



UNITED NATIONS  
INDUSTRIAL DEVELOPMENT ORGANIZATION

## **CLIMATE ADAPTATION STRATEGY**

*Mainstreaming resilience  
into future industrial development pathways*

Department of Energy, UNIDO

November 2021

Dr. Cara Tobin

## TABLE OF CONTENTS

<b>1. Introduction and background .....</b>	<b>3</b>
<b>2. The need to mainstream climate adaptation in industrial development.....</b>	<b>6</b>
<b>3. The entry points for the Department of Energy to address climate adaptation needs.....</b>	<b>8</b>
<b>4. The niche of the Department of Energy and potential cooperation partners .....</b>	<b>19</b>
<b>5. Closing remarks .....</b>	<b>24</b>
 <i>Acronyms and abbreviations.....</i>	 <i>25</i>
 <i>Annex 1: Climate adaptation funding sources .....</i>	 <i>28</i>
<i>Annex 2: Pipeline analysis of climate change adaptation projects .....</i>	<i>60</i>
<i>Annex 3: CTI/ESI/ETI priority geographical areas.....</i>	<i>78</i>
<i>Annex 4: CTI/ESI/ETI linkages with national programming/planning documents .....</i>	<i>110</i>
<i>Annex 5: Recommendations for adaptation project development – theories of change.....</i>	<i>137</i>
<i>Annex 6: Vulnerability assessment and adaptation planning tools and source data .....</i>	<i>150</i>

# 1

## INTRODUCTION AND BACKGROUND

Climate adaptation refers to adjustments in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.<sup>1</sup> It encompasses changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.<sup>2</sup> Climate adaptation depends greatly on the **adaptive capacity** or **adaptability** of an affected system, region, or community to cope with the impacts and risks of climate change. Enhancement of adaptive capacity by building resilience represents a practical means of dealing with changes, reducing vulnerabilities, and promoting sustainable development. The terms of **climate adaptation** and **resilience building** are often used interchangeably. For the purposes of this strategy, the term of (climate) adaptation will be used, as it is more comprehensive, i.e. it might encompass resilience building to withstand a hazard and recover from a disruption or to bounce back, mainly in the short term, and implies accommodation to long-term changes in climate. The adaptation as a concept has been discussed in global fora since the 1990s at the first UNFCCC COP meetings.

In its Fifth Assessment Report (AR5) the Intergovernmental Panel on Climate Change (IPCC) noted that in developing countries **existing and projected physical impacts resulting from climate change** include warmer temperatures with longer and hotter warm spells, extended periods of drought, heavy rain and wind storms, stronger tropical storms and cyclones, desertification, sea level rise, beach erosion, and saltwater infiltration of groundwater.<sup>3</sup> Other anticipated climate change impacts include land and ecosystem degradation, falling fisheries productivity and damage to public infrastructure. It has been estimated that **80% of the damage from climate change may become concentrated in developing countries**. In some instances, projected climate conditions may suggest that a revision of planned activities may not be enough and that infrastructure-related interventions might be needed. This is particularly the case when an increased occurrence of extreme precipitation events is expected, resulting in more frequent flooding. Furthermore, the time required to recover from natural disasters will be prolonged. If longer than the frequency in which such disasters occur, many developing economies could remain in a constant state of reconstruction.<sup>4</sup>

**Small Island Developing States (SIDS)**, among which 12 are classified as **Least Developed Countries (LDCs)**, are especially vulnerable to climate change due to their geographic locations, limited resource base, and strong influence of the oceanic circulation system. The slow and volatile economic growth performance for SIDS is directly influenced by global economic shocks and natural disasters. These climate characteristics, combined with particular socioeconomic circumstances, make SIDS some of the most vulnerable countries in the world to climate change. As an example, the Hurricane Maria in 2017 caused damages in Dominica totaling over 225% of the country's GDP, and displaced the entire population of Barbuda.<sup>5</sup> Notably, extreme weather events associated with climate change also lead to loss and damage in the sector of industrial production, **while the small and medium enterprises (SMEs) are disproportionately affected**, as they often lack technical capacity and financial

---

<sup>1</sup> IPCC Adaptation 2018: Adaptation to Climate Change in the Context of Sustainable Development and Equity Ch 18

<sup>2</sup> UNCTAD 2021 Trade climate-readiness for developing countries

<sup>3</sup> UNCTAD 2021 Trade climate-readiness for developing countries

<sup>4</sup> Schroders 2020. Climate change and the global economy: regional effects

<sup>5</sup> Climate Analytics 2020. <https://climateanalytics.org/blog/2020/climate-change-and-small-islands-more-scientific-evidence-of-high-risks/>



resources to address the climate change challenge. In general, designing and implementing effective adaptation actions is necessary to increase country long-term industrial productivity. What is more, according to the 2020 report by UNCTAD, due to adaptation measures developing countries can also enhance their trade-climate readiness, i.e. improve the resilience of their trade to climate change through adaptation actions and economic diversification.

In general, the climate risks for a given country or region are a derivative of three main factors, i.e. 1) **climate-related hazards** (e.g. exposure to floods, storms, droughts, etc.), 2) **vulnerability** (a state that exists within a system before it encounters a hazard event), and 3) **exposure** (e.g. presence of livelihoods, species, ecosystems, environmental functions, services, resources, infrastructure, economic/ social/ environmental assets, etc. in places or settings that could be adversely affected).<sup>6</sup> Due to their increased vulnerability, exposure, and hazards, it is critical to support adaptation to climate change in developing countries, particularly in LDCs and SIDs. In developing countries, people who are already most vulnerable and marginalized will experience the greatest negative impacts.<sup>7</sup> In many settings, **women will be more vulnerable than men to the adverse impacts of climate change because they are more dependent on threatened natural resources than men.** In addition, women have less access than men to resources such as land, credit, agricultural and fishing inputs, decision-making structures, technology, training and extension services that would enhance their capacity to adapt to climate change

Furthermore, extreme weather and the aftermath of natural disasters cause developing countries to spend vast financial resources on clear-up operations and healthcare. This is in addition to the budgets now increasingly being directed to address the **COVID-19 pandemic**.<sup>8</sup> However, it also needs to be noted that – on the global level – the policy responses to the pandemic often integrate climate change issues, which is a promising development and offers an opportunity for the climate adaptation action to be mainstreamed in the newly developed recovery strategies and action plans. Nevertheless, due to climate change, governments of developing nations will be forced to channel resources away from productive and growth-enhancing projects towards countering the loss and damages due to extreme weather events. Importantly, it has to be highlighted that significant lifetimes of major anthropogenic GHGs already emitted will persist long after emissions have ceased. For this reason alone, adaptation is an imperative regardless of the level of progress achieved in mitigating global emissions.<sup>9</sup>

The **aggregate cost of adapting to climate change** in developing countries is estimated by the United Nations Environment Programme (UNEP) to range between USD140–300 billion annually in 2030, and between USD280–500 billion annually in 2050.<sup>10</sup> Adaptation to climate change is gaining increased attention in developing countries as confidence in climate change projection models grows and demonstrated international actions to mitigate GHG emissions still remain insufficient. For example, due to present and expected climate change caused by GHGs emitted in the past, the costs of climate adaptation in Africa were estimated to be in the range of USD 7-15bn per year, with a rapid increase after 2020. This results in huge investment needs, and there is evidence that multilateral banks, such as for example the African Development Bank, are increasingly aware of this challenge. At COP21 the developed countries committed to continue their existing collective mobilization goal of USD100 billion per year until 2025. The urgency for adaptation financing is so critical that institutions like the Green Climate Fund have mandated that 50% of climate finance flows go towards adaptation.<sup>11</sup>

<sup>6</sup> Viner et al. (2020) "Understanding the dynamic nature of risk in climate change assessments—A new starting point for discussion"

<sup>7</sup> Osman-Elasha, B. 2012. UN Chronicle, Volume 46, Issue 4, Apr 2012, p. 54 - 55

<sup>8</sup> UNDESA 2020: The COVID pandemic has illustrated that small and open economies do not have the resources needed to effectively respond to large-scale disasters and economic dislocations with financial response and recovery packages

<sup>9</sup> UNCTAD 2021 Trade climate-readiness for developing countries

<sup>10</sup> UNEP, 2016; OECD, 2020

<sup>11</sup> Out of all climate finance flows, finance for mitigation represented 70 per cent, and finance for adaptation 21 per cent, of the total with remainder targeting cross-cutting activity

## VISION

UNIDO is the specialized agency of the United Nations mandated to promote and accelerate inclusive and sustainable industrial development in Member States. Its services include **i) policy advisory; ii) standards and quality-related activities; and (iii) convening and partnerships for knowledge transfer, networking and industrial cooperation.**

UNIDO's mission is fully recognized in the **SDG9** which calls to "build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation". More specifically, the mandate of UNIDO is to promote and accelerate **inclusive and sustainable industrial development** (ISID) in Member States. The responsibility of the Department of Energy (ENE) is to contribute to the realization of the overarching UNIDO ISID mandate by, among others:

- supporting governments and industries with the provision of sustainable and resilient energy infrastructure for industrial development,
- supporting government in fulfilling national commitments under the multilateral climate agreements and conventions, including access to climate finance, thereby facilitating a just transition towards sustainable industrialization,
- harnessing the role of entrepreneurship and innovation in climate action,
- strengthening partnerships between different stakeholders, and
- providing assistance to governments in mobilizing resources from financial mechanisms and funds to formulate and implement impactful projects and programs.

In line with the UNIDO/ENE mandate, with the Climate Adaptation Strategy it is attempted to **mainstream resilience in the future industrial development pathways**. The implementation of the Strategy should both ensure that, **on the one hand**, obstacles that hinder productivity in climate-sensitive sectors are removed and negative impacts of climate change on local communities, particularly in LDCs and SIDS, are mitigated as well as, **on the other hand**, that business and industry development opportunities associated with climate change are harnessed for the benefit of UNIDO Member States. UNIDO/ENE's objective is also to ensure that, as a result of the implementation of the Strategy, the government institutions, private sector and industry-related organizations have sustainable energy, water, and feedstock supplies, resilient infrastructure and the adaptive capacity to deal with the challenge of climate change.

The Strategy includes four multi-disciplinary and integrated **focal areas** for the delivery of UNIDO/ENE mandate, with the ultimate objective of contributing to the achievement of several SDGs, next to the **SDG9**, including also **SDG2** (no hunger), **SDG3** (good health), **SDG6** (clean water and sanitation), **SDG7** (affordable and clean energy), and **SDG8** (decent work and economic growth).

The Strategy is meant to facilitate short-term implementation, i.e. over a 3-year time horizon, of the most relevant cutting-edge adaptation practices with an effect of unlocking a transformative change.<sup>12</sup> Beyond this period, the Strategy is planned to be re-evaluated to reflect changes, if any, in adaptation priorities and targeted geographical areas.

<sup>12</sup> Priority geographies were defined in bilateral discussion with the divisions within the ENE department - please see Annex 3 for more details

# 2

## THE NEED TO MAINSTREAM CLIMATE ADAPTATION IN INDUSTRIAL DEVELOPMENT

All UNIDO Member States have detailed a set of adaptation needs in their communications to the UNFCCC such as in their National Adaptation Programmes of Action (NAPAs), Nationally Determined Contributions (NDCs) and more recently National Adaptation Plans (NAPs) and Technology Needs Assessments (TNAs).<sup>13</sup> As a result of a comprehensive review of these documents it can be concluded that the urge related to mainstreaming of climate adaptation in industrial development is clearly evident and exists in particular in the following areas:

### 1. Agriculture, forestry, and fishing value chains

Countries state their need for increasing the resilience of agriculture, forestry and fishing value chains, all of which are natural resource based, and for identifying alternative income-generating activities in their frameworks. In LDCs on average 60% of population finds employment in these sectors, and in African LDCs - 68%.<sup>14</sup> In particular, the **smallholder farming** will be strongly affected by climate change through reduced renewable surface water and groundwater resources in most dry tropical and subtropical regions, which is expected to significantly alter agricultural output. More than 70% of agriculture around the world depends on rainfall, as opposed to irrigation. As a result, rain-fed agriculture is very sensitive to changing patterns in precipitation, temperature, and extreme weather events. With limited land, technological, and financial resources, smallholder farmers are the least able to adjust to changes in temperature and precipitation. **Fisheries** in turn will experience mounting pressure through progressively increasing ocean warming, leading to changes in the distribution of fish stocks as species move to seas of cooler temperatures. Climate warming may also significantly affect aquaculture production in developing countries due to saltwater infiltration of production sites, limited freshwater supply, and increased risk of disease outbreaks associated with higher temperatures. Most countries voice the need to have more climate-resilient agricultural production, including approaches to reduce post-harvest losses. As temperatures rise further, continents across the globe will continue to face declining crop yields and will struggle to produce sufficient food for domestic consumption, whilst their major exports will likely fall in volume.<sup>15</sup> For example, overall mean reductions in yields for Africa are projected to be by 13% in West and Central Africa, 11% in North Africa, and 8% in East and Southern Africa.<sup>16</sup> All countries stress the urgency to ensure **food, energy and water security**. Specifically, they would like to have increased access to solar irrigation and enhance the water-energy-food nexus.

### 2. Infrastructure, including buildings as well as telecommunication, transport, water, and energy systems

Infrastructure, including **critical assets** such as electric power generation and transmission systems, water supply systems, transportation systems, buildings and hospitals, as well as

<sup>13</sup> NAPA – National Adaptation Programme of Action, NDC – Nationally Determined Contributions and NAP – National Adaptation Plan

<sup>14</sup> UNCTAD 2021 Trade climate-readiness for developing countries

<sup>15</sup> Schroders 2020. Climate change and the global economy: regional effects

<sup>16</sup> UNCTAD 2021 Trade climate-readiness for developing countries

telecommunication networks and emergency services, is a driver of social and economic development. It plays a crucial and multi-faceted role in improving access to healthcare, connecting farmers to markets, enabling industrial processes, and ensuring social security, while at the same time being costly and strongly interconnected across various industry sectors. Infrastructure must be made resilient to floods and other extreme weather events, as well as it must have appropriate technological solutions incorporated to improve efficiency and independence of the natural resource use (e.g. water reuse). The types of infrastructure requiring climate proofing include water and sanitation systems, energy systems, buildings such as schools, public health centers and rural housing. Also, a better drainage for roads is necessary and coastal areas must be flood proofed, e.g. through building of sea walls as well as providing support to adhere to international standards on energy and water security and efficiency. Some countries also voice a need for climate index insurance and development of an insurance market for climate-induced risks on infrastructure.

### 3. Renewable energy access

Currently, renewable resources account for 15% of the global primary energy supply, including mainly bioenergy (10%), hydropower (3%), and other renewables (2%) such as photovoltaic and wind energy. It is estimated by the International Energy Agency that by 2040, renewables may supply 20–30% of the world's primary energy. At the same time however, the renewable energy sources might be susceptible to climate change. For example, it is estimated that in case the GHG emissions keep increasing until 2080, there would be a growth in bioenergy supply, which might be harnessed as an **“upside” market opportunity**. The potential of utility scale solar could in turn decrease, while hydropower and wind energy might decline in some regions and increase in others. For example, under a dry climate scenario, the value of hydropower generation in Africa could be reduced by USD 83 billion leading to higher costs for consumers. Against this background, several countries request climate proofing of existing and future renewable energy sources, in particular off-grid. Also, the decentralized energy supplies, such as mini-grids, are a means to ensure energy self-sufficiency that will be more robust during climate extremes.

# 3

## THE ENTRY POINTS FOR THE DEPARTMENT OF ENERGY TO ADDRESS CLIMATE ADAPTATION NEEDS

To catalyze poverty reduction, inclusive globalization, and environmental sustainability, UNIDO/ENE is specialized in the provision of reliable energy and climate services to contribute to its Member States' industrial development and the creation of inclusive and sustainable employment. Until now, UNIDO/ENE has focused predominantly on the climate mitigation benefits of promoting renewable energy and clean technologies in developing countries. The objective of this document is to detail how UNIDO/ENE can **strategically expand from mitigation support to addressing the adaptation needs of its beneficiaries**. In this regard, UNIDO/ENE has a unique cross-cutting mandate that places it in a strategic position where climate mitigation, climate adaptation, and economic green growth can be achieved simultaneously.

In particular, in relation to climate adaptation, **ENE is mandated to:**

- promote sustainable infrastructure for industrial development and promote industrial decarbonization through crosscutting solutions,
- provide support to local entrepreneurs in creating sustainable climate technology solutions that can deliver climate adaptation services,
- develop capacity building programs to create local jobs across value chains to enable vulnerable populations to exploit different opportunities to diversify their sources of income,
- strengthen the capacity of public and private sector institutions that are involved in industrialization, sustainable energy, energy management and systems optimization,
- provide policy support with energy system transitions and industrial decarbonization,
- support the decentralized energy systems for industry and promote business models that can ensure sustainability,
- support de-risking of investments in low-carbon energy infrastructure including e-mobility.

This specific UNIDO/ENE mandate can be successfully employed to offer solutions that are required in response to the urge to mainstream climate adaptation in industrial development, in particular across the following lines of intervention:

### 1) Ensuring comparative advantage and competitiveness of climate-sensitive productive sectors

Climate change is expected to influence the suitability of land for crops and forestry as well as marine areas for fishing, resulting in new supply, demand, trade, and price dynamics that will lead to altering of markets. These changes will give rise to new patterns of **comparative advantage and competitiveness** for climate-sensitive productive sectors, generally, and for individual plant, crop, fish and livestock varieties, specifically. Farmers and fishers will need to use plant/fish/livestock varieties that have more productive yields as climatic conditions worsen, taking into account changing market dynamics. Notably, the **diversification** of value chains will be essential when it is often too costly to completely climate proof a productive sector, particularly highly climate-sensitive sectors such as agriculture, fisheries, and tourism. For example, in fisheries-dependent developing



countries, product diversification is possible within the realm of the blue economy.<sup>17</sup>

## 2) Promoting innovation as well as technology development and transfer, including entrepreneurship development

With climate change being a proven reality, technologies that will build resilience and enable impacted populations to adapt are essential. Yet, these technologies are not readily available in developing countries. To this end, there is a need for support mechanisms that would encourage the **development and transfer of relevant adaptation technologies and associated capacities**.<sup>18</sup> For example, Ghana has the goal of scaling up penetration of climate-smart technologies to increase livestock and fisheries productivity by 10%.

