets), and financial (cash and other liquid resources, such as savings, credit, remittances, pensions).<sup>95</sup>

The livelihood resilience approach, represented in the figure below, is underpinned by the fundamental idea that resilience of rural households is determined by the sustainable access to the five capitals outlined above and, as a result, the lack of these capitals undermines a household’s resilience to climate related shocks. It also situates household livelihood assets within wider sets of ecosystems, cultural contexts and policies that promote or hinder access to these diverse resource inputs and thus promotes a more system wide analysis and approach to resilience building.

The Livelihood Resilience Approach<sup>96</sup>



With its focus on capacities, vulnerabilities and livelihood strategies, the SLF helps develop resilience-building strategies that can be effective in increasing the capacity to cope with and adapt to climate-related impacts.<sup>97</sup> This livelihood resilience perspective is particularly useful in the context of the CRPP as it provides a basis for assessing people’s capacity for, and differences in, perceiving risk and taking anticipatory actions, either individually or collectively, and places people at the center of the analysis, located within, rather than dominated by, ecosystems, technologies, political contexts, markets and resource networks. As such, people are recognized as the main actors within adaptation policy and practice, underpinned by rights and justice, and

<sup>94</sup> Wright H, Kristjanson P, Bhatta G. 2012. *Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh*. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CAAFS), Copenhagen, Denmark.

<sup>95</sup> Ibid. See no. 93 (Serfilippi and Ramnath, 2018).

<sup>96</sup> Ibid. see no. 94 (Wright, Kristjanson and Bhatta, 2012).

<sup>97</sup> IFAD. 2008. *IFAD’s response to climate change through support to adaptation and related actions*. [online] available at <https://www.unclearn.org/wp-content/uploads/library/ifad71.pdf>

engaged with wider development processes.<sup>98,99</sup> The capitals of the SLF and the principals of the livelihood resilience perspective have been used as a framework to identify specific activities proposed under the three activity areas of output five.

The GCF has identified three interlinked paradigm shifting investment pathways to achieve transformation towards resilient and low-emission agriculture and food systems - (1) Promoting resilient agroecology; (2) facilitating climate informed advisory and risk management services; and (3) reconfiguring food systems. The core activity areas identified under output 5 are based on these three pathways and actions identified in the GCF's Sectoral Guide on Agriculture and Food Security that support lasting paradigm shifts in each of these pathways have been included. The sub-activities are also based on adaptation options that have been identified by the IPCC as feasible and likely to be effective, offering and the potential to support faster transitions in Land, Oceans, and Ecosystems that contribute to more fundamental system transformations.

### **Activity Area 5.1: Climate resilient agroecological systems.**

Building the resilience of poor populations to climate change will require transforming agroecological systems so that they can support sustainable livelihoods in the face of changing environmental conditions and climate risk. This will require reorientation of how farmers manage fields, farms, and natural habitats through a range of adaptation interventions that increase productivity and quality of food and agricultural products despite changing climate and uncertainty. Two of the key strategies to support such a change are (i) diversifying production practices and the adoption of climate resilient crop varieties/species; and (ii) improved soil and water management.

#### **Diversifying production practices and the adoption of climate resilient crop varieties:**

Traditional livelihood diversification options include various ways for farmers to take advantage of on-farm opportunities and/or expand activities beyond the farm (off-farm) to ensure a stable or even enhanced income base. Opportunities for on-farm diversification such as cultivating different crop varieties, crop species, integrating crop-fish/ livestock systems, etc. can improve resilience by buffering production from the effects of greater climate variability and extreme events, and by reducing pest and disease outbreaks<sup>100</sup>. Cultivar improvements and agricultural diversification, as well as community-based adaptation approaches have been identified by the IPCC as feasible and effective options at reducing climate impacts in different socio-cultural, economic and geographical contexts.<sup>101</sup> Studies show that households that diversify what they choose to

<sup>98</sup> Tanner, T., Lewis, D., Wrathall, D., Bronen, R., Cradock-Henry, N., Huq, S., Lawless, C., Nawrotzki, R., Prasad, V., Rahman, Alaniz, R., King, K., McNamara, K., Nadiruzzaman, Md, Henly-Shepard, S., Thomalla, F. (2014) Livelihood resilience in the face of climate change. *Nature Climate Change* [online] available at <https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/9673.pdf>

<sup>99</sup> Wright H, Kristjanson P, Bhatta G. 2012. *Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh*. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

<sup>100</sup> Green Climate Fund. 2021. *Sectoral Guide on Agriculture and Food Security*. [Online] available at <https://www.greenclimate.fund/sites/default/files/document/agriculture-and-food-security-sectoral-guide.pdf>

<sup>101</sup> Bezner Kerr, R., T. Hasegawa, R. Lasco, I. Bhatt, D. Deryng, A. Farrell, H. Gurney-Smith, H. Ju, S. Lluch-Cota, F. Meza, G. Nelson, H. Neufeldt, and P. Thornton, 2022: Food, Fibre, and Other Ecosystem Products. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Lösschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

produce, as well as to sell, are pursuing key livelihood strategies that make them more food secure, and more able to take up new agricultural practices to deal with changing circumstances<sup>102</sup>. In Lao PDR, crop diversification has been found to be an effective strategy to deal with climate risks and the uncertainties associated climate change, while also contributing to improved livelihoods for smallholder farmers<sup>103</sup>. In Pakistan, site specific adaptations such as farmers' changing crop type and variety and improving seed quality have also shown potentially promising outcomes<sup>104</sup>.

**Improved soil and water management:** As agriculture is largely rainfed in developing countries, shifts in seasonality and rainfall patterns as well as extreme weather events such as drought and floods are likely to cause increased soil erosion, water stress and reduced crop yields. Soil and water management will therefore be critical for adapting to rainfall variability and extremes induced by climate change. Many forms of climate smart agriculture that focus on improving land and water management using ecosystem-based approaches such as conservation agriculture and agroforestry can deliver the triple win of increased production, increased resilience, and reduced GHG emissions, while also increasing diversity and establishing new products<sup>105,106,107</sup>. Improved irrigation and water storage are also promising options to manage changes in rainfall variability and improve the reliability of supply of water for production. Community level water storage and irrigation systems that make use of local surface run-off is particularly interesting as it can reduce financial costs as well as avoid the costs to ecosystem integrity and human well-being that can be associated with intensive irrigation<sup>108</sup>. For example, rainwater harvesting techniques (RWHTs) present a low-cost approach for mediating dry spell impacts in rainfed agriculture. Such measures can provide an additional source of water for crop production at the most critical stages of the growing season, reducing the impact of extended periods of dry-spells and drought and changes in precipitation patterns, thereby increasing yields, nutrition and food security<sup>109,110,111</sup>. RWHTs have also been proposed as a measure to improve degraded land and

<sup>102</sup> Wright H, Kristjanson P, Bhatta G. 2012. *Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh*. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

<sup>103</sup> Vernooij, R. 2015. *Effective implementation of crop diversification strategies for Cambodia, Lao PDR and Vietnam: Insights from past experiences and ideas for new research*. [https://www.biodiversityinternational.org/fileadmin/\\_migrated/uploads/tx\\_news/Effective\\_implementation\\_of\\_crop\\_diversification\\_strategies\\_for\\_Cambodia\\_\\_Lao\\_PDR\\_and\\_Vietnam\\_1874.pdf](https://www.biodiversityinternational.org/fileadmin/_migrated/uploads/tx_news/Effective_implementation_of_crop_diversification_strategies_for_Cambodia__Lao_PDR_and_Vietnam_1874.pdf)

<sup>104</sup> Fahad, S. and J. Wang, 2018: Farmers' risk perception, vulnerability, and adaptation to climate change in rural Pakistan. *Land Use Policy*, 79, 301-309, doi:<https://doi.org/10.1016/j.landusepol.2018.08.018>.

<sup>105</sup> Food and Agriculture Organization (FAO). 2013. *Introducing Climate-Smart Agriculture*. URL: <http://www.fao.org/climate-smart-agriculture-sourcebook/concept/module-a1-introducing-csa/a1-overview/en/?type=111>

<sup>106</sup> Ibid. See no. 101 (Bezner Kerr *et al*, 2022)

<sup>107</sup> Urruty, N., D. Tailliez-Lefebvre, and C. Huyghe. 2016. *Stability, robustness, vulnerability and resilience of agricultural systems. A review*. *Agron. Sustain. Dev.* 36, 15. 2016. DOI: <https://doi.org/10.1007/s13593-015-0347-5>.

<sup>108</sup> Schipper, E.L.F., A. Revi, B.L. Preston, E.R. Carr, S.H. Eriksen, L.R. Fernandez-Carril, B. Glavovic, N.J.M. Hilmi, D. Ley, R. Mukerji, M.S. Muylaert de Araujo, R. Perez, S.K. Rose, and P.K. Singh, 2022: Climate Resilient Development Pathways. In: *Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegria, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

<sup>109</sup> Abdullah, Hasan M. & Rahman, Md. *Initiating rain water harvest technology for climate change induced drought resilient agriculture: Scopes and challenges in Bangladesh*. *Journal of Agriculture and Environment for International Development - JAEID*. 109. 189-208. 2015

<sup>110</sup> Rockström, Johan. "for food and nature in drought-prone tropics: vapour shift in rain-fed agriculture. *Philosophical transactions of the Royal Society of London. Series B, Biological sciences* vol. 358,1440. 1997-2009. 2003. DOI:10.1098/rstb.2003.1400

<sup>111</sup> Welderufael W.A., Le Roux P.A.L. and Hensley M. *Quantifying rainfall-runoff relationships on the dera-calcic fluvic regosol ecotope in ethiopia*. *Agricultural Water Management* 95 1223–32. 2008.

production capacity in saline affected soil systems and have desired impacts on hydrological processes.<sup>112,113</sup>

Moving towards more climate resilient agroecological systems will involve doing things differently (e.g. new varieties of crops), but also doing different things (i.e. switching to new crops or production systems). One of the key barriers to the adoption of diversified livelihood activities and soil and land management activities is human capital. Transformation of human resources especially knowledge and skills through programs such Technical and Vocational Education and Training (TVET) can help uplift poor out of poverty. Such programs while incorporating climate change can result in resilient livelihoods, also promote environmental awareness, competency, innovation and entrepreneurship, and new market opportunities for environmental goods and services.<sup>114</sup>