According to the EU Adaptation Strategy 2021, **digital innovations** such as remote sensing, smart weather stations, artificial intelligence, application of sensors and high-performance computing with new instruments such as Destination Earth and Digital Twins hold great promise to boost the understanding of present and future climate impacts. The EU also highlighted the importance of more and better climate-related risk and losses data and developing tools and models for climate stress testing. All data should be open source, such as the GreenData4All initiative. Digital technology and big data can be used to develop tools and methods for improved infrastructure and city management, with three main objectives: 1) Drive a cultural shift in the construction industry towards greener, low-impact design methods; 2) Turn data into knowledge that can inform sustainable infrastructure-management policy; 3) Add new simulation layers to digital twins to support the design, operation and maintenance of physical infrastructures. Digitization can also be used in rural settings by installing humidity sensors on warehouses and post-harvest storage facilities. Sensor technology and automated controls can prevent spoilage and enhance the productivity of each part of agriculture value chains.

**Entrepreneurship support** such as in Nigeria has focused on using indigenous cooperative systems that make it possible to run small businesses and encourage adoption and promotion of adaptation technologies. In turn, Fiji plans to use “bio-security” to enhance protection against invasive species using ecosystem-based adaptation (EbA) or nature-based solutions (NBS) such as integrated nutrient management. Several countries request training on Integrated Nutrient Management Technology (INMT)<sup>19</sup> to community-based extension services.

What is more, innovative tools and expertise are required to **communicate, monitor, analyze** and **prevent** the effects of climate change. For instance, it is necessary to apply ex-ante project assessment tools to better identify co-benefits of adaptation projects.<sup>20</sup> Also, providing information on weather advisory services to climate-sensitive sectors can help them prepare for extreme weather events, and access loans needed to respond to such events. Mobile-phone based weather and financial services can in turn help vulnerable populations that would otherwise remain beyond reach.

The private sector realizes the need for technology development and transfer. Most notably, Climate-KIC<sup>21</sup> and the 100 Accelerator<sup>22</sup> have established **climate-focused accelerators**. Climate-KIC incubates and accelerates promising start-ups offering climate adaptation and resilience solutions in African and Asian countries. The 100 Accelerator is sponsored by AbinBev, Coca-Cola, Colgate-Palmolive and

<sup>17</sup> According to the World Bank, the blue economy is the “sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystem”

<sup>18</sup> Institutional Investors Group on Climate Change (IIGCC) PRI Principles for Responsible Investment - A Guide on Climate Change for Private Equity Investors

<sup>19</sup> Integrated Nutrient Management Technology (INMT) uses a combination of synthetic and natural plant nutrients to improve soil fertility

<sup>20</sup> Climate-Adapt 2020: <https://climate-adapt.eea.europa.eu/>

<sup>21</sup> Climate-KIC: <https://www.climate-kic.org/news/climate-adaptation-solutions-in-african-and-south-asian-countries/>

<sup>22</sup> 100 Accelerator: <https://www.100accelerator.com/>

Unilever and has 3 relevant challenges to adaptation innovation: i) water stewardship, ii) climate action and iii) smart agriculture.

### 3) Catalyzing investments, private sector engagement, and innovative financing mechanisms

Bearing the potential to unlock large-scale transformative change, **infrastructure investments** in climate resilience are an urgent priority. The long-lived nature of infrastructure assets implies that decisions made now will lock-in vulnerability if they fail to consider the climate change impacts.<sup>23</sup> In fact, much of the existing infrastructure stock is not coping well with the changing climate. At the same time, a climate-proofing of infrastructure investments has demonstrated a cost-benefit-ratio of about 1:4.<sup>24</sup> Also, establishing infrastructure that protects against negative impacts of climate change enables significant gains. For instance, spending USD 50 billion per year (annualized) on flood defenses for coastal cities is expected to reduce expected losses in 2050 from USD 1 trillion to USD 60-63 billion.<sup>25</sup> Notably, the scale of financing required in the infrastructure sector is significant. The OECD estimated that USD 6.3 trillion per year will need to be invested in infrastructure globally between 2016 and 2030.<sup>26</sup> Therefore, there is a need to have innovative financial solutions to integrate public and private capital into infrastructure investments. Most capital expenditures on infrastructure will however need to be made from the government budget. In many developing countries national budgets have insufficient capacity to fund expenditures for climate adaptation due to considerable debt servicing payments and high costs of infrastructure upgrades. In particular, in the LDCs and SIDS the financial capital as well as technical capacity of decision-makers is currently not sufficient to plan infrastructure investments (e.g. in air conditioning, insulation, building improvements, tree cover for shade, etc.).

**Innovative financing mechanisms** such as insurance schemes and public private partnerships (PPP) can provide significant support for climate adaptation activities. It is estimated that a 1% increase in insurance coverage could reduce the global cost of climate-related disasters to taxpayers or governments by 22%.<sup>27</sup> However, insurance schemes in developing countries such as Bangladesh, India, Vietnam, Philippines, Indonesia, Egypt and Nigeria have a penetration rate of less than 1%.<sup>28</sup> These countries are also among the most exposed to climate change and some of the least able to fund recovery efforts.<sup>29</sup> Notably, there are however also schemes available to pool insurance risks, as has been exemplified in the case of Caribbean countries through the Caribbean Catastrophe Risk Insurance Facility.<sup>30</sup> PPPs can in turn overcome some of the pervasive challenges typical for infrastructure projects in developing countries such as agency problems involving different actors throughout the project cycle and requiring complex governance arrangements. Under conducive circumstances, PPPs can mobilize additional sources of funding and enhance project quality. The incentives of the private sector can be aligned with the interests of the contracting authority throughout the entire life cycle of the project, including the implementation phase. This alignment occurs by tying-in the private operator's revenue to a set of pre-agreed performance indicators and by requiring the latter to invest significant, long-term capital.<sup>31</sup>

**The private sector** is in general supportive of the achievement of established goals and principles to address climate change. This can be for example evidenced by companies' adherence to the SDGs and the Principles of Responsible Investment (PRI). In fact, the private sector realizes that although

<sup>23</sup> IPCC 2019. Adaptation to Climate Change in the Context of Sustainable Development and Equity

<sup>24</sup> Adapt now: a global call for leadership on climate resilience - Global Center on Adaptation (gca.org)

<sup>25</sup> IPCC 2019. Adaptation to Climate Change in the Context of Sustainable Development and Equity

<sup>26</sup> OECD, 2017: Investing in Climate, Investing in Growth: <https://www.oecd.org/env/cc/g20-climate/Key-findings.pdf>

<sup>27</sup> EU Adaptation Strategy 2021

<sup>28</sup> Real estate remains the best insured sector globally with an industrial insurance penetration rate of 0.74%. This is followed by transportation and storage (0.60%) and agriculture, forestry and fishing (0.60%)

<sup>29</sup> Lloyds underinsurance report 2011: A world at risk: closing the insurance gap

<sup>30</sup> UNCTAD 2021 Trade climate-readiness for developing countries

<sup>31</sup> PPPKnowledge Lab 2021 <https://pppknowledgelab.org/guide/sections/9-infrastructure-challenges-and-how-ppps-can-help#box-5>

there are risks, there is also opportunity and forward-thinking to leverage the upsides by applying a climate change lens to investments as a means of generating revenue and cost savings. For example, this could be achieved through the use of innovative technologies that enable production of drought resistant agricultural goods that can enhance returns.<sup>32</sup> Another example is the CEO Water Mandate which is a UN Global Compact initiative that has mobilized over 200 companies to address needs for water, sanitation, and the SDGs.<sup>33</sup> Endorsers of the CEO Water Mandate commit to continuous progress against six core elements of stewardship, most notably supply chain and watershed management. In this way, these companies are also managing their own water risks. Finally, the World Business Council on Sustainable Development is another CEO-led organization of over 200 leading businesses working together to accelerate the transition to a sustainable world.<sup>34</sup> Its two core programs concentrate on Climate Action (both mitigation and adaptation) and Natural Climate Solutions (e.g. achieving sustainable land use in the long term for agriculture and forestry).

#### 4) Supporting development of conducive policy instruments

Finally, **policy instruments** are needed to support climate impact management. It is crucial to enable policy makers to apply the climate lens in order to decide whether a policy (plan, program, strategy, regulation, etc.) is at risk from climate change. If deemed to be at risk, further work is required to identify the extent of the risk, assess climate change impacts and adaptation responses in more detail, and identify possible recommendations and downstream actions.<sup>35</sup> It is important to examine the extent to which policies could lead to increased vulnerability, resulting in maladaptation or, conversely, to missing important opportunities arising from climate change.

The above-described lines of intervention can be applied across the following focal areas (FAs) that have been identified at the intersection of UNIDO Member States needs and UNIDO/ENE thematic focus:

<b>FA1</b>	<b>Value chains with Integrated Solutions for Water, Energy and Land (ISWEL)</b>
<b>FA2</b>	<b>Climate-proofing of infrastructure</b>
<b>FA3</b>	<b>Climate resilient energy supplies</b>
<b>FA4</b>	<b>Nature-Based Solutions (NBS)</b>

The beneficiaries of UNIDO/ENE climate adaptation support are:

- Governments and national institutions
- Industry associations
- Universities and research institutes
- Infrastructure investors, banks, insurance agencies, microfinance institutions
- SMEs, small farmers and fishing organizations
- Larger private and public utilities
- Ports and other industrial infrastructure managers

<sup>32</sup> IIGCC Investor Guidelines 2020: Guidelines to examine climate risks including carbon and energy costs, adaptation and mitigation opportunities

<sup>33</sup> <https://ceowatermandate.org/>

<sup>34</sup> <https://www.wbcsd.org/Programs/Climate-and-Energy>

<sup>35</sup> Organisation for Economic Co-operation and Development OECD. 2009. Integrating Climate Change Adaptation into Development Co-operation. Paris

## FA1: VALUE CHAINS WITH INTEGRATED SOLUTIONS FOR WATER, ENERGY AND LAND (ISWEL)

### Adaptation rationale

Water, energy and food underpins main industrial activities in developing and emerging economies.<sup>36</sup> Agriculture, forestry and the energy sector simultaneously depend heavily on and affect water resources. Energy often accounts for more than half the operating costs for agricultural production and processing as well as water & sanitation services. Land is needed for the production of food, fodder and renewable energy, as well as for water resource protection. Many aspects of the nexus concept are not entirely new and borrow from existing approaches such as Integrated Water Resources Management (IWRM) and Sustainable Natural Resources Management (SNRM). Efficient energy and water use can make agricultural products more competitive and sustainable in local markets. Application of innovations in the fields such as water management, reuse of treated water, water storage or solar powered irrigation can not only greatly improve production efficiency but also have positive environmental impacts.

### Notable project highlights

Implementers	Country	Project title	Objective
South African Breweries (SAB Ltd) WWF South Africa GIZ	South Africa	Water Futures Partnership <sup>37</sup>	The production of barley, maize and hops is responsible for a considerable water footprint. Therefore, the project objective is to improve water efficiency in the industrial operations and restore the hydrological functionality of the catchment by removing alien vegetation.
IFAD GEF	Ghana	Promoting a Value Chain Approach to Climate Change in Agriculture <sup>38</sup>	The project's objective is to reduce climate-induced risks in the cassava value chain to the achievement of food security and income generation for pilot rural communities. This involves a selection of climate-resilient and water saving crop varieties and cropping systems as well as improved energy use and processing technologies.

## FA2: CLIMATE-PROOFING OF INFRASTRUCTURE

### Adaptation rationale

Climate proofing refers to the explicit consideration and internalization of the risks and opportunities that alternative climate change scenarios are likely to imply for the design, operation, and maintenance of infrastructure.<sup>39</sup> The core activities for climate-proofing related to project design fall

<sup>36</sup> Austrian Development Bank: Water – Energy – Food Security Nexus June 2015

<sup>37</sup> REEEP 2014 [https://www.reeep.org/sites/default/files/REEEP\\_Making\\_The\\_Case\\_0.pdf](https://www.reeep.org/sites/default/files/REEEP_Making_The_Case_0.pdf)

<sup>38</sup> IFAD 2015 <https://www.ifad.org/documents/38714170/39150184/GEF+Ghana+facsheet.pdf/0d6ea844-332c-40d8-94a7-25ba37592ffb>

<sup>39</sup> UNDP (2011)



under impact assessment, vulnerability assessment, and adaptation assessment.<sup>40 41</sup>

Examples of infrastructure risks include:

- Paved roads are vulnerable to extreme temperatures, while unpaved roads and bridges are vulnerable to extreme precipitation,<sup>42</sup>
- Rail networks fail in instances of extreme temperatures, storms and icing,
- Industrial sites located in flood plains can be vulnerable to flooding.

Given its context-specific nature, the measures used to climate-proof infrastructure vary widely. They can be broadly grouped into two categories:<sup>43</sup>

- 1) Structural adaptation measures (soft and hard): e.g. changing the composition of road surfaces so that they do not deform in high temperatures; using permeable paving surfaces to reduce run-off during heavy rainfalls; applying NBS such as permeable concrete to improve groundwater infiltration.
- 2) Management (or non-structural) adaptation measures: e.g. changing the timing of maintenance to account for changing patterns of energy demand and supply; investing in early warning systems; purchasing insurance to address financial consequences of climate variability; applying adaptive management to adjust to changing circumstances over the asset's lifetime.

#### Notable project highlights

Implementers	Country	Project title	Objective
Ministry of Health and Environment of Antigua and Barbuda GCF	Antigua and Barbuda	Resilience to hurricanes in the building sector in Antigua and Barbuda <sup>44</sup>	Interventions are targeted at ensuring optimal designs for wooden and concrete structures to reduce wind damage in essential service buildings such as health clinics, police stations and schools.
Development Bank of Latin America AF	Uruguay	Climate adaptation in vulnerable coastal cities and ecosystems of the Uruguay River <sup>45</sup>	The project aims to create a Revolving Fund for residents in medium flood-risk areas to enable them to upgrade their homes to withstand regular flooding, such as constructing entrance steps and raising the floor level above the street level, adapting the electrical and internal sanitary systems to withstand flooding situations, as well as installing rainwater harvesting systems across public buildings.
UN Habitat AF	Vietnam	Enhancing the resilience inclusive and sustainable	Elastocoast or porous coast is being established along coastal zones between mangrove trees and the land to protect dikes and mitigate coastal erosion

<sup>40</sup> Ebinger and Vergara (2011)

<sup>41</sup> <https://portals.iucn.org/library/sites/library/files/documents/2016-062.pdf>

<sup>42</sup> Huizenga *et al.* 2015. Expanding Efforts on Climate Change Adaptation and Resilience in the Transport Sector

<sup>43</sup> Climate Resilient Infrastructure: OECD Environment Policy Report No. 14, 2019. <http://www.oecd.org/environment/cc/policy-perspectives-climate-resilient-infrastructure.pdf>

<sup>44</sup> GCF 2020 [https://www.greenclimate.fund/sites/default/files/document/fp133-doe-atg-antigua-and-barbuda\\_0.pdf](https://www.greenclimate.fund/sites/default/files/document/fp133-doe-atg-antigua-and-barbuda_0.pdf)

<sup>45</sup> Adaptation Fund 2019 <https://www.adaptation-fund.org/project/climate-change-adaptation-vulnerable-coastal-cities-ecosystems-uruguay-river-argentina-uruguay-2/>

		eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Vietnam <sup>46</sup>	through absorbing the force of breaking waves.
--	--	---	--

### FA3: CLIMATE-RESILIENT ENERGY SUPPLIES

#### Adaptation rationale

Any renewable infrastructure must be designed with climate change projections in mind in order to not only provide mitigation benefits but also enable vulnerable populations to have resilient power generation and associated services. In particular, off-grid and distributed energy can i) improve livelihoods, especially for vulnerable populations, such as by enabling beneficiaries to better exploit the full spectrum of agriculture value chains with cooling; ii) catalyze economic development such as for SMEs; and iii) support access to Information Communication and Technology (ICT).<sup>47</sup> This can in turn have multiplier effects in enabling better education and healthcare. Recommended adaptation measures, both engineering and non-engineering, associated with different types of renewable energy sources are provided below.

**Hydropower:** For hydropower facilities, where discharge is expected to change over the lifetime of the system, it may be necessary to consider diverting upstream tributaries, building new storage reservoirs, modifying spillways, and installing turbines that are better suited to expected conditions. Greater discharge (whether from glacial melting or increased precipitation) may require higher and more robust dams and/or small upstream dams. Localized hydrological modeling with downscaled climate projections can suggest operational changes to optimize reservoir management and improve energy output by adapting to changes in rainfall or river flow patterns. Integrated water resource management strategies can improve upstream and downstream protection measures.

**Wind:** Where wind speeds are likely to increase, it may be possible to capture greater wind energy with taller towers or entirely new systems. Sites should be chosen taking into account expected and projected changes in wind speeds, storm surges, sea level rise, and river flooding during the lifetime of the turbines.

**Solar:** For solar photovoltaic systems, where temperature increases or significant heat waves are expected, it will be useful to consider solar modules with a higher temperature coefficient. String or micro inverters should be included in the design since they are easy to cool down. It may be necessary to consider more robust structures, tracking motors, and mountings, and to consider air or waterless cooling in water-restricted areas. For solar concentrating or tracking systems, avoiding locations with high, gusting winds or projections of increased cyclones and other extreme weather events may be an option. For solar photovoltaic power, it may be possible to select locations where expected

<sup>46</sup> Adaptation Fund 2020 <https://www.adaptation-fund.org/project/enhancing-the-resilience-inclusive-and-sustainable-eco-human-settlement-development-through-small-scale-infrastructure-interventions-in-the-coastal-regions-of-the-mekong-delta-in-viet-nam-2/>

<sup>47</sup> GIZ: Off-Grid Renewable Energy for Climate Action

changes in cloud cover, airborne grit, snowfall, and turbidity are relatively low.

#### Notable project highlights

Implementers	Country	Project title	Objective
AfDB SE4ALL	Niger	Green Mini-Grid (GMG) Country Programme <sup>48</sup>	GMGs are identified as an affordable tool to extend energy access to low-income communities in rural areas as an essential prerequisite for achieving improved livelihoods.

## FA4: NATURE-BASED SOLUTIONS (NBS)

### Adaptation Rationale

Implementation of NBS on a large-scale can significantly strengthen climate resilience.<sup>49</sup> The NBS interventions harness natural environment to reduce flooding, capture water, and improve ecosystem service provision for sustaining healthy water, oceans and soils. They play a critical role in improving land-use management and infrastructure planning to not only provide climate-resilient services but also to reduce costs. For example, the restoration of the sponge-like function of soils and the use of permeable paving can boost the supply of naturally filtered groundwater and reduce the risk of flooding. In turn, the use of green roofs can support cooling and reduce the urban heat island effect. Also, blue-green (as opposed to grey) infrastructures are multipurpose, “no regret” solutions that simultaneously provide environmental, social and economic benefits.