Diversifying production practices, the adoption of climate resilient crop varieties and improved soil and water management are highlighted as priority adaptation actions in a number of CRPP countries. For example, in Timor-Leste developing integrated agro-forestry and watershed management, enhancing water harvesting and building of environmentally friendly infrastructure to protect water sources have been prioritized to adapt to climate change.<sup>115</sup> Lao PDR's Agriculture Strategy for 2011-2020, recognizes the need for development of high value crops in lowland/flatland areas through irrigation for value-added processing and export to regional and global markets.<sup>116</sup> In PNG, the Medium-Term Development Plan III (2018-2022) has a renewed focus in agriculture as a priority area and the NAPA has identified the need to promote soil improvement, river bank protection for agricultural land, conservation and development of major watersheds. There is a clear need to push beyond current activities and support sustainable livelihoods through climate resilient agroecological systems.

**Proposed Activities:** The main focus will be preserving and increasing natural capital, such as water and soil for productive purposes, and building human capital as identified in the SLF, to deal with climate impacts through supporting knowledge and skills generation in relation to climate resilient production practices. Activities are closely aligned with the GCF Agriculture and Food Security Paradigm Shifting Investment Pathway 1: Promoting resilient agroecology, and include adaptation options related to transitions in land, ocean and ecosystems identified by the IPCC. This activity area will likely support; i) the provision of agriculture extension services, especially to women farmers, for new climate resilient crop varieties and production systems to enhance crop productivity based on the local farming systems, agro-ecological zones and climate risks; ii) supporting the adoption of agro-forestry (which also may have additional mitigation benefits)

<sup>112</sup> Abdullah, Hasan M. & Rahman, Md. *Initiating rainwater harvest technology for climate change induced drought resilient agriculture: Scopes and challenges in Bangladesh*. Journal of Agriculture and Environment for International Development - JAEID. 109. 189-208. 2015

<sup>113</sup> Johan Bouma, et.al. 2012. *Soil information in support of policy making and awareness raising*. Current Opinion iEnvironmental Sustainability, Volume 4, Issue 5, Pages 552-558. 2012.

<sup>114</sup> The Asia Foundation . 2018. *Greening Technical Vocational Education and Training (TVET) and Skills Development: Challenges and Opportunities*. [https://www.cedefop.europa.eu/files/Greening\\_VET\\_and\\_skills\\_development.pdf](https://www.cedefop.europa.eu/files/Greening_VET_and_skills_development.pdf)

<sup>115</sup> United Nations Development Program (UNDP). 2020. *Timor-Leste National Adaptation Programme of Action (NAPA)*. , Timor Leste.

<sup>116</sup> Ministry of Agriculture and Forestry. 2010. *Strategy for Agricultural Development 2011 to 2020: Agriculture and Forestry for Sustainable Development, Food and Income Security*. [https://www.gafspfund.org/sites/default/files/inline-files/5.%20LaoPDR\\_strategy.pdf](https://www.gafspfund.org/sites/default/files/inline-files/5.%20LaoPDR_strategy.pdf)

through developing the skills required to establish and manage an agroforestry system (selection of trees and crops, marketing of products, creating an enabling environment); (iii) promotion of effective and efficient use of water by adapting and scaling up water retention, communal water harvesting and storage; iv) supporting integrated land and water management and improvement of soil management techniques and drainage systems such as terracing which refers to the division of hills and mountains into narrow, graduated steps to facilitate crop cultivation, and minimum/no tillage that helps conserve soil moisture, reducing evaporative loss, thus requiring less water than conventionally tilled field; (v) provision of small grants that can support upfront capital for women farmers to adopt climate-resilient practices and vi) supporting national institutions to offer climate resilient employment through improved technical and vocational education and training (TVET), including trainings targeted at women employed in agriculture.

### **Activity Area 5.2: Information technology and risk management services for climate resilient livelihoods.**

Improved access to accurate, timely and actionable information on variables such as expected market prices, and short- and long-term growing conditions can empower smallholder farmers to exercise greater control over their production decisions and manage their exposure to environmental risk<sup>117</sup>. Information and advisory systems that are specifically tailored to smallholder farmers can lower transaction costs, increase productivity, support the successful adoption of diversified production practices, reduce the deployment of unsustainable practices, strengthening their resilience. However, evidence from Lao PDR and Cambodia shows that seasonal forecasts, agro-advisories, and other climate services provided by government agencies are not reaching resource-deficient smallholders that cannot easily access the platforms (television, and radio) via which the information is delivered. Moreover, climate services are being delivered in formats that do not necessarily fit the needs or preferences of the target end-users, particularly smallholder farmers. There is also a difference in access to agro-climatic information between men and women in many countries, with men farmers having easier access, which in turn constrains women's participation in decision-making at various levels.<sup>118</sup>

There is a need to invest in innovative ways of harnessing modern and traditional information and communication technologies to establish effective ways of providing small-holder farmers, especially women and other vulnerable groups (e.g ethnic minorities), with tailored and relevant information, advisory services (including early warning systems for various climate-related risks) and knowledge and resources so that they can be empowered to manage climate risks and better anticipate and respond to risks and opportunities from changes in weather patterns. Information and communication technologies need to be designed and deployed using multi-channel, multi-directional delivery mechanisms to ensure that all target groups have ample opportunities to receive information and services. Delivery mechanisms should also facilitate personal