#### Notable project highlights

Implementers	Country	Project title	Objective
UNEP GEF	Latin America & Caribbean	Building climate resilience of urban systems through ecosystem-based adaptation in Latin America and the Caribbean <sup>50</sup>	The project’s aim is to construct drains from natural materials to direct water runoff during heavy rainfall, as well as to build detention ponds from natural material to increase water availability during droughts.
UNEP	Lao PDR	Building the resilience of urban populations in Lao PDR <sup>51</sup>	Following objectives are pursued through the project: i) removing solid waste in and around the streams to increase drainage capacity of the channels, and ii) planting indigenous, climate-resilient vegetation along degraded stream banks to stabilize the banks and improve water quality.

<sup>48</sup> African Development Bank 2020 <https://www.afdb.org/fr/documents/niger-niger-green-mini-grid-country-programme-enabling-environment-sefa-appraisal-report>

<sup>49</sup> EU Adaptation Strategy

<sup>50</sup> GEF 2014 <https://www.thegef.org/project/building-climate-resilience-urban-systems-through-ecosystem-based-adaptation-eba-latin>

<sup>51</sup> GEF 2019 <https://www.greenclimate.fund/sites/default/files/document/funding-proposal-sap009-unep-lao-people-s-democratic-republic.pdf>

An overview of entry points for UNIDO/ENE climate adaptation activities is provided below.

	Value chains with Integrated Solutions for Water, Energy and Land (ISWEL)	Climate-proofing of infrastructure	Climate resilient energy supplies	Nature-Based Solutions (NBS)
<b>Ensuring comparative advantage and competitiveness of climate-sensitive productive sectors</b>	<ul style="list-style-type: none"> <li>• Include women and youth in exploiting local value chains sustainably</li> <li>• Enable beneficiaries to have more productive yields with climate-resilient varieties</li> </ul>	<ul style="list-style-type: none"> <li>• Decentralize renewable energy services (smart, mini-grids, and rooftop solar)</li> <li>• Promote co-benefits of off-grid renewable solutions such as i) reducing dependences on fossil fuel imports and ii) enhancing abilities to maintain electricity supply during and immediately after extreme weather events</li> <li>• Support off-grid renewable solutions for industry and SMEs so that they can have increased productivity and income-generating activities, incl. i) improved illumination for extended operating hours, ii) ability to freeze or refrigerate to reduce post-harvest losses, and iii) ability to create more value-added products with electricity to dry, grind, charge batteries, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Integrate inclusive watershed planning based on downscaled climate projections (rainfall and temperature) into hydrological modelling</li> <li>• Regularly maintain SHP dams such as via dredging to prevent interruptions</li> </ul>	<ul style="list-style-type: none"> <li>• Plant indigenous, climate-resilient vegetation to stabilize land and filter flood waters</li> <li>• Support mangrove conservation and restoration</li> <li>• Apply natural, resistant materials with renewable installations</li> <li>• Promote blue-green NBS (as opposed to grey) infrastructures as a means to improve ecosystem service provision and reduce the costs of climate-proofing</li> </ul>
	<ul style="list-style-type: none"> <li>• Support beneficiaries to diversify their income streams from climate-sensitive productivity sectors</li> </ul>			



<b>Promoting innovation as well as technology development and transfer, including entrepreneurship development</b>	<ul style="list-style-type: none"> <li>Assess the ISWEL innovation and entrepreneurial ecosystem to identify gaps in policy, knowledge, financing, capacities and infrastructure</li> <li>Develop ISWEL entrepreneurship and innovative business models for climate adaptation technologies</li> <li>Support ISWEL adaptation data uptake including digital and smart solutions</li> <li>Promote digitization and automation of storage and ISWEL value chains</li> <li>Provide training for universities and vocational training on mainstreaming ISWEL adaptation entrepreneurship programs</li> <li>Support site-appropriate irrigation schemes with local SME engagement that can also provide scalable ideas in vulnerable regions</li> </ul>	<ul style="list-style-type: none"> <li>Digitize &amp; automate port/building/e-charging operations and energy management</li> <li>Use metrics for benchmarking efficiency</li> <li>Provide inclusive training on O&amp;M of energy, water and digitized systems</li> <li>Provide training on the socio-economic cost benefit-analyses of sustainable infrastructure and risk management scenario development</li> <li>Promote more robust design specifications for renewable energy infrastructure, such as control systems an ICT components, to improve functionality under higher air and/ or water temperatures,, denote failures ahead of time, and withstand more extreme conditions (such as higher wind or water velocity), e.g. to improve airflow beneath mounting structures to reduce heat gain and increase outputs, or to use heat-resistant PV cells and module components designed to withstand short peaks of very high temperature</li> </ul>	<ul style="list-style-type: none"> <li>Include cost-effective and energy-efficient extraction technologies, water usage and re-use</li> <li>Apply water reuse and energy storage innovations</li> <li>Include water for the cooling and cleaning of solar panels or collectors to improve efficiency</li> <li>Incorporate solar-power (e.g. for hydropower) to enable redundancy</li> <li>Digitize renewable energy operation &amp; management</li> </ul>	<ul style="list-style-type: none"> <li>Support local entrepreneurs to manage Rainwater Harvesting (RWH) and water recycling and reuse systems, emphasizing community-managed water supplies</li> <li>Collect rainwater from rooftops for productive use, including redirection of water for storage or flood-proofing measures</li> <li>Install geotextile sandbags or Elastocoasts to absorb storm surges in coastal areas</li> <li>Use permeable paving surfaces to reduce run-off during heavy rainfalls and improve groundwater infiltration</li> <li>Use green roofs to support cooling and reducing the urban heat island effect</li> </ul>
	<ul style="list-style-type: none"> <li>Enable scaling up of entrepreneurs that provide adaptation technologies, products and services</li> </ul>			

<b>Catalyzing investments, private sector engagement, and innovative financing mechanisms</b>	<ul style="list-style-type: none"> <li>• Develop cross-cutting projects (adaptation – mitigation) with focus on the Water-Energy-Food nexus finance</li> <li>• Facilitate greater access to financial and demand-driven extension services</li> </ul>	<ul style="list-style-type: none"> <li>• Develop climate-smart and gender inclusive capital investment plans with public and private financial, insurance and banking sectors</li> <li>• Promote public-private partnerships (PPPs) to integrate private capital into infrastructure projects, as this would allow public sector to share climate risks with private investors and reduce required government capital outlay</li> </ul>	<ul style="list-style-type: none"> <li>• Examine demand management and downstream efficiencies to extend capital life</li> </ul>	<ul style="list-style-type: none"> <li>• Support in developing payment schemes to maintain RWH systems and green roofs</li> <li>• Promote use of insurance as a risk-transfer mechanism to absorb financial losses</li> </ul>
	<ul style="list-style-type: none"> <li>• Promote use of insurance as a risk-transfer mechanism to absorb financial losses</li> <li>• Promote innovative financing mechanisms to support acquisition and continual upkeep of adaptation technologies and services</li> </ul>			
<b>Supporting development of conducive policy instruments</b>	<ul style="list-style-type: none"> <li>• Develop regional and national taxonomy for sustainable activities that promote adaptation in ISWEL</li> <li>• Promote global standards for ISWEL adaptation technologies</li> </ul>	<ul style="list-style-type: none"> <li>• Enable policy and regulatory framework for green, resilient ports, buildings and e-charging stations</li> <li>• Apply internationally-recognized climate-proofing infrastructure standards</li> <li>• Provide support with climate-informed decision-making tools that can remove the uncertainty of costly retrofitting</li> </ul>	<ul style="list-style-type: none"> <li>• Add climate-proofing into the design of O&amp;M guidelines (e.g. spillways, gated systems, and fuse plugs for hydropower)</li> </ul>	<ul style="list-style-type: none"> <li>• Ensure that NBS are evaluated as policy options for climate-proofing of infrastructure, as they are often cheaper than traditional approaches</li> </ul>
	<ul style="list-style-type: none"> <li>• Enable greater open access to climate and socio-economic data for informed decision-making incl. evaluation of cost-benefits</li> </ul>			
<ul style="list-style-type: none"> <li>• Capture lessons learned from existing projects (e.g. GEF-funded projects in DRC and Sierra Leone) to scale up successful ideas in the planned geographies</li> </ul>				

# 4

## THE NICHE OF THE DEPARTMENT OF ENERGY AND POTENTIAL COOPERATION PARTNERS

An analysis of UNIDO/ENE's previous and current cross-cutting or adaptation projects was conducted to identify gaps and opportunities to integrate innovative adaptation ideas such as those aforementioned. Representative Theory of Changes (TOCs) were developed to demonstrate how UNIDO/ENE can highlight its value proposition (Annex 5, Section 5.1). ENE's climate adaptation niche is defined below:

### ISWEL

UNIDO/ENE has unique expertise that will help it in implementing the ISWEL.<sup>52</sup> Specifically, UNIDO/ENE is well placed to conduct multi-sectoral analytical work to identify the benefits and tradeoffs of adaptation investments and to conduct the prioritization of response options such as determining water availability for food. UNIDO/ENE is also well-placed to support innovation and entrepreneurship by SMEs to promote adaptation technologies and practices that enhance climate-sensitive sector production. UNIDO/ENE can also set the groundwork for diversification of agriculture, fisheries and tourism products. What is more, UNIDO/ENE has experience in supporting countries with increasing value-added products.

### Small Hydropower (SHP)

Due to the fact that UNIDO/ENE is the world leader in designing educational and technical material for SHP, UNIDO/ENE has a unique niche for integration of adaptation principles into its SHP projects. Cross-cutting adaptation concepts such as enabling redundancy and energy efficiency can be integrated into project design, construction and operations.

### Climate proofing

UNIDO/ENE is well-placed to build on existing innovation momentum in the infrastructure climate proofing space. Its extensive experience with renewables development provides cross-cutting benefits of resilient, low-carbon services. Since much of manufacturing operations are required to be improved by making them more water and energy efficient and climate proofed, UNIDO/ENE is likely to have a competitive edge with the following types of projects:

- smart grids and e-charging stations that are more robust due to their decentralized nature and protection against extreme weather,
- resource-efficient and resilient infrastructure (e.g. manufacturing plants),
- porous pavement to promote groundwater infiltration,
- road infrastructure projects that focus on increased protection from erosion, and
- digitization and automation of energy and water saving controls.

### E-Mobility

UNIDO/ENE is also well placed and experienced with piloting e-mobility in developing countries. Other than the mitigation benefits, electric vehicles can enable more resiliency due to the independence from petrol supply chains. However, just like any infrastructure, the electric vehicle charging stations require climate-proofing. UNIDO/ENE can also support the development of appropriate business models to ensure the sustainability of e-charging stations.

<sup>52</sup> [ISWEL – Integrated Solutions for Water, Energy, and Land](#)

### Highlight | Catalyzing e-charging with PPPs

An important consideration when facilitating a transition in the transportation sector toward electronic vehicles (EVs) is how to **encourage private sector investment** in upscaling climate-resilient pilot projects to a regional and national level. Studies have shown that initial public investment in public charging infrastructure is a prerequisite to stimulating a transition from internal combustion engine (ICE) vehicles to EVs<sup>53</sup>. The availability of public charging infrastructure contributes to reducing range anxiety<sup>54</sup> among consumers and creates an enabling environment to demonstrate the viability of the EV business model to potential private investors. UNIDO/ENE has proven expertise in launching e-charging in places like in China in addition to providing business model support.

Relative to developing countries, private investment groups<sup>55</sup> view **the best PPPs** as i) initially engaging the private sector to pay for the chargers. The private company would then lease the stations to a municipality or industry over time or ii) the electricity provider or municipality paying for the chargers and leasing to private companies. For option i), the e-charging stations would be transferred back to the city or municipality after target returns are achieved. The municipality or industry would have to provide an agreement on the volumes of vehicles that would come through the stations. For option ii), a competitive tender process is used to attract a private company to manage and operate the stations. Ideally, public financing or industrial sites would provide the land for e-charging locations for free and e-charging stations would be developed in bundles.

Discussions during the development of the Adaptation Strategy with private infrastructure investment groups<sup>56</sup> indicated that any *e-charging pilot should not be a demonstration of technology but should rather ensure there is a **viable business model***. Infrastructure funds will generally not take market risk and will require long-term offtake contracts. A pilot could be used to test the viability of long-term contracts with industrial players. Also, the business model ideas of providing e-charging for only trucks or certain specialty vehicles should be evaluated. Another option to evaluate would be if the model of a typical 'gas station' marketing strategies such as 'loyalty cards' could become viable.

The **strengths**, that will enable UNIDO/ENE to successfully fill in the above-described niche, include:

- Unique knowledge on the state-of-the-art water and energy efficiency techniques and best farming practices used in agriculture thanks to collaboration with PFAN and also as evidenced with GEF-financed agriculture value chain proposals being developed or beginning implementation.
- Successful track record in projects focused on reduction of harvest losses through storage and processing facilities.
- Proven capacity to ensure that climate-resilient infrastructure has the potential to improve the reliability of service provision, increase asset life and protect asset returns.
- Proven experience in implementing NBS in the existing project pipeline.

<sup>53</sup> Interreg Europe. 2019. E-mobility: A Policy Brief from the Policy Learning Platform on Low-carbon economy. [online] Available: [https://www.interregeurope.eu/fileadmin/user\\_upload/plp\\_uploads/policy\\_briefs/FINAL\\_PolicyBrief\\_e-mobility\\_TO4\\_v4.pdf](https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/FINAL_PolicyBrief_e-mobility_TO4_v4.pdf)

<sup>54</sup> Range anxiety refers to 'the fear of being unable to complete a trip due to a depleted battery'. From: Greene, D. L., Kontou, E., Borlaug, B., Brooker, A., and Muratori, M. 2020. Public charging infrastructure for plug-in electric vehicles: What is it worth? *Transportation Research Part D*, 78

<sup>55</sup> Based on interviews on e-mobility with private investment groups Persistent Energy and Climate Fund Managers

<sup>56</sup> idem



What is more, UNIDO/ENE:

- Is the only UN organization with an industry focus. At the same time, industries are a relatively underserved territory for building climate resilience and integrating adaptation concepts.
- Focuses on cross-cutting solutions with industry, which is timely. Due to numerous recent climate shocks on industry (e.g. Texas and Shell), industry is prime to act to develop resilience-building solutions.
- Maintains very good links to relevant industrial sectors (especially SMEs) and can rely on its already proven partnerships including PFAN, GCIP, CTCN, AECF and CRAFT.
- Maintains country-level implementation nodes, regional offices, and has business-related networks.

## POTENTIAL COOPERATION PARTNERS FOR PROJECT IMPLEMENTATION

UNIDO/ENE's unique service offering can benefit from a diversified collaboration with **international organizations and public sector partners**, such as those described below:

### African Development Bank (AfDB)

has committed to allocating half of climate finance to adaptation. Furthermore, AfDB is engaged in numerous partnerships and initiatives in themes such as infrastructure development, agricultural development and water and wastewater management. In particular, AfDB's 2016–2020 Second Climate Change Action Plan<sup>57</sup> identifies five priority areas for climate adaptation and climate resilience, namely: i) Promoting climate-resilient agriculture, including infrastructure, technology access and access to finance; ii) Scaling up investments in sustainable water resources management; iii) Sustainable infrastructure, particularly for transport and urban and coastal environments; iv) Promoting climate-resilient energy systems, including infrastructure; and v) Scaling up adaptation finance. A new Global Commission for Adaptation (GCA) initiative will galvanize USD 25 billion to scale up engagement in adaptation through the Africa Adaptation Acceleration Program (AAAP).

### Development Bank of Southern Africa (DBSA)

aims to support Southern African regional development by investing in infrastructure projects and promoting collaboration in sectors such as water, energy, transport and ICT. DBSA has committed to spending ~USD 1.15 billion for these purposes. DBSA has notably established the first private sector climate finance facility (CFF) in Africa, using a pioneering green bank model, with financial support from the GCF. The CFF will specifically focus on infrastructure projects and private enterprise scale-up for both adaptation and mitigation.

### Japan International Cooperation Agency (JICA)

is one of the largest bilateral development agencies, with ~USD 8 billion in annual resources and official development aid (ODA). In 2017, ~46% of JICA commitments were focused on adaptation<sup>58</sup>, with 1.4% for cross-cutting projects. Main sectors of intervention included energy, water and sanitation, infrastructure, as well as agriculture and fisheries. One specific priority issue in climate change cooperation is the promotion of low-carbon and climate-resilient urban development and infrastructure investment, particularly in developing countries with rapidly growing economies. The two greatest beneficiaries of JICA funds are Asia and Africa (the first and second largest beneficiary of JICA funds respectively). Provision of support has been in the form of technical

<sup>57</sup> The Third Action plan for 2021–2025 has not yet been developed

<sup>58</sup> The share of spending for CCA dropped to ~12% in 2018

cooperation, involving the dispatching of experts and the provision of equipment and training. JICA has set three priorities for its interventions, namely: i) accelerating economic transformation and improving the business environment through innovation and private-sector engagement; ii) deepening sustainable and resilient society; and iii) strengthening peace and stability. JICA is also funding innovation challenges, including in Africa, to accelerate development towards the SDGs, such as the Africa Open Innovation Challenge.

#### **Korea International Cooperation Agency (KOICA)**

has a strong focus on innovation and new technologies and shares similar areas of intervention as UNIDO/ENE, such as: i) agriculture and rural development, including promoting sustainable production, value chains and infrastructure; ii) science, technology and innovation, including cultivating technological research, supporting industrial development and promoting innovative solutions for development. KOICA already has significant experience of collaboration with UN agencies. KOICA has also funded global programs for PPPs, multilateral cooperation, and innovation, such as the Development Innovation Program (DIP). KOICA provided over USD 90 million to 21 African countries in 2018.

#### **United Nations Capital Development Fund (UNCDF)**

provides financing mechanisms that unlock investment from predominantly domestic public and private resources for the financing of catalytic local infrastructure with high local economic development impact. The recently established Local Climate Adaptive Living (LoCAL) Facility serves as a mechanism to integrate climate change adaptation into local governments' planning and budgeting systems, increase awareness of and response to climate change at the local level, and increase the amount of finance available to local governments for climate change adaptation.