<sup>117</sup> Davis, K.F., Downs, S. & Gephart, J.A. (2021) Towards food supply chain resilience to environmental shocks. *Nat Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>

<sup>118</sup> Leocadio S. Sebastian and Eisen Bernard V. Bernardo. 2019. *Making the Smallholder Farmers in Southeast Asia Climate Smart - The CCAFS R4D Thrust*. [online] available at [https://cgspace.cgiar.org/bitstream/handle/10568/107003/csa\\_sebastian.pdf](https://cgspace.cgiar.org/bitstream/handle/10568/107003/csa_sebastian.pdf)

relationships, including in-person extension, cooperatives, community representatives, knowledge exchange platforms, and social mobile apps<sup>119</sup>.

There are a number of programs that show potential for upscaling and replication such as the Integrated Agro-meteorological Advisory Service (IAAS) introduced in India in 2007. The program combined weather forecasts with agricultural advice and information to farmers in local languages using a variety of channels, including SMS messages on mobile phones, local radio and newspapers, and face-to-face advisory and extension services. The programme helped farmers cope with current short-term climate-induced risks with roughly 2.5 million smallholder farmers receiving IAAS advisories, experiencing 10-15% yield increases and 2-5% cost decreases compared to the control group<sup>120</sup>.

Investments in improved information and warning, such as seasonal crop forecasting and early response recommendations (based on seasonal climate forecasts), are particularly effective at improving livelihoods and building resilience of vulnerable food-insecure farmers when coupled with increased access to financial services and risk management interventions, such as adaptive social protection and index-based insurance programs<sup>121</sup>. Microfinance services (MFS) are especially helpful for the poor, and the provision of post-disaster finances for recovery and pre-disaster payment are fundamental means to reduce lower and medium level risks<sup>122</sup>. Timely compensation for the impacts of weather-related shocks can provide a financial buffer against the impacts of climate related shocks which prevents farmers from resorting to negative coping strategies such as selling of animals and assets, migration, and trading long-term benefits such as school attendance for short-term survival.<sup>123</sup> As such, agriculture insurance is viewed as a promising adaptation approach to reduce risks and increase the financial resilience of farmers and herders in many Asian countries<sup>124</sup>. Besides protecting rural livelihoods, financial instruments for risk sharing and transfer mechanisms, such as development of insurance markets and

<sup>119</sup> Green Climate Fund (GCF). 2021. Sectoral guide on agriculture and food security. [online] available at <https://www.greenclimate.fund/document/sectoral-guide-agriculture-and-food-security>

<sup>120</sup> Venkatasubramanian, K. et al. (2014) Assessment of India's Agrometeorological Advisory Service from a farmer perspective | CCAFS: CGIAR research program on Climate Change, Agriculture and Food Security. 54. Available at: <https://ccafs.cgiar.org/publications/assessment-indias-agrometeorological-advisory-service-farmer-perspective#.XSOocpNKIRs> (Accessed: 8 July 2019).

<sup>121</sup> Green Climate Fund (GCF). 2021. Sectoral guide on agriculture and food security. [online] available at <https://www.greenclimate.fund/document/sectoral-guide-agriculture-and-food-security>

<sup>122</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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 [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf).

<sup>123</sup> de Coninck, H., A. Revi, M. Babiker, P. Bertoldi, M. Buckeridge, A. Cartwright, W. Dong, J. Ford, S. Fuss, J.-C. Hourcade, D. Ley, R. Mechler, P. Newman, A. Revokatova, S. Schultz, L. Steg, and T. Sugiyama, 2018: Strengthening and Implementing the Global Response. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press

<sup>124</sup> Shaw, R., Y. Luo, T.S. Cheong, S. Abdul Halim, S. Chaturvedi, M. Hashizume, G.E. Insarov, Y. Ishikawa, M. Jafari, A. Kitoh, J. Pulhin, C. Singh, K. Vasant, and Z. Zhang, 2022: Asia. In: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegria, M. Craig, S. Langsdorf, S. Lösschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press.

improved index-based weather insurance programmes, may be crafted to incentivize more sustainable and resilient on-farm choices. Therefore, these are important counterparts to agroecological landscape approaches to agricultural risk management<sup>125,126</sup>. For example, index insurance has the potential to build the resilience of smallholder farmers, not only by providing a payout in response to negative climate impacts to help farmers survive and protect their livelihood assets over the longer term; but also by allowing farmers to access credit, which they can then use to invest in new agricultural technologies, higher-value crop varieties or inputs. This could allow the farmers to use their increased profits to pay for the insurance premium, knowing that the insurance would allow them to repay their loan in the event of a climate shock<sup>127</sup>.