What is more, several international finance and other institutions, including the *Austrian Development Bank*, *Inter-American Development Bank (IDB)*, *World Bank*, *OPEC Fund for International Development (OFID)* and *German Agency for International Cooperation (GIZ)*, have adopted or supported the WEF nexus approach. They can therefore play a pivotal role in the financing of nexus-related projects through lending and equity participation, and by supplying risk mitigation products such as guarantees.

While UNIDO/ENE has specialized in collaborating with public funding agencies over the past years, in view of the multi-sector and cross-cutting nature of climate adaptation, it is also advisable to partner with the **private sector** entities such as for example:

- **Bamboo Finance (Geneva)** – a private equity that invests in business models that benefit low-income communities in developing economies. Bamboo Finance raised the first USD 10 million for its planned agribusiness fund, named “Nisaba”, whose mandate will stretch across nine East and West African countries. The fund intends to build distribution channels for smallholder farmers who operate on less than two hectares of land (that is around 80% of African farmers).
- **ResponsAbility (Zurich)** – provides private debt and private equity for medium to large scale renewable and agri-business projects in developing countries. Also, it supports innovative business models for African-based companies.
- **Persistent Energy (NYC / Zurich)** – develops commercial businesses from African enterprises that are focused on clean energy and other essential services to customers in emerging markets (currently e-mobility). Persistent Energy offers both human and financial capital to help build companies that provide competitive financial returns and long-term social impact.
- **InfraCoAfrica and Climate Fund Managers** – have debt and equity funding and expertise for infrastructure projects.

It is also recommended that UNIDO/ENE seeks collaborations with large multinationals that have the experience of adding in adaptation elements into renewables operations, particularly SHP (e.g. EDF, Hydro-Québec, Vestas, ENEL, SunPower).

What is more, UNIDO/ENE is well placed to establish strategic synergies with internationally-recognized, sustainable **infrastructure standard initiatives**. There are three-fold incentives for applying standards:<sup>59</sup> i) financial (e.g. some fund managers require them), ii) regulatory (e.g. tender requirements), and iii) reputational (e.g. visibility for good practice projects).

Potential collaboration partners such as UNCDF and InfraCoAfrica support infrastructure that adhere to or are in the process of developing sustainable infrastructure standards. Additionally:

- UNCDF is trying to establish resilience standards through the *ISO 37120 Sustainable Development of Communities initiative*. This initiative is currently being developed within ISO to create standardized metrics for resilience to assist local governments to determine their exposure to and capacity to cope with potential hazards, extreme events or stresses while maintaining their essential functions and safeguarding populations.
- Global Infrastructure Basel (GIB) has developed the SURE<sup>®</sup> standard to promote a new hybrid asset class – sustainable infrastructure. Working with SURE<sup>®</sup> enhances the evaluation of environmental effects of infrastructure projects and ensures that nature-based infrastructure is evaluated as an option.
- The European Standards Organization is updating standards governing the safety and performance of infrastructure in a changing climate. It has initiated an update of 12 infrastructure standards as a pilot. Consensus and convergence of these ideas is required to accelerate the standardization of adaptation solutions.<sup>60</sup>
- Regarding Environmental and Social Standards (ESS) for SHP, UNIDO/ENE could partner with the International Finance Corporation (IFC). IFC's 8 Performance Standards provide guidance to companies on how to better manage their environmental and social risks with hydropower. This includes insights into how to engage affected communities and other stakeholders throughout the entire project cycle. Women affected by hydropower development may also benefit from developers adhering to standards, as they can promote equitable project planning and implementation. For example, in Brazil an IFC supported project encouraged job applications from women. What is more, a technical training taught women recruits the skills they needed to become masons, carpenters, riggers, welders, or equipment operators. Another key partner for climate adaptation related to SHP would be Climate-Adapt, an EU based organization with significant expertise in adaptation options for hydropower operations.<sup>61</sup> Climate Adapt provides soft and hard engineering climate-proofing ideas for SHP.<sup>62</sup>

<sup>59</sup> According to Global Infrastructure Basel discussions June 2021

<sup>60</sup> EU Adaptation Strategy 2021

<sup>61</sup> <https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-options-for-hydropower-plants>

<sup>62</sup> [https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-options-for-hydropower-plants/#costs\\_benefits](https://climate-adapt.eea.europa.eu/metadata/adaptation-options/adaptation-options-for-hydropower-plants/#costs_benefits)

# 6

## CLOSING REMARKS

To define the UNIDO/ENE Climate Adaptation Strategy, initially the most pressing adaptation needs in developing countries were analyzed and then categorized into four relevant focal areas that also correspond with UNIDO/ENE's mandate. Also, a comprehensive adaptation project pipeline analysis of global adaptation projects indicated the state-of-the-art in adaptation practices. Subsequently, an internal adaptation project pipeline review on UNIDO/ENE projects revealed the gaps and opportunities for the integration of more innovative adaptation measures. Recommendations on how to fill these gaps while building on UNIDO/ENE's strengths and lessons learnt from already implemented projects, and at the same time enabling cooperation with key partners were provided.

This Climate Adaptation Strategy presents the way ahead for UNIDO/ENE's involvement in the climate change adaptation space over the next 3 years. With this Strategy, ENE as part of UNIDO envisions to be the lead UN agency that facilitates the creation of sustainable and efficient industries while simultaneously enabling climate-resilient income generation opportunities and environmental benefits. Specific Theories of Change (ToC) for selected potential UNIDO/ENE projects are provided in Annex 5.

## Acronyms and Abbreviations

AAAP	Africa Adaptation Acceleration Program
ADB	Asian Development Bank
AF	Adaptation Fund
AFD	French Development Agency
AfDB	African Development Bank
ASAP	Adaptation for Smallholder Agriculture Programme
ASAP	Adaptation SME Accelerator Project
BFI	Bilateral Financial Institution
BMZ	German Federal Ministry for Environment, Nature Conservation and Nuclear Safety
CBA	Community-based Adaptation
CBD	Convention on Biological Diversity
CBIT	Capacity-building Initiative for Transparency
CC	Climate Change
CCM	Climate Change Mitigation
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CIDA	Canadian International Development Agency
CIFs	Climate Investment Funds
COP	Conference of Parties
CRAFT	Climate Resilience and Adaptation Finance and Technology Transfer Facility
CTF	Clean Technology Fund
CTI	Climate Technology and Innovation
DCI	Development Cooperation Instrument
DFI	Development Finance Institution
DFID	Department for International Development
EAE	Directorate of Environment and Energy
EBRD	European Bank for Reconstruction and Development
EDF	European Development Fund
EE	Executing Entity
EIB	European Investment Bank
ENE	Department of Energy
ESI	Energy Systems and Infrastructure
EST	Environmentally Sound Technologies
ETI	Energy Technologies and Industrial Application
EU	European Union
EUR	Euro
FAO	United Nations Food and Agriculture Organisation
FCDO	Foreign, Commonwealth and Development Office
FIP	Forest Investment Program
GAC	Global Affairs Canada
GARI	Global Adaptation and Resilience Investment Working Group
GCA	Global Commission on Adaptation
GCCA+	Global Climate Change Alliance Plus
GCECA	Global Centre of Excellence for Climate Adaptation
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEB	Global Environmental Benefit
GEEREF	Global Energy Efficiency and Renewable Energy Fund
GEF	Global Environment Facility

GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GIG	Green Investment Group
GIZ	German International Cooperation Agency
GPCC	Global Public Goods and Challenges
GRP	Global Resilience Partnership
HIV/AIDS	Human immunodeficiency virus infection and acquired immunodeficiency syndrome
IBRD	International Bank for Reconstruction and Development
ICF	International Climate Fund
ICFA	International Climate Finance Accelerator Luxembourg
IDA	International Development Association
IDBG	Inter-American Development Bank Group
IE	Implementing entity
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IKI	International Climate Initiative
INMT	Integrated Nutrient Management Technology
IsDB	Islamic Development Bank
ISWEL	Integrated Solutions for Water, Energy and Land
JICA	Japan International Cooperation Agency
KfW	German Development Bank
KIC	Knowledge and innovation community
KOICA	Korea International Cooperation Agency
KP	Kyoto Protocol
LDC	Least Developed Country
LDCF	Least Developed Country Fund
MDB	Multilateral Development Bank
MEA	Multilateral Environmental Agreement
MIC	Middle-income Country
MIE	Multilateral Implementing Entity
MIGA	Multilateral Investment Guarantee Agency
MoU	Memorandum of Understanding
MSME	Micro, Small and Medium Enterprises
MTS	Medium Term Strategy
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NBS	Nature Based Solutions
NDB	National Development Bank
NDC	Nationally Determined Contribution
NDF	Nordic Development Fund
NEFCO	Nordic Environment Finance Corporation
NGO	Non-governmental Organisation
NIE	National Implementing Entity
ODA	Official Development Assistance
POP	Persistent Organic Pollutant
PPCR	Pilot Program for Climate Resilience
PPP	Public-Private Partnership
RDB	Regional Development Bank
REDD	Reducing Emissions from Deforestation and Forest Degradation
RIE	Regional Implementing Entity
RWH	Rainwater Harvesting
SCCF	Special Climate Change Fund

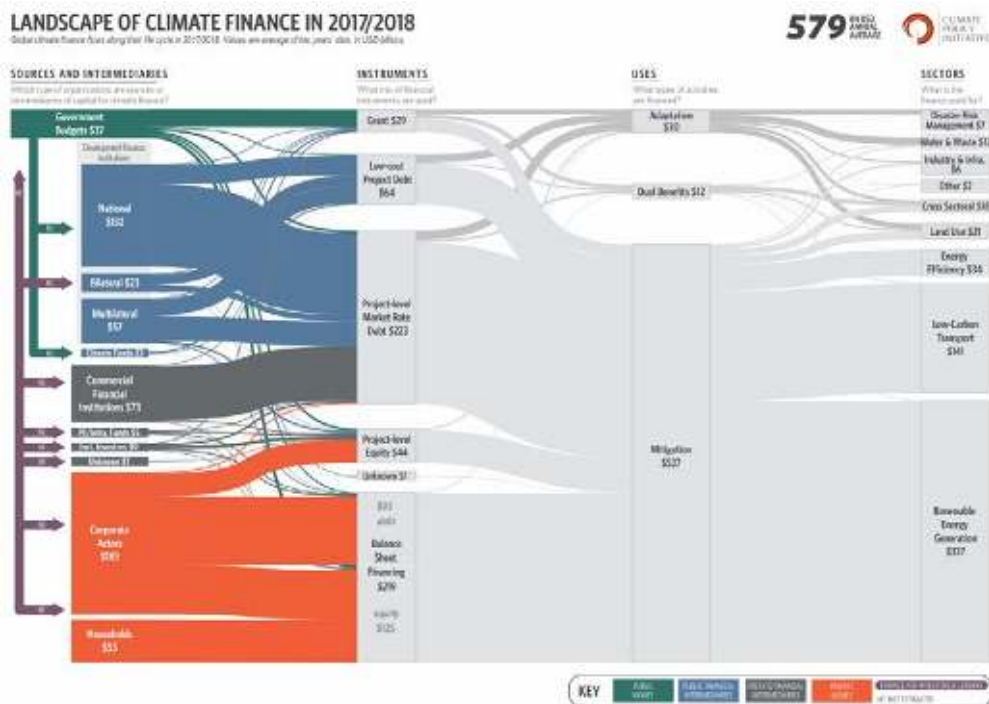


SCF	Strategic Climate Fund
SDG	Sustainable Development Goal
SHP	Small Hydropower
SIDS	Small Island Developing State
SLR	Sea-level rise
SREP	Scaling Up Renewable Energy Program in Low-income Countries
TDB	Eastern and Southern African Trade and Development Bank
TNA	Technology needs assessment
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children's Fund
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USD	United States Dollar
WACA	West African Coastal Areas Management
WBG	World Bank Group

## Annex 1: Climate adaptation funding sources

The cost of adaptation in developing countries could range between USD140–300 billion annually by 2030<sup>63</sup>. At the global scale, costs are likely to be USD280–500 billion annually by 2050, with even higher costs under higher emissions scenarios<sup>64</sup>. While the shortfalls impact financial flows in both climate adaptation (CCA) and climate change mitigation (CCM), the adaptation gap is particularly wide, partly due to the asymmetrical allocation of climate finance to CCM and the challenges with attracting private sector investments in adaptation<sup>65</sup>.

Nonetheless, adaptation finance increased 35% in 2017/2018 from USD22 billion in 2015/2016 to USD30 billion (Figure 1), indicative of increasing importance of climate-resilient development and the urgency of building adaptive capacity to reduce vulnerability to climate change<sup>66</sup>. Despite significant climate risks, tracked global climate investment towards CCA activities only reached 5% of total climate finance, with 93%, or USD537 billion, invested in CCM<sup>67</sup>. Cross-cutting investments represents an additional 2% of climate finance flows in 2017/2018 after considerably increasing, reflecting the recognition that CCA and CCM activities are interdependent and should be addressed holistically<sup>68</sup>.



**Figure 1.** Global climate finance flows (2017/2018 average, USD billion).

Approximately 44% of adaptation finance in 2017/2018 was funded by public actors, notably from national, bilateral and multilateral development finance institutions (DFIs), which account for 84% of total public adaptation finance<sup>69</sup>. Sources of public adaptation finance can take the following forms<sup>70</sup>: (Financial flows

<sup>63</sup> UNEP. 2016. Adaptation Finance Gap Report 2016. Nairobi, Kenya

<sup>64</sup> UNEP. 2016. Adaptation Finance Gap Report 2016. Nairobi, Kenya

<sup>65</sup> Murphy D, Parry JE. 2020. Filling the gap: A review of Multilateral Development Banks' efforts to scale up financing for climate adaptation. International Institute for Sustainable Development

<sup>66</sup> Buchner B, Clark A, Falconer A, Macquarie R, Meattle C, Tolentino R, Wetherbee C. 2019. Global Landscape of Climate Finance 2019. Climate Policy Initiative

<sup>67</sup> Buchner B, Clark A, Falconer A, Macquarie R, Meattle C, Tolentino R, Wetherbee C. 2019. Global Landscape of Climate Finance 2019. Climate Policy Initiative

<sup>68</sup> Buchner B, Clark A, Falconer A, Macquarie R, Meattle C, Tolentino R, Wetherbee C. 2019. Global Landscape of Climate Finance 2019. Climate Policy Initiative

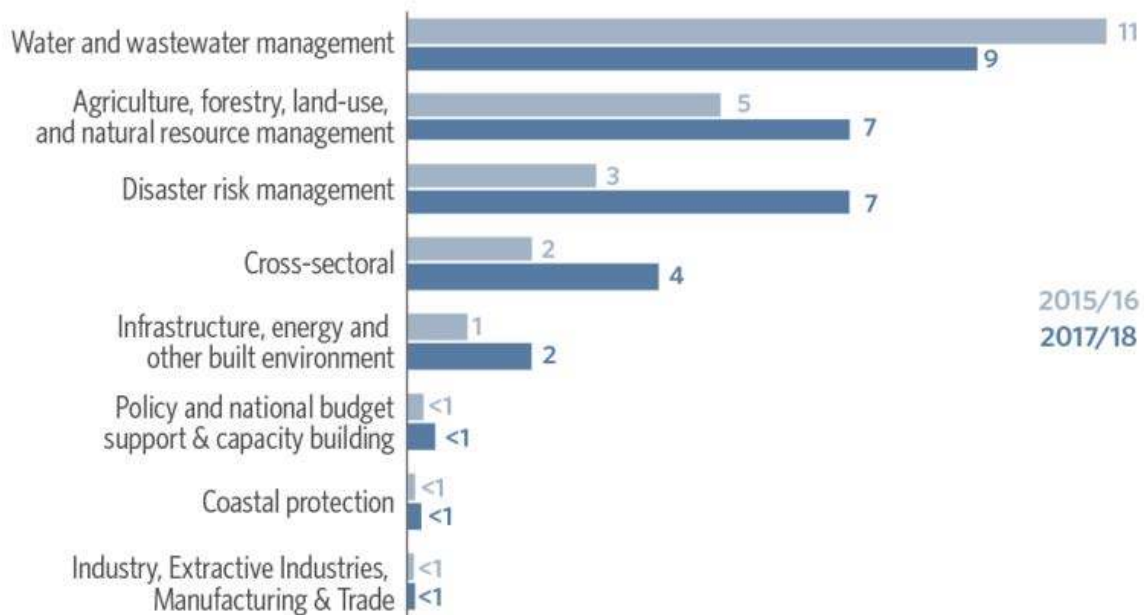
<sup>69</sup> Micale V, Tonkonogy B, Mazza F. 2018. Understanding and Increasing Finance for Climate Adaptation in Developing Countries

<sup>70</sup> Smallridge D, Buchner B, Trabacchi C, Netto M, Gomes Lorenzo JJ, Serra L. 2013. The role of national development banks in catalysing international climate finance. Inter-American Development Bank

for CCA and CCM in developing countries in shown in Figure 3).

- Multilateral channels and mechanism. These have governing members from multiple countries, often both borrowing and donor countries and include MDBs and UN agencies. Their capital is raised through government contributions, borrowing as well as income from loans.
- Bilateral channels and mechanisms. These are managed by individual countries, such as through bilateral DFIs, development cooperation agencies and government departments of individual countries. These sources depend on the public budgets of the donor countries, as well as their own funds and revenues from capital markets.
- Climate funds. These are set up by national, bilateral and multilateral organisations. They are usually managed through trustee or administrative services and usually have a finite lifetime and sectoral focus. There are different types of climate funds, including: i) global donor funds established by UN agencies and processes (UNFCCC, WBG, UNDP, UNEP, FAO), such as GEF, CIFs and GCF; ii) global donor funds managed by EU institutions, such as GCCA+; iii) regional recipient funds managed by RDBs, BFIs and NDBs; and iv) national recipient funds managed by BFIs and NDBs. Climate funds are usually themselves funded by multiple donors, with sums leveraged through MDBs and DFIs.

Sectors which received the largest share of public adaptation finance in 2017/2018 include: i) water and wastewater management (USD9 billion); ii) agriculture, forestry, land-use and natural resource management (USD7 billion); and iii) disaster risk management (USD7 billion). Funding for cross-sectoral adaptation doubled to USD4 billion from 2015/2016 to 2017/2018, as did funding for infrastructure, energy and built environment (from USD1 billion to USD2 billion). Public adaptation finance for industry, extractive industries, manufacturing and trade remains below USD1 billion (Figure 2).