The feasibility of insurance for adaptation in low-income countries with less developed insurance markets has been questioned, and the IPCC attributes medium evidence and medium agreement on its feasibility, highlighting financial, social, and institutional barriers to implementation and uptake, in low-income nations.<sup>128</sup> However, index-based micro-crop and livestock insurance programmes have been rolled out in regions with less developed insurance markets and concrete evidence is building from a few initiatives in the region that have been able to overcome the challenges, and demonstrate substantial demand and tangible development impacts among farmers previously considered difficult to insure that suggests that index insurance has the potential to benefit smallholder farmers at a meaningful scale. For these initiatives to be successful, there is a need to establish, strengthen and consolidate related policies, institutions, products and services to better respond to national and local climate risks and shocks and implement innovative approaches to bring down the premiums to manageable levels and explicitly target obstacles to improving farmer income. For example, tying the insurance and pay-outs to mobile platforms and linked to climate-informed advisories that reduce risk and bring the premiums down to manageable levels. These types of insurance products should be tied to other development interventions, farmers must be given a voice in the design of products, and training on financial literacy, and specific measures to ensure they reach to women must comprise the interventions<sup>129</sup>.

**Proposed Activities:** The focus will be to build human and financial capital, as identified in the SLF, through improving access to digital information services and low-cost risk transfer

<sup>125</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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 [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf)

<sup>126</sup> Davis, K.F., Downs, S. & Gephart, J.A. (2021) Towards food supply chain resilience to environmental shocks. *Nat Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>

<sup>127</sup> Greatrex H, Hansen JW, Garvin S, Diro R, Blakeley S, Le Guen M, Rao KN, Osgood, DE. 2015. Scaling up index insurance for smallholder farmers: Recent evidence and insights. CCAFS Report No. 14 Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CAAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

<sup>128</sup> IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

<sup>129</sup> Greatrex H, Hansen JW, Garvin S, Diro R, Blakeley S, Le Guen M, Rao KN, Osgood, DE. 2015. Scaling up index insurance for smallholder farmers: Recent evidence and insights. CCAFS Report No. 14 Copenhagen: CGIAR Research Program on Climate Change, Agriculture and Food Security (CAAFS). Available online at: [www.ccafs.cgiar.org](http://www.ccafs.cgiar.org)

mechanisms. Building on the climate information generated through the expanded and upgraded climate information services under output 4, this activity area will likely support; (i) investing in information technology systems to facilitate rapid information flows to small-holder farmers (ii) developing low cost risk transfer mechanisms for small-holder farmers, such as weather indexed based micro-insurance schemes tailored to individual country contexts, to support the adoption of climate resilient production practices, (iii) design and deliver capacity building programs on financial literacy for insurance consumers (iv) design and deliver trainings and awareness raising for social protection program beneficiaries, especially women, on climate-resilient livelihoods (linked to output 4.2). This activity area is closely aligned with the GCF Agriculture and Food Security Paradigm Shifting Investment Pathway 2: Facilitating climate informed advisory and risk management services. It also includes activities identified by the IPCC as overarching adaptation options supporting adaptation transitions.

### **Activity Area 5.3 Climate resilient agriculture supply chains.**

Smallholder farmers are not only responsible for the production of food and other agricultural products, in many cases they also oversee the near-term storage and processing, and transport of their products to local markets. This exposes subsistence agriculture to multiple forms of climate risk<sup>130</sup>. Climate change may render some agricultural activities inviable in the future as certain thresholds are breached making the costs of storage, transportation and/or processing too high<sup>131</sup>. An increase in the frequency and intensity of extreme climate events can lead to the destruction of storage and processing facilities and cut off or destroy crucial transport networks that can cause large-scale disruption of food supply chains, especially if they are centrally organized in larger cities. This can not only impact farmers livelihoods but also the food security of poor population leading to negative coping strategies such as selling productive assets trapping them in a cycle of poverty and food insecurity<sup>132</sup>. This was clearly demonstrated in the floods in Pakistan in 2010 which not only impacted 2.4 million hectares of standing crops, but also 1 million tonnes of food and seed stocks, as well as damage to manufacturing facilities, and rail and road networks. This led to widespread declines in domestic food grain stocks (>60% of households lost food grain stocks in the short term)<sup>133</sup>. This not only has implications for the rural poor, many poor street vendors in urban areas, and other informal workers, are involved in processing and selling of food and thus rely on the steady supply of produce for their income.

Building climate resilient livelihoods of the poor and vulnerable sectors of society thus requires expanding investments in resilient livelihoods beyond a focus solely on making production more resilient to enhancing the resilience of the entire supply chain. This will be crucial in countries

<sup>130</sup> Davis, K.F., Downs, S. & Gephart, J.A. (2021) Towards food supply chain resilience to environmental shocks. *Nat Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>

<sup>131</sup> International Fund for Agricultural and Development (IFAD). *Environment and climate change: How to do Climate change risk assessments in value chain projects*. Rome, Italy. 2015.

<sup>132</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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* [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf)

<sup>133</sup> Davis, K.F., Downs, S. & Gephart, J.A. (2021) Towards food supply chain resilience to environmental shocks. *Nat Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>

such as Timor-Leste, for example, where agriculture development is critical for sustainable growth and poverty reduction as 80% of active population are engaged in subsistence agriculture. However, the agricultural production systems are one of the least developed in the world.<sup>134</sup> It will require building supply chain resilience through re-evaluating how food is stored, transported, processed and sold, ensuring that producers and other workers that rely on the agricultural value chain can maintain and potentially grow their income despite the impacts of climate shocks and stresses, also reshaping value chains to shift consumer demand towards sustainable and climate resilient crops and production practices that support of rural employment opportunities, including off farm employment<sup>135</sup>.