**Figure 2.** Public adaptation finance by sector (2015/2016 and 2017/2018 averages, USD billion)<sup>71</sup>.

<sup>71</sup> Buchner B, Clark A, Falconer A, Macquarie R, Meattle C, Tolentino R, Wetherbee C. 2019. Global Landscape of Climate Finance 2019. Climate Policy Initiative

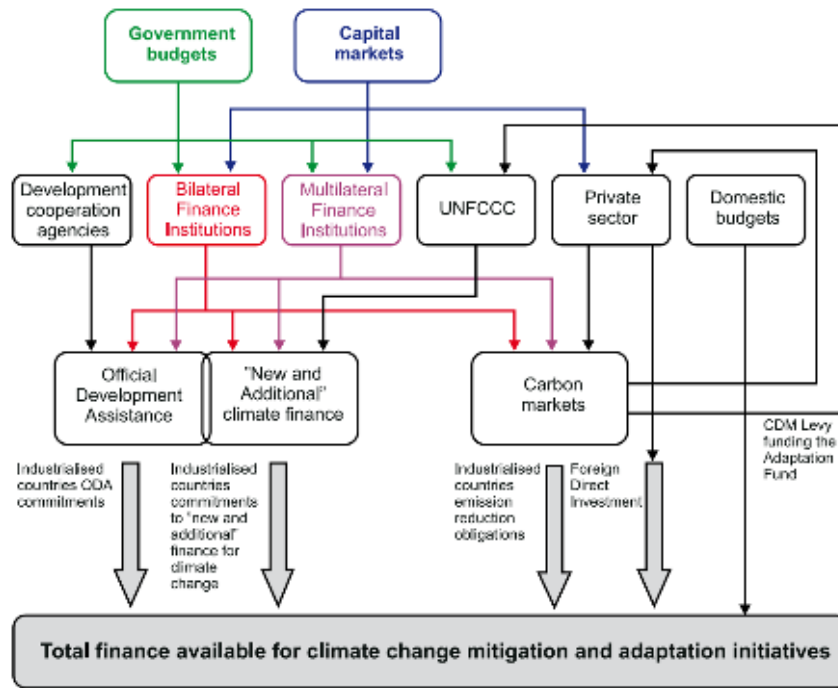


Figure 3. Financial flows for CCA and CCM in developing countries<sup>72</sup>.

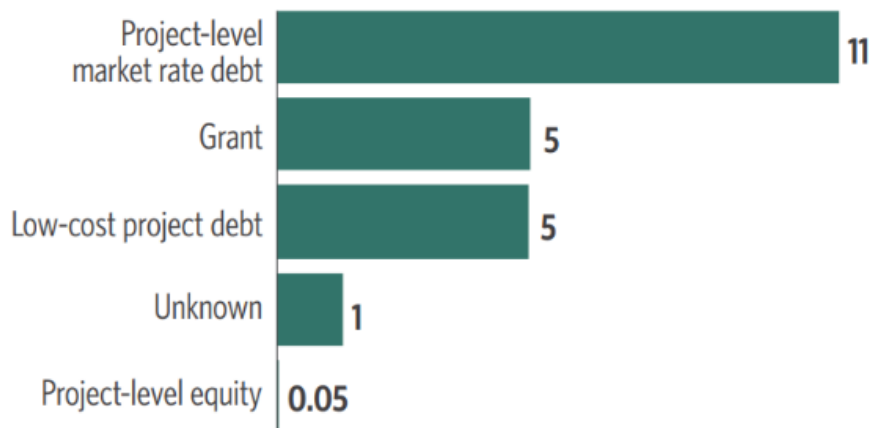


Figure 4. Adaptation financing instruments (2015/2016 average, USD billion)<sup>73</sup>.

The following section will provide an overview of existing sources of adaptation funding, including their objectives and geographic and thematic focus, to identify and clarify where and how UNIDO interventions align, to assist in the design of current UNIDO pipeline CCA projects and provide guidance for the future. The funding sources presented below are divided by type, namely multilateral institutions, bilateral institutions, and non-governmental and private sector organisations and partnerships. These are summarised in Table 1 below.

<sup>72</sup> Atteridge A, Kehler Siebert C, Klein RJT, Butler C, Tella P. 2009. Bilateral Finance Institutions and Climate Change: A Mapping of Climate Portfolios  
<sup>73</sup> Oliver P, Clark A, Meattle C. 2018. Global Climate Finance: An Updated View 2018. Climate Policy Initiative

**Table 1.** Adaptation funding sources overview.

Source	Type (public or private)	Funding	Geography	Adaptation objectives and focus, as relevant to UNIDO	Thematic focus <sup>74</sup>	Potential association to UNIDO <sup>75</sup>		
						FP	CP	Co
<p>Global Environment Facility (GEF)</p> <p>Including: Least Developed Countries Fund (LDCF); Special Climate Change Fund (SCCF); and</p> <p>GEF Challenge Program for Adaptation Innovation</p>	Public (Multilateral climate fund)	~USD10 million (average)	<p>Worldwide</p> <p>LDCF: LDCs</p> <p>SCCF: All developing countries</p>	<ul style="list-style-type: none"> <li>Objective 1: Reduce vulnerability and increase resilience through innovation and technology transfer for climate change adaptation;</li> <li>Objective 2: Mainstream climate change adaptation and resilience for systemic impact; and</li> <li>Objective 3: Foster enabling conditions for effective and integrated climate change adaptation.</li> <li>SCCF has explicit funding window for technology transfer.</li> <li>Active focus on innovation, with role in piloting emerging practices and novel technologies, techniques and business models for CCA, through: <ul style="list-style-type: none"> <li>Innovation and technology transfer, and private sector engagement;</li> <li>Climate security; and</li> <li>Incubation and accelerator support.</li> </ul> </li> <li>LDCF and SCCF encourage the mainstreaming of CCA through partnerships to leverage alternative financing for greater impact.</li> </ul>	1,2,3,4			
Green Climate Fund (GCF)	Public (Multilateral climate fund)	Up to USD50 million	<p>LDCs and MICs</p> <p>(10% for LDCs, SIDS and African countries)</p>	<ul style="list-style-type: none"> <li>Goal of USD100 billion per year.</li> <li>Investment criteria indicators: i) paradigm shift; ii) sustainable development; iii) country ownership; iv) stakeholder engagement; v) efficiency and effectiveness; vi) impact potential.</li> <li>Specific sub-criteria for, <i>inter alia</i>: <ul style="list-style-type: none"> <li>Market development and transformation (incentivising market and eliminating barriers for climate-resilient solutions);</li> <li>Economic co-benefits; and</li> </ul> </li> </ul>	1,2,3,4			

<sup>74</sup> Based on the themes used in pipeline analysis of CCA projects: Theme 1: Adaptation innovation and technology transfer; Theme 2: Climate-proofing infrastructure; Theme 3: Cross-cutting projects involving adaptation and energy; and Theme 4: Value chains for agriculture

<sup>75</sup> FP: Funding partner; CP: Cooperation partner; Co: Competitor

				<ul style="list-style-type: none"> <li>○ Industry best practices (degree of innovation, use of best available technologies).</li> </ul>			
Adaptation Fund (AF)	Public (Multilateral climate fund)	<p>USD5 million–9.9 million (average)</p> <p>USD15 million (regional programme)</p>	LDCs, developing countries	<ul style="list-style-type: none"> <li>● Strategy to mainstream cross-cutting themes:               <ol style="list-style-type: none"> <li>1. Engaging and empowering most vulnerable groups;</li> <li>2. Advancing gender equality and women’s empowerment;</li> <li>3. Strengthening long-term institutional and technical capacity for CCA; and</li> <li>4. Building complementarity and coherence with other climate finance channels.</li> </ol> </li> <li>● Three strategic pillars:               <ol style="list-style-type: none"> <li>1. Action: CCA interventions consistent with national priorities and needs, reduced vulnerability, strengthened resilience and capacity, effective action scaled up;</li> <li>2. Innovation: promotion, development and diffusion of innovative adaptation practices, tools and technologies; and</li> <li>3. Learning and sharing: sharing lessons learned, developing knowledge and guidance, strengthening analytical capacity.</li> </ol> </li> <li>● Preference for South-South collaboration.</li> <li>● 50% funding cap for MIEs; USD10 million funding cap per country.</li> </ul>	1,2,3,4		
World Bank Group (WBG)  And other RDBs	Public (Multilateral development finance institution)	USD50 billion for CCA between 2021–2025 (WBG)	Worldwide, with focus on Sub-Saharan Africa, South Asia, Latin America and the Caribbean and East Asia and the Pacific	<ul style="list-style-type: none"> <li>● MDBs provide CCA funding through climate funds, direct project implementation and partnerships.</li> <li>● CCA finance increasing.</li> <li>● Collective efforts to double the total level of adaptation finance provided compared to 2019 levels, to USD18 billion annually by 2025. Largest MDBs have CCA finance targets.</li> <li>● MDBs have several partnerships with UN agencies through specific projects and programmes.</li> </ul>	1,2,3,4		
African Development Bank (AfDB)	Public (Regional development finance institution)	>USD2 billion for CCA (in 2019; 56% of total climate finance)	Africa	<ul style="list-style-type: none"> <li>● Aims to promote sustainable economic development and social progress in its member countries, contributing to the SDGs, by: i) mobilising and allocating resources for investment; and ii) providing policy advice and</li> </ul>	1,2,3,4		



				<p>technical assistance to support development efforts.</p> <ul style="list-style-type: none"> <li>• Relevant partnerships and initiatives: Africa Adaptation Acceleration Program (AAAP; see GCA); Africa Climate Change Fund (ACCF); African Development Fund (ADF); African Guarantee Fund (AGF) for SMEs; Agriculture Fast Track (AFT) Fund; ClimateDev Special Fund; New Partnership for Africa's Development (NEPAD); Programme for Infrastructure Development in Africa (PIDA); African Financial Alliance on Climate Change (AFAC); Green and Social Bond Programs; Africa Infrastructure Resilient Facility, Adaptation Benefit Mechanism (ABM); Africa Adaptation Initiative (AAI).</li> <li>• Approximately 50% of climate finance commitments in 2020–2025 to be allocated to CCA.</li> <li>• 2016–2020 Second Climate Change Action Plan (Third Action plan for 2021–2025 not yet developed) identifies five priority areas for adaptation and climate resilience, namely: <ol style="list-style-type: none"> <li>1. Promoting climate-resilient agriculture, including infrastructure, technology access and access to finance;</li> <li>2. Scaling up investments in sustainable water resources management;</li> <li>3. Sustainable infrastructure, particularly for transport and urban and coastal environments;</li> <li>4. Promoting climate-resilient energy systems, including infrastructure; and</li> <li>5. Scaling up adaptation finance.</li> </ol> </li> </ul>			
<p>Climate Investment Funds (CIF)</p> <p>Including: Clean Technology Fund; Pilot Program for Climate Resilience (PPCR); Scaling Up Renewable Energy Program</p>	Public (Multilateral climate fund)	PPCR: USD14.8 million (average; USD0.4 million–63.4 million)	PPCR: 28 highly vulnerable countries, including LDCs and SIDS	<ul style="list-style-type: none"> <li>• PPCR aims to integrate climate resilience in development planning for transformation at scale, through innovative public and private sector solutions to pressing climate-related risks.</li> <li>• Main objectives of PPCR: <ul style="list-style-type: none"> <li>○ Pilot and demonstrate approaches for integrating climate resilience in development policies and planning;</li> <li>○ Strengthen capacities at national level to mainstream CCA;</li> </ul> </li> </ul>	1,2,3,4		

(SREP)				<ul style="list-style-type: none"> <li>○ Scale-up and leverage climate-resilient investment; and</li> <li>○ Enable learning-by-doing and knowledge sharing.</li> <li>● Original sunset clause in place when GCF operationalised, but indefinitely postponed in 2019, leaving possibility of recapitalisation.</li> </ul>				
Global Facility for Disaster Reduction and Recovery (GFDRR)	Public (Multilateral DRR fund)	USD1 million	Over 140 countries, with focus on Africa, Latin America and Caribbean and East Asia and Pacific	<ul style="list-style-type: none"> <li>● Operating principles are: <ul style="list-style-type: none"> <li>○ Demand-drive approach for maximum impact;</li> <li>○ Leveraging development investment and policies;</li> <li>○ Focusing on inclusivity and participation;</li> <li>○ Empowering women and mainstreaming gender;</li> <li>○ Jointly addressing disaster and climate risks;</li> <li>○ Developing knowledge and sharing best practices; and</li> <li>○ Prioritising a results-oriented approach.</li> </ul> </li> <li>● Grants are organised around areas of engagement, namely: <ol style="list-style-type: none"> <li>1. Promoting open access to risk information;</li> <li>2. Scaling-up resilience of cities;</li> <li>3. Deepening financial protection;</li> <li>4. Deepening engagements in resilience to CC;</li> <li>5. Promoting resilient infrastructure (built environment and resilient energy);</li> <li>6. Strengthening hydrometeorological services and EWS;</li> <li>7. Building resilience at community level; and</li> <li>8. Enabling resilient recovery.</li> </ol> </li> </ul>	1,2			
Adaptation for Smallholder Agriculture Programme (ASAP)	Public (Multilateral climate fund)	USD80 million (2018)	Worldwide (41 IFAD-recipient countries)	<ul style="list-style-type: none"> <li>● Provides co-finance for mainstreaming CCA in IFAD operations.</li> <li>● ASAP outcomes are: <ul style="list-style-type: none"> <li>○ Improved land management and gender-sensitive climate-resilient agricultural practices and technologies;</li> <li>○ Increased availability of water and efficiency of water use for smallholder agriculture production and processing;</li> <li>○ Increased human capacity to manage short- and long-term climate risk and</li> </ul> </li> </ul>	1,2,4			

				<p>reduce losses from weather-related disasters;</p> <ul style="list-style-type: none"> <li>○ Climate-resilient rural infrastructure; and</li> <li>○ Knowledge on climate-smart smallholder agriculture documented and disseminated.</li> </ul>			
Development Bank of Southern Africa (DBSA)	Public (National development bank)	>USD840 million (2020)	South Africa, SADC region, Africa	<ul style="list-style-type: none"> <li>● The purpose of DBSA is to accelerate sustainable development in Africa by funding physical, social and economic infrastructure.</li> <li>● Main thematic focuses are: i) transport; ii) social infrastructure; and iii) energy.</li> </ul>	2,3		
Foreign, Commonwealth and Development Office (FCDO) (previously DFID)	Public (Bilateral development agency)		Worldwide, with focus on Asia-Pacific and Africa	<ul style="list-style-type: none"> <li>● CC is important theme but not a top priority.</li> <li>● CC programmes prioritise green growth, low-carbon development, CCA, climate risk reduction and transfer, sustainable infrastructure development, energy efficiency and sustainable transportation.</li> </ul>	1,2,3,4		
French Development Agency (AFD)	Public (Bilateral development finance institution)		90 developing countries, including LDCs and SIDS	<ul style="list-style-type: none"> <li>● Commitment of USD3 billion in 2019.</li> <li>● Projects cover renewable energy, energy efficiency, public transport, DRM, water resource management and agriculture.</li> <li>● Strategic objectives: i) ensure consistency of all operations with Paris agreement; ii) increase climate and adaptation finance; iii) contribute to redirect financial flows; and iv) co-construct solutions and standards.</li> <li>● Half of AFD projects to have an emphasis on climate</li> </ul>	2,3,(4)		
German Development Bank (KfW)	Public (National development bank)	EUR5.1 billion (58% of commitments) in 2018 for climate and environmental protection	Worldwide, with 2020 focus in North Africa and Middle East, Asia and Sub-Saharan Africa	<ul style="list-style-type: none"> <li>● CC touches on relevant KfW sectors, such as DRR, resilient infrastructure, sustainable land management and climate financing.</li> <li>● InsuResilience Solutions Fund provides support for climate risk insurance, including product development, capacity building and knowledge generation to reduce vulnerabilities of MSMEs and lower-income households to CC.</li> </ul>	1,2,3,4		
German International Cooperation Agency (GIZ)	Public (Bilateral development agency)		Currently in ~120 countries	<ul style="list-style-type: none"> <li>● GIZ works in collaboration with the private sector and other international organisations.</li> <li>● Paradigm of sustainable development and CC central to GIZ activities.</li> <li>● Long-term capacity building and policy reform processes and operations in land management, food security, water resource management, sustainable infrastructure, sustainable sanitation, DRM, among others.</li> </ul>	1,2,3,4		

Global Climate Change Alliance Plus (GCCA+)	Public (EU multilateral initiative)	EUR420 million in 2014–2020	Worldwide, with focus on SIDS and LDCs in Africa, Asia, the Caribbean and the Pacific	<ul style="list-style-type: none"> <li>• Alliance between EU and lower-income countries most affected and least-capacitated to address CC.</li> <li>• Two pillars: i) platform for dialogue and cooperation; and ii) technical and financial support.</li> <li>• Thematic focus has so far related to agriculture (43%), poverty reduction (43%) and natural resources (33%), but also includes energy (23%), water sanitation (17%), infrastructure (4%) and waste (3%).</li> <li>• Funding target of 20% of EU budget for climate action.</li> </ul>	1,2,3,4			
International Climate Fund (ICF)	Public (Bilateral climate fund)	~GBP11 billion for 2021–2026	Developing countries worldwide	<ul style="list-style-type: none"> <li>• Three large areas of interventions: CCA, CCM and protection of forests.</li> <li>• CC is addressed through: i) evidence-building by funding and learning from programmes demonstrating the viability of climate-resilient development; ii) innovation by working with the private sector and making use of innovative approaches; iii) knowledge by contributing to and sharing knowledge on best practices; and iv) achieving value for money buy monitoring and evaluating their impact to maximise results.</li> <li>• CCA target sectors include: <ul style="list-style-type: none"> <li>○ Agriculture, food and farming systems;</li> <li>○ DRR;</li> <li>○ Water resource management; and</li> <li>○ Infrastructure and urban development.</li> </ul> </li> </ul>	1,2,3,4			
International Climate Initiative (IKI)	Public (Bilateral climate fund)	Over USD4 billion for more than 700 CC-related projects		<ul style="list-style-type: none"> <li>• Aims to provide financial support to international CCA and CCM projects and ensure that investments generate private investments of greater magnitude.</li> <li>• Thematic focus includes: i) mitigation, particularly in rapidly industrialising countries and MICs; ii) adaptation, particularly in the most vulnerable countries and regions; iii) conservation of carbon sinks; and iv) conservation of biodiversity.</li> </ul>	1,2,3,4			
Japan International Cooperation Agency (JICA)	Public (Bilateral development agency)	~USD8 billion in annual resources (CCA+CCM), 46.3% CCA and 1.4% cross-cutting (2017)	39 countries, notably in Asia, Africa and Latin America	<ul style="list-style-type: none"> <li>• One of the largest bilateral development organisations.</li> <li>• Provides ODA in form of technical and financial support to CCA and CCM projects, focusing on energy efficiency, renewable energy, public</li> </ul>	1,2,3,4			