Strengthening logistics infrastructure, transportation and food distribution networks to ensure market access under extreme weather events would significantly enhance resilience to climate change, while improving food and nutrition security<sup>136</sup>. The structures and technologies for storing seed and produce in areas of high climate risk, such as elevated grain stores in flood prone areas must also be considered to protect from post-harvest losses and losses to seeds and protect crops more safely and for longer periods from postharvest insect pests that are projected to increase as result of climate change. The processing of food is another important entry point in the supply chain where resilience can be built through both protecting production and processing facilities from the impacts of extreme weather events. Extreme heat has been shown for example to increase the growth of bacteria that spoil meat and poultry products during storage<sup>137</sup> and will thus require specific measures to reduce this risk. Measures that facilitate food trade can also increase the availability of food and maintain farmer incomes in the face of shocks and stresses by enabling products to flow from surplus to deficit areas, while pooling production risks across individual markets to maintain stability<sup>138</sup>.

These types of measures that link farmers to consumers can contribute to transforming currently fragile food systems as they can facilitate the uptake from households of new more resilient production practices, such as the adoption of planting hybrid crop varieties that maybe more susceptible to insect pests in storage than traditional lower-yielding varieties, if new logistics support is required. However, such interventions can be capital intensive and beyond the financial

<sup>134</sup> Asian Development Bank (ADB). 2016. *Country Partnership Strategy Timor-Leste 2016–2020*. Sector Assessment (Summary): Agriculture, Natural Resources and Rural Development. (accessible from the list of linked documents in Appendix 2). Manila, Philippines.

<sup>135</sup> Green Climate Fund. 2021. *Sectoral Guide on Agriculture and Food Security*. [Online] available at <https://www.greenclimate.fund/sites/default/files/document/agriculture-and-food-security-sectoral-guide.pdf>

<sup>136</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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 [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf)

<sup>137</sup> European Food Safety Authority. 2016. Growth of spoilage bacteria during storage and transport of meat. *EFSA Journal*. Volume 14, Issue 6 <https://doi.org/10.2903/j.efsa.2016.4523>

<sup>138</sup> Mbow, C., C. Rosenzweig, L.G. Barioni, T.G. Benton, M. Herrero, M. Krishnapillai, E. Liwenga, P. Pradhan, M.G. Rivera-Ferre, T. Sapkota, F.N. Tubiello, Y. Xu, 2019: Food Security. 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 [P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D.C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.)]. In press. [online] available at [https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08\\_Chapter-5\\_3.pdf](https://www.ipcc.ch/site/assets/uploads/sites/4/2021/02/08_Chapter-5_3.pdf)

capacity of individual smallholders<sup>139</sup>. Through investing in the supply chain, GCF investments have the potential to not only improve resilience to climate impacts, but also to other shocks, such as COVID-19.

**Proposed Activities:** The focus of the interventions under this activity area will be to build human capital and physical capital, as identified in the SLF, to deal with climate impacts to the agricultural supply chain, and is closely aligned with the GCF Agriculture and Food Security Paradigm Shifting Investment Pathway 3: Reconfiguring food systems. This will likely support; i) improving the transport and logistics infrastructure, especially through the use of ICT solutions, to successfully bring products to market despite the impact of extreme weather events due to climate change; (ii) introduction of protective measures to the siting and storage of seeds, tools, vehicles and energy infrastructure as well as installation of new or improved post-harvest storage and processing facilities to protect against the impact of climate change on productive inputs and marketable produce; (iii) providing technological solutions and capacity building for improved food processing strategies that can help increase the value and durability of perishable foods such as fruits and vegetables.

### **Output 6: Climate adaption pro-poor infrastructure implemented**

**The solution:** Countries in the Asia and Pacific region are already experiencing increasing impacts of climate related disasters and in particular, poor and the vulnerable populations are disproportionately affected due to their high level of exposure and vulnerability. Recurrent climate related disaster events and future climate change risks pose significant challenge for poverty reduction efforts and to achieve the SDGs. Countries in the region have recognized the importance of building the resilience of poor and vulnerable as a priority action to deal with climate change. Complementing adaptation measures targeting poor individual households and vulnerable groups, there is a need to minimize exposure and physical vulnerabilities and protect their productive assets through investments in infrastructure and services which can also provide possible additional benefits. For e.g., experience from India's shows that the investments in social protection programs linked to small-scale community infrastructure and decentralized decision making, also benefit marginalized and resource dependent communities.<sup>140</sup> There is empirical evidence that suggests land (natural capital) and household asset ownership (physical capital) are positively linked to household well-being outcomes through their associated positive impact on resilience.<sup>141</sup> Protecting these physical and natural assets through pro-poor, local-level, climate adaptive infrastructure investments provide such avenue to support and strengthen the poor and vulnerable populations. However, there is a need for targeted climate-adaptive investments with such focus to build their resilience as they are often excluded or having limited support. Such investments can promote innovation and the accumulation of an adequate asset base for poor populations to graduate out of poverty.<sup>142</sup>

<sup>139</sup> Davis, K.F., Downs, S. & Gephart, J.A. (2021) Towards food supply chain resilience to environmental shocks. *Nat Food* 2, 54–65. <https://doi.org/10.1038/s43016-020-00196-3>

<sup>140</sup> Fischer, H. 2020. *Policy innovations for pro-poor climate support: social protection, small-scale infrastructure, and active citizenship under India's MGNREGA, Climate and Development*.