				<p>transport systems, stable water supply, climate-resilient agriculture, sustainable forest management, disaster risk reduction and coastal protection</p> <ul style="list-style-type: none"> <li>• Four priority issues in CC cooperation. <ol style="list-style-type: none"> <li>1. Promoting low-carbon climate-resilient urban development and infrastructure investment, particularly in developing countries with rapidly growing economies.</li> <li>2. Enhancing climate risk assessment and counter measures.</li> <li>3. Supporting climate policy and institutional development.</li> <li>4. Enhancing conservation and management of forests and other ecosystems.</li> </ol> </li> </ul>			
Korea International Cooperation Agency (KOICA)	Public (Bilateral development agency)	USD490 million (2008–2017) for 600 CC projects	Worldwide, with current focus on Asia and Pacific (>50%), Africa (24%) and South America (9%)	<ul style="list-style-type: none"> <li>• Aims to, <i>inter alia</i>, promote sustainable development through support to CC projects and development and application of innovative technologies for climate technology-intensive enterprises.</li> <li>• Also aims to enhance access to climate funds through catalysing access to global development and cultivating partnerships.</li> <li>• Funding has mostly been directed in water (49%), energy (24%) and environmental management (10%).</li> </ul>	1,2,3,4		
Nordic Development Fund (NDF)	Public (Multilateral development finance institution)		Lower-income and fragile countries, particularly Africa (52%), Asia (22%) and LAC (21%)	<ul style="list-style-type: none"> <li>• Key targets for 2020–2025 are: <ul style="list-style-type: none"> <li>○ Climate, with at least 50% of funding for CCA projects;</li> <li>○ Country focus, with at least 60% of funding for Sub-Saharan Africa; and</li> <li>○ Concessionality, with at least 50% of financing with grants.</li> </ul> </li> <li>• Objective is to facilitate CC investments in low-income countries, for activities within the development and CC nexus.</li> <li>• Strategy for 2020–2025 relies on three strategic pathways: i) applying Nordic leadership in climate action; ii) developing early-stage design and structures; and iii) providing catalytic financing for launch and upscale.</li> </ul>	1,2,3,4		
United States Agency for International Development (USAID)	Public (Bilateral development agency)		~30 countries in Africa, Asia and Latin America	<ul style="list-style-type: none"> <li>• Environment and global CC one of ten thematic priorities, covering sectors such as adaptation clean energy, sustainable landscape, food</li> </ul>	1,2,3,4		

Including: USAID Green Invest Asia			Southeast Asia	<p>security, infrastructure and low-carbon development.</p> <ul style="list-style-type: none"> <li>USAID Green Invest Asia provides capital matchmaking, technical and business advisory services and access to financing for businesses in Southeast Asia.</li> <li>Initial focus on agricultural production (rice, rubber, timber, coffee)</li> </ul>				
Bezos Earth Fund	Private (International environmental fund)	USD10 billion total (grants range USD5million–100million)	Worldwide	<ul style="list-style-type: none"> <li>The Fund has so far provided USD791 million in grants to 16 recipients.</li> <li>Grants targeted at scientists, NGOs, initiatives and organisations that contribute to preserving and protecting the environment.</li> </ul>	2,3,4			
Bill and Melinda Gates Foundation	Private (International development fund)	USD5.1 billion in 2019 (all sectors)	135 countries worldwide, with focus on developing countries	<ul style="list-style-type: none"> <li>Covers a wide range of complex issues relating to global health, global development, policy, advocacy and gender equality.</li> <li>Contribution to CCA is through global health and development grants, such as the Agricultural Development initiative.</li> <li>Donations also provided to CCA organisations, such as the Global Commission on Adaptation.</li> </ul>	1,2,3,4			
Climate and Development Knowledge Network (CDKN)	Public-private partnership		LAC, Africa, Asia	<ul style="list-style-type: none"> <li>Combines research, advisory services and knowledge management.</li> <li>Provides funding for innovative approaches that tackle the challenges related to CC and development</li> <li>Works across four themes: i) the water-energy-food nexus; ii) climate finance; iii) cities and urban resilience; and iv) gender and social inclusion.</li> </ul>	1,2,3,4			
Climate Fund Managers (CFM)	Private (Climate investment manager)	EUR160 million for CCA focus	Currently, Southeast Asia and Africa	<ul style="list-style-type: none"> <li>Climate Investor Two (CI2) fund has focus on water, oceans and sanitation, such as: <ul style="list-style-type: none"> <li>municipal and industrial water and wastewater supply;</li> <li>desalination;</li> <li>bulk water supply;</li> <li>waste and wastewater to energy; and</li> <li>riverine and coastal ecosystem management and protection.</li> </ul> </li> </ul>	1,2,3		?	
Climate Pledge Fund	Private (Corporate venture fund)	USD2 billion	Worldwide	<ul style="list-style-type: none"> <li>The fund invests in innovative companies whose products and solutions will contribute to the transition to a low-carbon economy.</li> <li>Thematic focus on: i) transportation and logistics; ii) energy generation, storage and</li> </ul>				



				utilisation; iii) manufacturing and materials; iv) circular economy; and v) food and agriculture.				
Earthshot Prize	Private (international environmental fund)	GBP1 million (five prizes annually)	Worldwide	<ul style="list-style-type: none"> <li>• Awarded yearly 2021–2030.</li> <li>• Designed to incentivize change and contribute to addressing global environmental issues.</li> <li>• Earthshots identified as simple but ambitious goals for the planet: <ul style="list-style-type: none"> <li>○ Protecting and restoring nature;</li> <li>○ Cleaning the air;</li> <li>○ Reviving the oceans;</li> <li>○ Promoting waste-free development;</li> <li>○ Addressing climate change issues.</li> </ul> </li> </ul>	1,3,4			
EIT Climate-KIC	Public-private partnership (Knowledge and innovation community)	EUR2.5 billion leveraged	EU-based	<ul style="list-style-type: none"> <li>• Network of partners and stakeholders from public and private sectors, academia and non-profit organisations.</li> <li>• Four areas of focus: <ul style="list-style-type: none"> <li>○ Urban transitions, such as promoting decentralised energy and creating green and resilient cities;</li> <li>○ Sustainable land use, such as making agriculture climate-smart and resilient and transforming food systems;</li> <li>○ Sustainable production systems, such as recasting materials production and stimulating regional economies; and</li> <li>○ Decision metric and finance, such as mainstreaming climate in financial markets and democratising climate risk information.</li> </ul> </li> <li>• Climate-KIC can share innovation ideas with UNIDO and could potentially collaborate with exchange programmes. Climate-KIC can support building a supportive MSME ecosystem for the adaptation space that can train young innovators, develop corporate relationships and provide investor introductions.</li> </ul>	1,2,3,4			
Global Adaptation and Resilience Investment (GARI) Working Group	Public-private partnership			<ul style="list-style-type: none"> <li>• Over 300 private investors and other public and private stakeholders gathering to discuss the impacts and risks of climate change affecting investment portfolios, as well as the opportunities for investing in adaptation and resilience solutions.</li> </ul>				
Global Commission on Adaptation (GCA)	Public-private partnership		Worldwide	<ul style="list-style-type: none"> <li>• Acts as a solutions broker to accelerate action and support for CCA solutions, notably in sectors</li> </ul>	1,2,3,4			

Including: Africa Adaptation Acceleration Program (AAAP) with AfDB				<p>such as water, infrastructure and NBS, food security and climate finance.</p> <ul style="list-style-type: none"> <li>● Specific areas of focus include: <ul style="list-style-type: none"> <li>○ Raising standards for climate-resilient investment;</li> <li>○ Mainstreaming NBS through system-based infrastructure planning;</li> <li>○ Mobilising finance for NBS in climate-resilient infrastructure; and</li> <li>○ Developing private sector value chains.</li> </ul> </li> </ul>			
Global Innovation Lab for Climate Finance	Public-private partnership	USD2.3 billion mobilised to date	Worldwide, developing countries	<ul style="list-style-type: none"> <li>● Fast-tracks the development of innovative ideas for on-the-ground implementation by identifying, developing and piloting transformative climate finance instruments.</li> <li>● Current funding cycle focuses on: i) CCA and CCM; ii) sustainable energy access; and iii) sustainable cities.</li> </ul>	1,2,3,4		
<b>Green Investment Group (GIG)</b>	Private (public limited company)	GBP4.8 billion (2020) invested or arranged in RE and EE	Worldwide	<ul style="list-style-type: none"> <li>● Sustainable infrastructure investment specialists channelling private capital for CCA and CCM.</li> <li>● Also provides advisory services for green finance investment impact investments and fund management.</li> </ul>	2,3		
Global Climate Resilience Partnership (GRP)	Public-private partnership	USD160 million in contributions	Focus on Sahel, Horn of Africa and South and Southeast Asia	<ul style="list-style-type: none"> <li>● GRP is committed to using innovative methods and solutions to build climatic resilience from traditional and new innovators.</li> <li>● Organised around four interrelated value additions: <ol style="list-style-type: none"> <li>1. Innovation and scalability;</li> <li>2. Sharing and learning;</li> <li>3. Convening diverse voices; and</li> <li>4. Advancing knowledge.</li> </ol> </li> </ul>	1,2,3,4		
International Climate Finance Accelerator Luxembourg (ICFA)	Public-private partnership	Loan of up to EUR280,000		<ul style="list-style-type: none"> <li>● ICFA supports innovative investment fund managers in addressing CC through measurable, positive-impact investments in funds.</li> <li>● Fund managers are selected yearly for a two-year acceleration programme to kick-start their climate finance funds.</li> </ul>			
Lightsmith Group  Including: Climate Resilience and Adaptation Finance & Technology Transfer	Private (private equity firm)	USD150 million of commercial funding and USD100 million of concessional funding to de-risk investments in developing countries		<ul style="list-style-type: none"> <li>● The firm invests in companies that address major societal needs with measurable and social impacts.</li> <li>● ASAP initiative (with international partners) funds small- and medium-sized companies in emerging markets that offer technologies,</li> </ul>	1,2		

Facility (CRAFT)				<p>products and services for increased climate resilient.</p> <ul style="list-style-type: none"> <li>● CRAFT is a private adaptation fund focusing on expanding the availability of technologies and solutions for CCA and resilience.</li> <li>● Estimated leverage of USD3.3 of direct commercial investment for every USD1 of concessional financing and technical assistance grants to enhance the resilience of communities, businesses and critical infrastructure.</li> </ul>			
United Nations Office for Disaster Risk Reduction	Public (International organisation; UN agency)		Worldwide	<ul style="list-style-type: none"> <li>● Has published guidance on integrating DRR and CCA, notably through risk-proofing the built environment.</li> <li>● In 2020 also developed recommendations for Reducing Risk &amp; Building Resilience of SMEs to Disasters</li> </ul>	1,2,3		
Task Force on Climate-related Financial Disclosures (TCFD)				<ul style="list-style-type: none"> <li>● Develops recommendations for more effective climate-related disclosures to promote better-informed financial decisions.</li> <li>● Key thematic areas: i) governance; ii) strategy; iii) risk management; and iv) metrics and targets.</li> </ul>	1,2,3,4		
United Nations Human Settlements Programme (UN-Habitat)	Public (International organisation; UN agency)		Worldwide	<ul style="list-style-type: none"> <li>● In 2018 developed a guide to Addressing Urban and Human Settlement Issues in NAPs to highlight the role of upscaling climate action by integrating human settlements into national adaptation planning and processes.</li> <li>● MIE for AF with a number of projects, completed and in the pipeline.</li> </ul>	1,2,3		

### 1.1. Multilateral institutions

The multilateral institutions explored under this section consist of climate funds, multilateral development banks (MDBs) and other DFIs, namely the: i) World Bank Group (WBG) and Regional Development Banks (RDBs), as well as Climate Investment Funds (CIFs) and the Global Facility for Disaster Reduction and Recovery (GFDRR); and ii) Adaptation for Smallholder Agriculture Programme (ASAP).

#### 1.1.1. The Global Environment Facility

The Global Environment Facility (GEF) was established in 1991 as an independent financial organisation to assist in the protection of the global environment and promotion of environmentally sustainable development. Currently, 182 countries are members of GEF, which serves as the operating entity of the financial mechanisms of the: United Nations Framework Convention on Climate Change (UNFCCC), UN Convention to Combat Desertification (UNCCD), Convention on Biological Diversity (CBD) and the Stockholm Convention on Persistent Organic Pollutants (POPs). The GEF also informally supports the implementation of the Montreal Protocol (MP) in countries with economies in transition.

The objective of the GEF Trust Fund is to help developing countries and economies in transition contribute to the overall objectives of the UNFCCC. Projects under the GEF Trust Fund support measures that reduce the risks and impacts of climate change. The GEF provides grants and concessional financing for eligible projects and enabling activities to developing countries and economies in transition. The GEF administers three funds: the GEF Trust Fund, the Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF). The GEF Trust Fund is the main funding resource of the GEF and supports climate change as one of six focal areas<sup>76</sup>.

- **Adaptation Strategy**

The overall goal of the GEF-7 adaptation strategy is to strengthen resilience and reduce vulnerability to the adverse impacts of climate change in developing countries and support their efforts to enhance adaptive capacity. To achieve this goal, the strategy emphasises three strategic objectives for the LDCF and SCCF, which are elaborated on below. The GEF's distinctive value is in supporting innovative approaches to address national and global priorities for adaptation.

- Objective 1: Reduce vulnerability and increase resilience through innovation and technology transfer for climate change adaptation.

Expression of innovation can be interpreted broadly. Innovations in technologies and practices vary in countries and regions and cover not only measures to install highly advanced technologies, but also those to reinvent indigenous knowledge to suit the times or use new widespread and accepted media such as information and communication technology.

The LDCF support should play a catalytic role in testing and adapting technologies and innovative practices to specific conditions and capacity, creating favourable policies and strategies, providing systemic support to innovation through incubation and accelerators, piloting financial tools, risk transfer mechanisms, including risk insurance, climate risk pooling and other risk sharing solutions and strengthening private sector engagement in adaptation.

Recognising the LDCF's core target group of the poorest and most vulnerable, the GEF will support local private actors and micro, small, and medium enterprises (MSMEs) in their efforts to contribute to adaptation ambitions.

This objective to promote innovation and technology transfer for adaptation to reduce vulnerability has three entry points for the LDCF:

1. Innovation and technology transfer in priority sectors and themes and private sector engagement;
2. Climate security; and

---

<sup>76</sup> The six GEF focal areas are: i) biodiversity; ii) climate change; iii) international waters; iv) land degradation; v) the ozone layer; and vi) persistent organic pollutants.

### 3. Incubation and accelerator support.

- Objective 2: Mainstream climate change adaptation and resilience for systemic impact.

Opportunities for enhanced adaptation and resilience impacts merit further attention in the LDCs, given the high level of alignment of LDC NAPA implementation projects to date in themes/areas of agriculture, land-based actions, sustainable rural livelihoods and climate smart urban areas.

Examples of the integrated benefits that can ensue include:

- Cities that deliver efficient, integrated and sustainable development solutions while also building resilience of populations and infrastructure to CC and variability through integrated urban management, local physical planning for municipalities and regions, and support for decentralised decision-making;
- Delivery of clean and resilient energy solutions, particularly for vulnerable populations, such as rural communities and SIDS.

- Objective 3: Foster enabling conditions for effective and integrated climate change adaptation

The GEF may also support actions and activities to sustainably develop and enhance the capacity of countries to engage in adaptation planning processes, through a global and/or regional program, within its mandate.

Support for technology needs assessments (TNAs), NDC updating, and Capacity-building Initiative for Transparency (CBIT) is primarily addressed under the GEF-7 Climate Change Mitigation Focal Area.

#### 1.1.2. GEF Challenge Program for Adaptation Innovation

The Challenge Program aims to promote innovation in adaptation technologies and techniques by supporting sustainable innovation ecosystems for micro, small, and medium enterprises (MSMEs), thereby creating private sector opportunities to reduce CC vulnerabilities. Fostering innovation and entrepreneurship environments for technologies in the resilience space will allow developing countries to build more sustainable and resilient economies. The Challenge Program can support entrepreneurship development, incubators, seed funding, venture capital and other potentially impactful approaches.

#### 1.1.3. Green Climate Fund<sup>77</sup>

The Green Climate Fund (GCF) aims to support paradigm shifts in both climate change mitigation and adaptation efforts. GCF aims for a 50:50 balance between mitigation and adaptation investments over time.

GCF seeks to have an impact within eight mitigation and adaptation results areas. The adaptation result areas for GCF-funded projects are: i) the most vulnerable people and communities; ii) health and well-being, and food and water security; iii) infrastructure and built environment; and iv) ecosystems and ecosystem services. GCF recently developed three sector strategies on agriculture and food security, cities/buildings/urban systems and water. The first two sector strategies were developed in November 2020 while the water strategy was presented in April 2021. All three strategies are briefly explained below.

- **Agriculture and Food Security**<sup>78</sup>

The agriculture and food security framework consists of three complementary pathways namely i) promoting resilient agriculture through the diversification of crops and ensuring sustainable practices; ii) facilitating climate informed advisory and risk management services by providing early warning systems, access to finance and financial literacy training; and iii) reconfiguring food systems through changing how food is stored, transported, sold and consumed (improving value chains for agriculture). To achieve food security under climate change, GCF has estimated the financial requirements to become ~ USD100 billion per year.

<sup>77</sup> <https://www.greenclimate.fund/>

<sup>78</sup> <https://www.greenclimate.fund/event/introductory-webinar-gcf-sectoral-guide-agriculture-and-food-security>

- **Cities, Buildings and Urban Systems**<sup>79</sup>

It is estimated that 50 cities with the largest populations generate 2.6 billion tonnes of carbon dioxide per year which is why cities can accelerate ambition and upscale climate action globally. The cities, buildings and urban systems sectoral guide has identified four paradigm shifting pathways namely, i) the decarbonization of energy systems; ii) energy efficiency; iii) compact & resilient urban forms or cities; and iv) circular urban economy. Each pathway is based on the expectation of increased number of people living in cities, with even more infrastructure to continue being developed. The urban guide has identified some cross-sectoral topics in the following thematic areas: i) Agriculture and food security; ii) Forest and land use; iii) Ecosystem services; iv) Transport; v) Infrastructure; vi) Water; and vii) Health. Compact, connected and coordinated cities are projected to reduce infrastructure requirements by approximately USD 3 trillion over the next 15 years.