<sup>141</sup> Wright H, Kristjanson P, Bhatta G. 2012. *Understanding Adaptive Capacity: Sustainable Livelihoods and Food Security in Coastal Bangladesh*. CCAFS Working Paper No. 32. CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), Copenhagen, Denmark.

<sup>142</sup> Olsson, L., M. et.al. 2014. *Livelihoods and poverty*. In: *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O.

An extensive review of the Investments under Output 6 of the CRPP will directly support activities that minimize impacts of cyclone wind, storm surge and sea level rise through ecosystem-based approaches, protective infrastructure and multipurpose emergency shelters. As such there is a close link to the sustainable livelihoods approach highlighted in output 5, as these measures directly relate to the conservation and promotion of natural capital and the protection of physical capital, through the deployment of nature based solutions and protective grey infrastructure. The CRPP will keep in mind that such approaches are integrated and targeted while offering additional benefits effective than standalone efforts to reduce climate-related risks<sup>143</sup> The key areas of intervention which will form the framework for the design and selection of specific project activities under Output 6 are discussed below.

### Activity Area 6.1: Ecosystem-based infrastructure.

The deployment of natural capital, the world's stocks of natural assets which include geology, soil, air, water and all living things, has an important role in resilient livelihoods, adaptation to climate change and achieving the sustainable development goals. The sustainable management, conservation and restoration of ecosystems can contribute to climate change adaptation by providing protection from extreme events through their natural ability to regulate changes and absorb the impacts of rapid on-set hazards such as storm surges and flash floods.<sup>144</sup> Ecosystem based green infrastructure are cost-effective measures to address multiple risks than grey infrastructure. Scaling-up approaches that rehabilitate natural systems using ecosystem-based adaptation (Eba) can not only mitigate the impacts of natural hazards and climate change but they can also contribute to sustainable livelihoods as well as generating additional environmental, economic, and social benefits and thus build resilience<sup>145</sup>. Well-integrated ecosystem-based adaptation interventions are often referred to as low regrets or no-regrets options as they can generate benefits regardless of uncertainties in climate projections as well as often being more cost effective and sustainable than non-integrated physical engineering approaches<sup>146</sup>.

The CRPP will invest in EbA that builds and maintains natural infrastructure in river basins and coastal areas in order to strengthen water and food security in the face of climate change and protect livelihood assets from extreme flooding events. This may include increasing vegetative cover through natural reforestation to improve appropriate drainage, and the application of bioengineering to increase water retention and natural storage. In coastal zones, activities will focus on the rehabilitation of natural systems such as mangroves and coastal wetlands to reduce coastal erosion, provide protection from storm surge, and reduce saline intrusion, protecting livelihoods in coastal areas against climate risks.<sup>147</sup> In all cases implementation will be done in

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Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)). Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832.

<sup>143</sup> Mimura, N., et.al. 2014. *Adaptation planning and implementation*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 869-898.

<sup>144</sup> Klein, R.J.T. et al. *Adaptation opportunities, constraints, and limits*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 899-943. 2014.

<sup>145</sup> Monty, F., Murti, R., Miththapala, S., Buyck, C., . *Ecosystems protecting infrastructure and communities: lessons learned*. IUCN, International Union for Conservation of Nature. 2017. URL:<https://doi.org/10.2305/IUCN.CH.2017.14.en>

<sup>146</sup> Organisation for Economic Co-operation and Development (OECD). 2019. *Implementing adaptation policies: towards sustainable development*. URL: <https://www.oecd.org/g20/summits/osaka/OECD-G20%20Paper-Adaptation-and-resilient-infrastructure.pdf>.

<sup>147</sup> Olsson, L., M. et.al. *Livelihoods and poverty*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate

consultation with local communities and through participatory land use planning and emphasis will be placed on livelihood protection.

**Proposed Activities:** This will likely support (i) national and local governments in collaboration with national scientific organizations in identifying locally appropriate green infrastructure to reduce exposure and vulnerability of climate impacts on lives and livelihoods of poor and vulnerable communities; (ii) in undertaking trainings for local governments, communities and community-based organizations in planting, rehabilitation and maintaining green and blue infrastructure; (iii) local governments/communities (especially women's groups) by providing small grants for planting and rehabilitation of green infrastructure; and (iv) in developing policy, legal frameworks and financial models for scaling up investments in green and blue infrastructure in partnerships with private sector.