- **Water**<sup>80</sup>

GCF has financed a wide range of projects in the water sector spanning water resource management, flood control, drought management, sanitation and water supply. There is growing demand for water sector projects in developing countries, but many Direct Access Entities remain unclear on the GCF financing requirements. To address this issue, the GCF requested the Netherlands government to develop a guideline on designing good quality water projects to guide the respective GCF funding proposals. In this guideline, three paradigm shifting pathways have been identified namely, i) water conservation, use efficiency and water reuse; ii) water supply and water management; and iii) nature-based solutions for water management. Underlying these pathways are the key principles of ownership by stakeholders, adopting an integrated approach of the water system, and ensuring a clear climate science-based argument. The guideline also includes suggestions on developing specific water sector projects by differentiating between developing a drought management project as opposed to an integrated water resource management (IWRM) project for example.

#### 1.1.4. Adaptation Fund<sup>81</sup>

The Adaptation Fund (AF) supports vulnerable developing countries in adaptation based on the strategic pillars of Action, Innovation, and Learning and Sharing. It calls for the AF to ‘accelerate and enhance the quality of adaptation action in developing countries and support country-driven projects and programmes, innovation and multi-level global learning and sharing for effective adaptation. All activities are designed to be gender-responsive and benefit the most vulnerable’.

The Adaptation Fund Board (AFB) at its second session recently approved and invited eligible parties to submit proposals for large grant projects through either National Implementing Entities (NIEs), Regional Implementation Entities (RIEs) and Multilateral implementing Entities (MIEs). A grant received may fund single country, regional or multi-regional projects and programmes. The opportunity consists of available grants of up to USD5 million. Any proposals submitted will be reviewed under the AF Programme on Innovation: Large Grants Project which is supported by the establishment of an Innovation Facility<sup>82</sup>. The grants received under the Innovation Facility may be used to address adaptation challenges under various themes such as food security, urban adaptation and the advancement of gender equality to name a few.

#### 1.1.5. The World Bank and Regional Development Banks

Multilateral development banks (MDBs) and regional development banks (RDBs) include the: World Bank Group (WBG); African Development Bank (AfDB); Asian Development Bank (ADB); European Bank for Reconstruction and Development (EBRD); European Investment Bank (EIB); Inter-American Development Bank Group (IDBG); and the Islamic Development Bank (IsDB).

MDB finance is usually combined with substantial funds from other public and private sources of finance.

<sup>79</sup> <https://www.greenclimate.fund/event/introductory-webinar-gcf-sectoral-guide-cities-buildings-and-urban-systems>

<sup>80</sup> <https://www.greenclimate.fund/event/workshop-draft-water-sector-guidelines-daes>

<sup>81</sup> <https://www.adaptation-fund.org/>

<sup>82</sup> <https://www.adaptation-fund.org/apply-funding/innovation-grants/large-grants-for-innovation/>



MDBs provide CCA financing to developing countries through the following two different financing streams<sup>83</sup>.

- Dedicated climate finance stream. This includes specific external financial resources delivered through MDBs that are provided by higher-income countries to assist lower income countries in implementing the UNFCCC, as well as the incremental costs of CCA provided by MDBs' own resources. The external resources include dedicated climate funds and financial mechanisms, such as the Climate Investment Funds (CIFs), GCF, GEF, AF. This financing stream can be used to support discrete adaptation projects designed and delivered by the MDBs.
- Climate-related development finance stream (development finance with climate co-benefits). This refers to MDB funding with the primary goal of economic development that is delivered in a climate-friendly way, including concessional assistance and non-concessional finance. Much of this type of finance has gone to funding the marginal costs of making existing infrastructure resilient.

Most MDBs have dedicated climate funds. For example: i) ADB manages the Asian Development Fund, the ASEAN Infrastructure Fund and the Climate Change Fund; ii) IDB manages the Sustainable Energy and Climate Change Initiative; and iii) AfDB managed the Adaptation Benefit Mechanism. In addition, individual MDBs have set targets and commitments for increasing their financing towards CCA and the assessment of climate risks (Table 2). Adaptation flows of the six largest MDBs accounted for 34% of their funding in 2019, lagging behind CCM (Table 3), but demonstrated a 30% increase from 2018.

**Table 2.** CCA finance targets and commitments of the largest MDBs<sup>84</sup>.

MDBs	Adaptation finance targets and commitments
All	Collective efforts to double the total level of adaptation finance provided compared to 2019 levels, to USD18 billion annually by 2025.
African Development Bank	Approximately 50% of climate finance commitments in 2020–2025 to be allocated to CCA.
Asian Development Bank	All projects screened for climate risks; those identified as medium or high risk undergo a detailed climate risk and vulnerability assessment; viable adaptation options and climate-proofing measures are identified.
European Bank for Reconstruction and Development	Systematic integration of climate risk assessments and adaptation measures into investment operations.
European Investment Bank	Residual physical climate risk of each investment loan assessed using the EIB Climate Risk Assessment system that was adopted in 2019.
<b>Inter-American Development Bank Group</b> (including Inter-American Investment Corporation)	Adaptation to be tracked by the number of beneficiaries of enhanced disaster and climate change resilience. All projects categorised as having a high disaster and climate risk to include risk analysis and resilience measures by 2023.
<b>World Bank Group</b> (including International Bank for Reconstruction and Development, International Development Association, IFC, MIGA)	Increase adaptation climate finance to USD50 billion over 2020–2025 and pilot new approaches to scale up private finance for adaptation and resilience; help countries mainstream adaptation by systematically managing and incorporating climate risks and opportunities in policy planning, investment design, implementation and evaluation; develop a new rating system to improve global progress on adaptation and resilience; and promote public and private sector investments in adaptation. All IDA and IBRD operations undertake climate risk screening. IFC began systematic climate risk screening of projects in seven industry sectors in 2019.

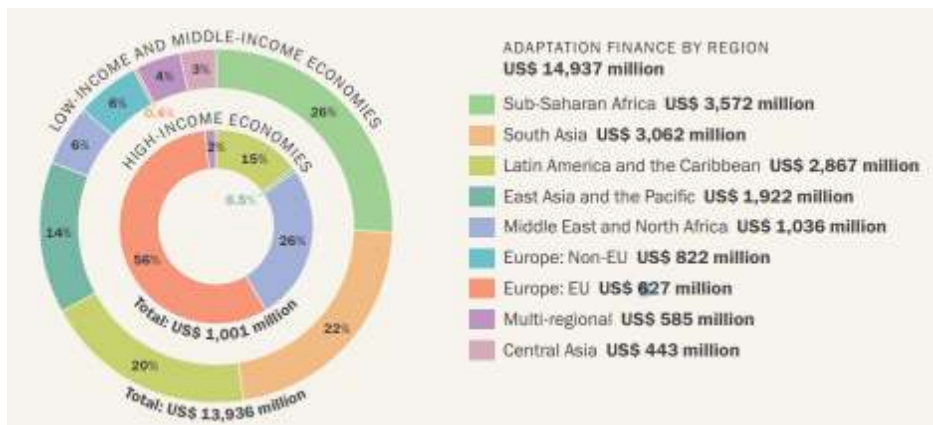
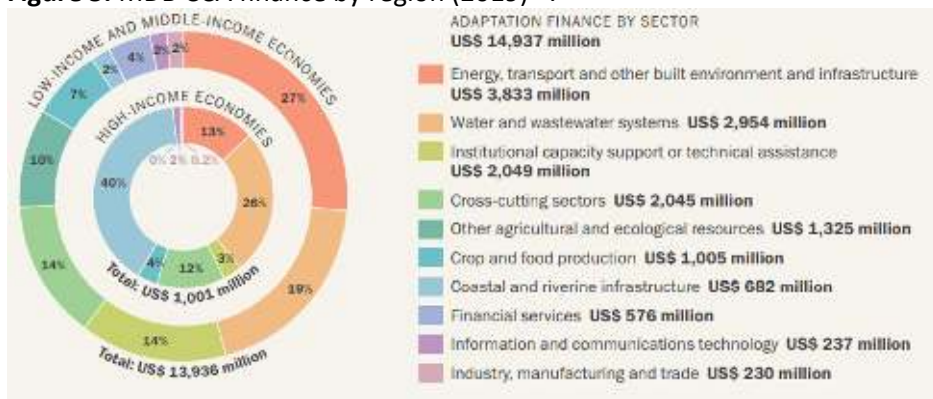
<sup>83</sup> Murphy D, Parry JE. 2020. Filling the gap: A review of Multilateral Development Banks' efforts to scale up financing for climate adaptation. International Institute for Sustainable Development.

<sup>84</sup> Murphy D, Parry JE. 2020. Filling the gap: A review of Multilateral Development Banks' efforts to scale up financing for climate adaptation. International Institute for Sustainable Development.

**Table 3.** MDB climate finance for low- and middle-income economies (2019, USD million) <sup>85</sup>.

MDB	Adaptation finance	Mitigation finance
AfDB	2,016	1,584
ADB	1,531	5,537
EBRD	569	3,354
EIB	387	3,170
IDBG	1,887	2,531
IsDB	217	247
WBG	7,329	11,108
Total	13,936	27,532

Governments, NGOs and the private sector can express interest in accessing financing. While all countries are eligible to MDB financing, ~93% of adaptation finance was directed to low- and middle-income countries in 2019, notably in Sub-Saharan Africa, South Asia and Latin America and the Caribbean (Figure 5). The sectors to receive the most adaptation finance by MDBs in 2019 were: i) energy, transport, built environment and infrastructure; ii) water and wastewater systems; and iii) institutional capacity support and technical assistance. Cross-cutting sectors also represented a significant share of adaptation funding (Figure 6). In 2019, 63% of MDB CCA finance to low- and middle-income economies was made through investment loans, followed by 13% through policy-based financing, 13% through grants and 6% through guarantees.

**Figure 5.** MDB CCA finance by region (2019)<sup>86</sup>.**Figure 6.** MDB CCA finance by sector (2019)<sup>87</sup>.

<sup>85</sup> African Development Bank, Asian Development Bank, Asian Infrastructure Investment Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank Group, Islamic Development Bank, World Bank Group. 2020. The 2019 joint report on Multilateral Development Banks' climate finance.

<sup>86</sup> African Development Bank, Asian Development Bank, Asian Infrastructure Investment Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank Group, Islamic Development Bank, World Bank Group. 2020. The 2019 joint report on Multilateral Development Banks' climate finance.

<sup>87</sup> African Development Bank, Asian Development Bank, Asian Infrastructure Investment Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank Group, Islamic Development Bank, World Bank Group. 2020. The 2019 joint report on Multilateral Development Banks' climate finance.

**Table 4.** MDB CCA finance by sector and region (2019)<sup>88</sup>.

	Central Asia	East Asia and Pacific	Europe (EU)	Europe (non-EU)	Latin America and Caribbean	Middle East and North Africa	South Asia	Sub-Saharan Africa	Multi-regional
Coastal and riverine infrastructure	–	67	134	10	16	264	157	3	31
Crop and food production	4	87	38	22	50	83	159	534	28
Cross-cutting	11	245	64	32	476	94	336	634	154
Energy, transport, built environment and infrastructure	152	543	115	419	389	99	1,088	788	240
Financial services	38	146	–	19	33	106	30	205	0
Industry, manufacturing and trade	43	1	2	178	–	–	–	5	2
Information and communications technology	1	45	16	1	56	–	61	47	12
Institutional capacity support or technical assistance	4	294	22	3	1,006	116	282	276	46
Other agricultural and ecological resources	87	230	–	9	200	–	476	254	70
Water and wastewater systems	103	265	238	131	641	274	474	826	2

- **Partnerships and collaboration with United Nations Agencies**

MDBs and RDBs have been known to enter into partnerships with UN agencies through specific projects and programmes, as well as establishing frameworks for continual collaboration, combining efforts to reach a common goal.

The ADB has also been collaborating with several UN agencies since 1972, such as the Joint UN Programme on HIV/AIDS, UNICEF, UNEP, UNDP, UNIDO, UN Population Fund and the WHO. ADB's Memorandum of Understanding (MoU) with UNIDO (1996) contains the working arrangements in implementing activities for the promotion of industrial development for poverty reduction, inclusive globalisation and environmental sustainability<sup>89</sup>.

In November 2019, the Eastern and Southern African Trade and Development Bank (TDB) signed an MoU with UNEP, to establish a framework of cooperation through which the two institutions can collaborate in a number of global environment issues, such as clean energy finance and access to finance for climate change adaptation<sup>90</sup>.

#### 1.1.6. Climate Investment Funds

The Climate Investment Funds (CIFs) were established in 2008 and are administered by the WBG, operating in partnership with RDBs. The CIFs are composed of the Clean Technology Funds (CTF) and the Strategic Climate Fund (SCF), which have respectively provided ~USD7 billion and ~USD3.4 billion, mostly in grants and

<sup>88</sup> African Development Bank, Asian Development Bank, Asian Infrastructure Investment Bank, European Bank for Reconstruction and Development, European Investment Bank, Inter-American Development Bank Group, Islamic Development Bank, World Bank Group. 2020. The 2019 joint report on Multilateral Development Banks' climate finance.

<sup>89</sup> ADB and UNIDO. 1996. Memorandum of understanding on working arrangements between the Asian Development Bank and the United Nations Industrial Development Organisation. Available at: <https://www.adb.org/sites/default/files/institutional-document/33505/files/mou-unido.pdf>

<sup>90</sup> UNEP. 2019. Trade and Development Bank, UNEP to collaborate on climate finance. Press release 5 November 2019. Available at: <https://www.unenvironment.org/news-and-stories/press-release/trade-and-development-bank-unep-collaborate-climate-finance>

concessional loans<sup>91</sup>. Although the CIFs had a sunset clause that would come into effect when improved global architecture for climate finance was in place — this was understood to be the operationalisation of the GCF — the clause was revisited in 2019 and indefinitely postponed, leaving the possibility of recapitalisation of the CIFs.

The CTF focuses on transformation in middle-income and developing countries by providing resources to scale up the demonstration, deployment, and transfer of low-carbon technologies with a significant potential for long-term greenhouse gas emissions savings. The CTF supports low-carbon technologies in transport (bus rapid transit, public transportation, efficiency vehicles, and modal shifts), renewable energy (wind, solar photovoltaic and concentrating solar power, and geothermal), and energy efficiency (industry, building, district heating). The CTF notably aims to: i) fund low-carbon projects that are embedded in national priorities, scaling up development and accelerating the diffusion and transfer of clean technologies; ii) realise environmental and social benefits, illustrating the interconnectedness between low-carbon technologies and sustainable development; and iii) share experiences and lessons learned in responding to climate change challenges. The CTF is a mitigation-focused climate fund that also finances cross-cutting projects. It is active in 28 countries and provides grants of USD2–200 million, with an average grant size of USD46 million.

SCF is composed itself of three programmes, namely the: i) Pilot Program for Climate Resilience (PPCR); ii) Scaling Up Renewable Energy Program in Low Income Countries (SREP); and iii) Forest Investment Program (FIP).

The PPCR aims to integrate climate resilience in development planning for transformation at scale, through innovative public and private sector solutions to pressing climate-related risks. It is active in 28 countries, mostly middle-income countries. The PPCR has a portfolio of USD1.2 billion and provides grants with an average grant size of USD14.8 million, spanning USD0.4–63.4 million). The PPCR gives priority to highly vulnerable countries and LDCs, including small island developing states (SIDS). Activities supported by the PPCR include agriculture and landscape management (25%), water resource management (18%), climate information systems and disaster risk management (17%), infrastructure (16%), enabling environments (15%)<sup>92</sup>. The PPCR has played a leading role in engaging the private sector in adaptation, with USD137 million of its portfolio earmarked for private sector funding.

The four main objectives of the PPCR are to:

1. pilot and demonstrate approaches for integration of climate risk and resilience into development policies and planning;
2. strengthen capacities at the national levels to integrate climate resilience into development planning;
3. scale-up and leverage climate resilient investment, building on other on-going initiatives; and
4. enable learning-by-doing and sharing of lessons at country, regional and global levels.

The SREP promotes the scale-up of renewable energy solutions by enhancing energy access. SREP was founded to demonstrate the economic, social, and environmental viability of climate change mitigation and low-carbon development pathways in the energy sector, by creating new economic opportunities, as well as increasing the use of renewable energy. It is active in 27 countries, mostly LDCs and SIDS. The SREP has provided grants of up to USD25 million. Technologies supported by the SREP include wind, waste-to-energy, solar, mixed renewable energy, hydropower, geothermal and cook stoves.

The FIP supports developing countries in reducing emissions from deforestation and forest degradation and promoting sustainable forest management and the enhancement of forest carbon stocks. It is active in 23 countries.

<sup>91</sup> Watson C, Schalatek L. 2020. The Global Climate Finance Architecture. Climate Finance Fundamentals 2. Climate Funds Update, Overseas Development Institute.

<sup>92</sup> CIFs. 2018. PPCR Factsheet. Available at: [https://www.climateinvestmentfunds.org/sites/cif\\_enc/files/knowledge-documents/ppcr\\_factsheet.pdf](https://www.climateinvestmentfunds.org/sites/cif_enc/files/knowledge-documents/ppcr_factsheet.pdf)

### 1.1.7. Global Facility for Disaster Risk Reduction and Recovery

The Global Facility for Disaster Reduction and Recovery (GFDRR) is a grant-funding mechanism, managed by the WBG to support developing countries to: i) mainstream disaster risk management and CCA in development strategies and investment programmes; and ii) improve the quality and timeliness of resilient recovery and reconstruction following a disaster. The GFDRR awards grants averaging USD1 million for specific activities in line with its operating principles, namely: i) demand-driven approach to ensure maximum impact; ii) leveraging development investments and policies; iii) focusing on inclusive design and participation; iv) empowering women and mainstreaming gender; v) jointly addressing disaster and climate risks; vi) developing knowledge and sharing best practices; and vii) prioritising a results-oriented approach.