The investments in ecosystem-based infrastructure implemented under activity area 6.1 of the CRPP will be guided by the IUCN Global Standards for Nature-based Solutions. The NbS Global Standards serve as a mechanism for developing a consistent approach to designing and implementing NbS, including EbA, and will guide the CRPP to deploy such investments in a systematic way, and ensure quality in the design and execution. By ensuring that the Standards 8 criteria are closely followed, interventions under output 6 will be aligned with internationally accepted NbS principles and a robust framework for designing NbS that will result in consistent and grounded applications. The Standards also provides a systematic learning framework so that lessons can improve and evolve the applications, leading to greater confidence in NbS among decision makers and give credibility to the intervention when speaking to governments and potential private investors, laying the foundations for sustainable outcomes and future scalability and<sup>148</sup>. As such, the 28 indicators will be closely integrated into the relevant project DMFs to facilitate this shared learning and formation of an evidence base.

## Activity Area 6.2: Flood and landslide protection infrastructure

Recurrent flood events and extensive damage caused by landslides pose significant risk for poor, marginalized and remote communities. Landslide risk is increasingly recognized as a major threat due to high mortality rate, irreparable damages and disruption to services.<sup>149, 150</sup> In the future due to climate change, floods and landslides risk will increase due to increased intensity of rainfall and also development induced land use changes, deforestation etc. In PNG, flooding and landslide risk has increased due to increased rainfall and caused extensive damages to agriculture, transport infrastructure and rural communities. Identification and quantification of risk is one of the adaptation strategies identified to inform local level interventions. The IPCC has identified green urban infrastructure as a cost effective strategy for increasing urban resilience to climate impacts as it can mediate runoff, encourage groundwater recharge and enhance water quality<sup>151</sup>.

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Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 793-832. 2014.

<sup>148</sup> IUCN. 2020. *IUCN Global Standard for Nature-based Solutions: A user-friendly framework for the verification, design and scaling up of NbS* [Online] available at <https://portals.iucn.org/library/sites/library/files/documents/2020-020-En.pdf>

<sup>149</sup> World Health Organization (WHO). *Landslides*. <https://www.who.int/health-topics/landslides>

<sup>150</sup> Mirus, B. B., Smith, J. B., & Baum, R. L. 2017. *Hydrologic impacts of landslide disturbances: implications for remobilization and hazard persistence*. *Water Resources Research*, 53, 8250– 8265. <https://agupubs.onlinelibrary.wiley.com/doi/pdfdirect/10.1002/2017WR020842>.

<sup>151</sup> IPCC, 2018: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.

Timor-Leste has identified the need for investments in combined structural and nature-based solutions as a priority to mitigate the impact of floods and landslides as part of its NAPA. Due to its diverse eco-system, Lao PDR has identified forestry-based actions to prevent flooding, soil erosion and landslides. Failure to investments in protection infrastructure can exacerbate the vulnerabilities and increased risk due to climate change. The CRPP will invest in infrastructure (grey and green) based on the current and future risks and to local context to reduce their vulnerabilities and minimize the impacts on the poor and vulnerable communities. It will also strengthen the community participation in construction and maintenance of protection infrastructures.

**Proposed Activities:** This will likely support (i) in undertaking local planning processes to identify and prioritize small scale protective infrastructure and recognize its linkages with wider infrastructure systems; (ii) in undertaking civil works for small scale flood protection and/or landslide protection measures, especially measures that use a combination of grey and green measures and are prioritized by local communities; and (iii) in undertaking trainings for local governments and communities in maintenance of protective infrastructure.

### **Activity Area 6.3: Multi-purpose emergency shelters**

Poor and vulnerable communities living in hazard prone areas and informal settlements are of high risk, due to high vulnerability of their housing, damages caused to natural systems such as drainages, mangroves or vegetations and lack of protection infrastructure such as cyclone or flood shelters. Experience from Bangladesh, which has made significant investments in construction of cyclone shelters and proven to be an effective in reducing the casualties over the past decades. However, review shows that protection infrastructure such as shelters are often not located close to where the poor and vulnerable reside, inadequate capacities, lack of maintenance strategies, and due to poor facilities local populations and vulnerable groups are reluctant to use those structures during emergencies.<sup>152</sup> Moreover, existing shelters are not adequately designed to withstand extreme events and also sea level rise. Current formal government structures and planning mechanisms are often barriers for participation of poor households living in informal settlements to participate in local level planning and decision-making process. In addition, local governments have limited resources to take necessary actions to support towards long term pro-poor adaptation actions and services.

The investments will support pro-poor protective investments that will target poor and vulnerable people in high-risk communities and build resilience to current and future climate change associated risks. It will also build the capacity of local institutions to collaborate and work with poor and vulnerable communities and engage them proactively in planning and decision-making processes to ensure long-term sustainability of the protective infrastructure.

**Proposed Activities:** This will likely support (i) undertaking local planning, with active participation of women, to identify the need of multipurpose emergency shelters to save the lives and livestock of poor and vulnerable population in times of extreme weather events; (ii) local governments in constructing emergency shelters (with gender inclusive and socially appropriate design features) to reduce the exposure of poor and vulnerable population to extreme weather events; (iii) in undertaking trainings for local governments and communities in planning and maintenance of multipurpose emergency shelters; and (iii) in undertaking capacity building for local communities on disaster preparedness including evacuation planning.

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<sup>152</sup> Asian Development Bank. 2012. *Bangladesh: Coastal Climate-Resilient Infrastructure Project*. Consultant Report. Manila, Philippines.