Grants are organised around the following areas of engagement:

1. Promoting open access to risk information
2. Scaling up the resilience of cities
3. Deepening financial protection
4. Deepening engagements in resilience to climate change
5. Promoting resilient infrastructure
6. Strengthening hydrometeorological services and EWS
7. Building resilience at community level
8. Enabling resilient recovery

### 1.1.8. Adaptation for Smallholder Agricultural Programme<sup>93</sup>

The Adaptation for Smallholder Agriculture Programme (ASAP) is a climate fund administered by the International Fund for Agricultural Development (IFAD) and made operational in 2012. It aims to channel climate finance to smallholder farmers, scale up CCA in rural development programmes and mainstream CCA in IFAD's work. ASAP funds focus on: i) policy engagement; ii) climate risk assessment; iii) women's empowerment; iv) private sector engagement; v) climate services; vi) natural resource management and governance; and vii) knowledge management. ASAP is scaling up successful multi-benefit approaches to smallholder agriculture, which improve production while reducing climate risks and diversifying opportunities. Activities supported by ASAP include:

- Improving land management and climate-resilient agricultural practices and technologies;
- Making rural infrastructure climate-resilient;
- Increasing availability of water and efficiency of water use for smallholder agriculture production and processing; and
- Improving the dissemination of climate-smart smallholder agriculture knowledge.

During its first phase (2012–2017), ASAP provided USD305 million in grants in 41 countries. Its goal for the second phase is USD100 million.

ASAP grants are joined with IFAD baseline investments implemented by government entities, reflecting a different operation to other funds. ASAP does not employ a specific application procedure that can be accessed by NGOs or CSOs directly, but through country-specific strategic opportunities in which CCA is a strategic decision for IFAD operations in a specific country, therefore providing a new source of co-financing.

## 1.2. Bilateral Institutions

A large share of public adaptation finance is provided bilaterally, though development and cooperation agencies and banks in a range of donor countries. The allocation of funds is decided through bilateral government negotiations. The organisations presented under this section consist of national development finance institutions (DFI) as well as national development banks (NDBs), development and cooperation

<sup>93</sup> <https://www.ifad.org/en/asap>

agencies or government departments, which are involved with CCA and may be of interest to UNIDO. These institutions will be elaborated in the sections below.

#### 1.2.1. Development Bank of Southern Africa<sup>94</sup>

The Development Bank of Southern Africa (DBSA) is a DFI owned by the Government of South Africa. Its purpose is to contribute to sustainable development by funding physical, social and economic infrastructure and to improve the quality of life of people in South Africa and the wider region. In 2020, the DBSA disbursed over USD480 million, focusing on transport (58%), social infrastructure (19%), energy (18%) and water and sanitation (2%)<sup>95</sup>. In the wider region, an additional USD360 million was disbursed to African countries, between energy (38%), social infrastructure (36%) and transport (26%). The DBSA is an accredited entity to GEF (since 2014) and GCF (since 2016) and currently has a range of project in their pipeline, notably CCA and cross-cutting projects. It has been awarded USD55 million to establish a climate finance facility, which will address market constraints in the private sector and play a catalytic role, with a blended finance approach, in increasing climate-related investments in Southern Africa<sup>96</sup>.

#### 1.2.2. Foreign, Commonwealth and Development Office<sup>97</sup>

The Foreign, Commonwealth and Development Office (FCDO), previously the Department for International Development (DFID), is the UK government department responsible for ODA. In 2016, 73.8% of the UK's ~EUR17 billion ODA was channeled through DFID. Humanitarian assistance accounted for 15% of British ODA and was identified as the single most important sector<sup>98</sup>. Climate change — adaptation, mitigation and disaster risk reduction — is an important theme for DFID but does not rank amongst the top priorities.

Governmental and non-governmental entities, depending on the program or call are eligible. DFID works globally, but has a prioritised geographic focus on Asia-Pacific and Africa. Pakistan, Syria, Afghanistan, Jordan, Bangladesh and Nepal, as well as Nigeria, Ethiopia, Tanzania, and Kenya, amongst others are top recipient countries. DFID supports climate-related programs in most of these and many other countries.

The DFID climate change programmes prioritise sectors such as green growth and low-carbon development, climate adaptation, climate risk reduction and transfer, sustainable infrastructure development, energy efficiency and sustainable transportation. Financial support is provided in the form of grants, concessional loans, equity and guarantees.

#### 1.2.3. French Development Agency<sup>99</sup>

The Agence Française de Développement (AFD) is a public international DFI established several decades ago as France's bilateral development-policy platform. It is wholly owned by the French State and is dedicated to industrial and commercial activities, as well as being essential in the implementation of French ODA. The mandate of the AFD is to contribute to social and economic development through sustainable and inclusive growth, enhancing livelihoods and natural resource management. AFD is funded by the French government, philanthropic organisations, grants from EU agencies and capital markets, through the distribution of bonds and private placements<sup>100</sup>.

With operations in more than 90 developing countries across all regions, including least developed countries and small island developing states, AFD is actively engaged in climate change mitigation and adaptation actions across all sectors. AFD made a commitment of almost USD3 billion to climate finance last year, employing a range of financial instruments. AFD has delivered projects and programmes in renewable energy, energy

<sup>94</sup> <https://www.dbsa.org/EN/Pages/default.aspx>

<sup>95</sup> DBSA. 2020. 2020 Sustainability Review. Building Africa's Prosperity. DBSA.

<sup>96</sup> <https://www.greenclimate.fund/project/fp098>

<sup>97</sup> <https://www.gov.uk/government/organisations/foreign-commonwealth-development-office>

<sup>98</sup> Hirsch T. 2018. A resource guide to climate finance: An orientation to sources of funds for climate change programmes and action. ACT Alliance.

<sup>99</sup> <https://www.afd.fr/fr>

<sup>100</sup> Hirsch T. 2018. A resource guide to climate finance: An orientation to sources of funds for climate change programmes and action. ACT Alliance.



efficiency, public transport, disaster risk management in urban areas and water resources management, improving livelihoods and well-being, adaptive agriculture and forestry. National governments, NGOs, the private sector and local authorities are eligible to apply for projects.

The strategic positioning of AFD for the period 2017–2022 is set out through the following objectives.

- **Strategic objective 1: 100% Paris agreement.** This first objective is to ensure the consistency of all AFD operations with countries' long-term low-carbon and climate-resilient development pathways.
- **Strategic objective 2: increased climate finance.** By 2020, AFD aimed to make USD5 billion available for climate finance, including USD1.5 billion for adaptation.
- **Strategic objective 3: contribute to redirecting financial flows,** as exemplified in the AFD-GCF Programme "Transforming Financial Systems for Climate", which aims to shift the paradigm of financial flows towards local finance institutions and project developers with limited access to climate finance.
- **Strategic objective 4: co-construct solutions and standards** to develop a new strategic approach to partnerships to enhance AFD's roles and contribution in delivering its objectives.

Through its Adapt'Action tool, AFD supports countries in the implementation of their NDCs for climate-resilient development and has made up to USD30 million available to 15 countries until 2021 to 15. The potential recipient countries are mainly SIDS, LDCs and African countries. Its overall objective is to facilitate access to climate finance and encourage investment in climate change adaptation. The three axes of intervention are: i) support for improved climate governance; ii) support for adaptation mainstreaming in public policy; and iii) support for adaptation project preparation, such as funding for vulnerability and feasibility studies.

#### 1.2.4. German Development Bank<sup>101</sup>

Kreditanstalt für Wiederaufbau Bank Group (KfW) is a state-owned German DFI, founded in 1948 and originally focused on reconstruction. KfW provides financing to governments, public enterprises and commercial banks. Climate change is relevant across various sectors of KfW's portfolio, such as disaster risk reduction, resilient infrastructure, sustainable land management and climate financing. KfW has supported efforts to address climate change, notably focusing on resilience strengthening, risk management and risk transfer, as well as mitigation — including low carbon infrastructure development, renewable energies, energy efficiency and transportation. Eligibility differs depending on the specific programme but ranges from national and subnational governmental institutions to NGOs and the private sector. Funding may be provided in the form of grants, concessional loans, blended finance products, equity and guarantees. From 2013 to 2018, KfW invested approximately EUR23.6 billion in climate-related projects. Although it aims for a 50-50 split for CCA and CCM, around CCA only represents 25% of funding.

The InsuResilience Solutions Fund was established in 2017 to provide support for the development, promotion and implementation of climate risk insurance, including for product development, capacity building and knowledge generation. InsuResilience specifically contributes to reducing the vulnerability of micro-, small- and medium-sized enterprises, as well as lower-income household, to extreme climate events.

#### 1.2.5. German International Cooperation Agency<sup>102</sup>

Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) is a German development agency which mainly implements the technical cooperation projects of the Federal Ministry for Economic Cooperation and Development (BMZ). GIZ also works with the private sector and other international organisations. The agency offers services such as advice, capacity development, network and dialogue management, and management and logistics. Central to the work of GIZ is the paradigm of sustainable development and climate change. GIZ supports long-term capacity-building and policy reform processes, and operates in all sectors relevant to

<sup>101</sup> <https://www.kfw.de/kfw.de-2.html>

<sup>102</sup> <https://www.giz.de/en/html/index.html>



sustainable development and climate change mitigation and adaptation, including land management, food security, water resource management, sustainable infrastructure, sustainable sanitation, disaster risk management, environmental finance, insurance and others. GIZ operates worldwide, currently in ~120 countries. Eligibility may vary depending on the specific programme but can include government and non-governmental entities, such as the private sector and NGOs.

#### 1.2.6. Global Climate Alliance Plus

The Global Climate Change Alliance Plus (GCCA+) is a European Union (EU) initiative that aims to build a new alliance on climate change between the EU and lower-income countries that are most affected and that have the least capacity to deal with climate change. The initiative has funded over 80 projects of national, regional and international scope in Africa, Asia, the Caribbean and the Pacific, particularly SIDS and LDCs. The GCCA+ is working through the EU's established channels for dialogue and cooperation at the national and international levels. The GCCA+ rests on two pillars, namely: i) platform for dialogue and cooperation; and ii) technical and financial support. While agriculture, poverty reduction and natural resources have received most support, sectors targeted by technical and financial support also include: i) energy (23%); ii) water sanitation (17%); iii) infrastructure (4%); and iv) waste (3%).

Supported by the Development Cooperation Instrument (DCI) through the Global Public Goods and Challenges (GPCC) programme and the European Development Fund (EDF), funding for GCCA+ has increased from EUR317.5 million in 2007–2014 to EUR420 million in 2014–2020, contributing towards the overall target of at least 20% of the EU budget spent for climate action.

Countries are assessed based on their level of vulnerability to climate change, adaptive capacity, and engagement in climate change efforts. Funds, mostly in the form of grants, are provided for interventions in target sectors according to availability of resources and population structure.

#### 1.2.7. International Climate Fund<sup>103</sup>

The UK International Climate Fund (ICF) is the UK's primary instrument for funding international action on climate change. It was set up to drive urgent action against climate change in developing countries. The ICF focuses on CCA, CCM and REDD through: i) evidence-building by funding and learning from programmes demonstrating the viability of climate-resilient development; ii) innovation by working with the private sector and making use of innovative approaches; iii) knowledge by contributing to and sharing knowledge on best practices; and iv) achieving value for money by monitoring and evaluating their impact to maximise results. In CCA, the ICF works with the poorest countries in vulnerable sectors that are most important to local livelihoods, such as agriculture (food and farming systems), DRR, water resource management and infrastructure and urban development. The UK committed GBP5.8 billion to the ICF for 2016–2021 and has doubled this investment for the period 2021–2026. Grants and concessional loans are available to both governmental and non-governmental entities.

#### 1.2.8. International Climate Initiative<sup>104</sup>

The German International Climate Initiative (IKI) is an initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) that has provided over USD4 billion for more than 700 climate change adaptation and mitigation projects. IKI originated from a decision taken by the German parliament to auction emission allowances from the European carbon market to provide financial support to international projects for CCM and CCA, as well as biodiversity with a climate focus, with the aim of ensuring that investments generate private investments of a greater magnitude. IKI has provided grants for projects covering thematic focuses that include: i) mitigation, particularly in rapidly industrialising countries and MICs; ii) adaptation, particularly in the most vulnerable countries and regions; iii) conservation of carbon

<sup>103</sup> [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/48217/3389-uk-international-climate-fund-brochure.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48217/3389-uk-international-climate-fund-brochure.pdf)

<sup>104</sup> <https://www.international-climate-initiative.com>

sinks; and iv) conservation of biodiversity. The funds are eligible as ODA, with additional funding possible through the Energy and Climate Fund, launched in 2011. Entities eligible for funding include the implementing organisations of GIZ, NGOs, governmental organisations, academia and research organisations, the private sector, MDBs and UN agencies.

#### 1.2.9. Japan International Cooperation Agency<sup>105</sup>

The Japan International Cooperation Agency (JICA) is an entity headquartered in Japan with a strong global presence. JICA is one of the largest bilateral development organisations, with annual resources of ~USD8 billion<sup>106</sup>. Climate change has become an important focus of JICA. The agency has been providing ODA in the form of financial and technical support to climate change mitigation and adaptation projects, focusing on energy efficiency, renewable energy, public transport systems, stable water supply, climate-resilient agriculture, sustainable forest management, disaster risk reduction and coastal protection. Building upon international best practices, JICA aims to make the best use of Japanese knowledge, experience and technologies in driving a paradigm shift towards a low- carbon and climate-resilient society in developing countries.

JICA has implemented over 137 projects and programmes in 39 countries, notably in Asia, Africa and Latin America, focusing on sectors such as energy, water and sanitation and infrastructure. Financial support through concessional loans and grants is made available to governmental, international and non-governmental entities.

JICA has set the following four priority issues in climate change cooperation.

1. Promoting low-carbon carbon-resilient urban development and infrastructure investment, particularly in developing countries with rapidly growing economies.
2. Enhancing climate risk assessment and counter measures.
3. Supporting climate policy and institutional development.
4. Enhancing conservation and management of forests and other ecosystems.

#### 1.2.10. Korea International Cooperation Agency<sup>107</sup>

The mandate of KOICA is to contribute to the advancement of international cooperation through projects that build collaborative relationships and exchanges between Korea and developing countries and support economic and social development in those countries. It aims to do so by:

- Promoting sustainable development through climate change response through: i) support to CCA and CCM projects and the enhancement of climate change response capacity; and ii) the mainstreaming of climate projects, the development and application of innovative climate technologies for climate technology-intensive enterprises;
- Strengthening capacity building for climate change response through: i) the enhancement of adaptive capacity and support for developing countries to build capacity for climate response and effectively access global climate funds; and ii) support for establishing national GHG inventories; and
- Enhancing access to climate funds through financial mechanisms through: i) catalysing access to global development by linking developing countries and potential investors; and ii) the cultivation of partnerships and co-financing.

KOICA has financed 601 climate-related projects worth USD490 million during 2008–2017, mostly in water (49%), energy (24%) and environmental management (10%). While over half of this funding has been directed at Asia and the Pacific, Africa received 24% of funding and Central and South America 9%.

#### 1.2.11. Nordic Development Fund<sup>108</sup>

The Nordic Development Fund (NDF) is the joint development finance institution of the five Nordic countries.

<sup>105</sup> <https://www.jica.go.jp/english/index.html>

<sup>106</sup> Hirsch T. 2018. A resource guide to climate finance: An orientation to sources of funds for climate change programmes and action. ACT Alliance.

<sup>107</sup> [http://www.koica.go.kr/sites/koica\\_en/index.do](http://www.koica.go.kr/sites/koica_en/index.do)

<sup>108</sup> <https://www.ndf.fi/>

The objective of NDF's operations is to facilitate climate change investments primarily in low-income countries. NDF provides financing to mitigation and adaptation activities within the nexus of climate change and development in lower-income countries and countries in fragile situations, including SIDS. NDF has mostly focused its support on Africa (52%) as well as Asia (22%), but has also supported projects in Central and South America (21%)<sup>109</sup>. NDF's financing is provided on concessionary terms in the form of grants, loans and equity. The fund's key targets for 2020–2025 relate to: i) climate change, with at least half of funding directed towards CCA projects; ii) geographic focus, with at least 60% of funding targeted towards Sub-Saharan Africa; and iii) concessionality, with at least 50% of financing with grants. It aims to do so by following three strategic pathways that underpin and support this achievement. These pathways integrate and mutually reinforce each other, namely the following<sup>110</sup>.

- Applying Nordic leadership in climate action. The NDF will seek to: i) mobilise action around Nordic priorities in climate and development; ii) strengthen synergies with Nordic financing organisations; and iii) use its expertise, networks and leadership to increase action for prioritised climate and development areas.
- Developing early-stage design and structures, in order to: i) engage with strategic partners in the design, preparation and delivery of early-stage projects, investment and climate solutions; and ii) mitigate issues relating to limited financing and support due to perceived risks related to early-stage financing.
- Providing catalytic financing for launch and scale. The NDF will aim to: i) create financing arrangements with various types of strategic partners; ii) co-finance public projects through concessionary loans and grants to leverage financing from other source; iii) take higher-risk position in the private sector to improve investment risk profiles and catalyse other sources of financing; and iv) help raise further financing once a project has demonstrated its viability, replicability and scalability.

#### 1.2.12. United States Agency for International Development<sup>111</sup>

The United States Agency for International Development is an independent federal government entity responsible for delivering foreign aid and development assistance. USAID seeks to maximise the sustainability and resiliency of its development investments. Environment and global climate change is one of the ten thematic priorities of USAID which covers sectors such as adaptation, clean energy, sustainable landscape, mainstreaming climate change in development, food security, infrastructure, and low-carbon development. USAID has been engaged in CCA in approximately 30 countries across Africa, Asia and Latin America. It aims to help countries and communities around the world develop strategies to build resilience to climate variability and risks, such as floods, storms, drought and sea-level rise. Both governmental and non-governmental entities are eligible to receive funding from USAID in the form of grants and concessional loans.

USAID Green Invest Asia is a facility of USAID that supports agriculture and forestry businesses in Southeast Asia strengthen the sustainability of their operations by providing them with capital matchmaking, technical and business advisory services and access to financing. The programme also supports investors in identifying low-risk and climate-smart opportunities and conducting due diligence to ensure the environmental sustainability of their investments. USAID Green Invest Asia encourage knowledge-sharing and networking between businesses interested in green financing. The initial focus has been on production of rice, rubber, timber, coffee, coconut and cacao in Cambodia, Indonesia, Malaysia, Philippines, Thailand and Vietnam. By 2022, the programme aims to mobilise up to USD400 million of private finance in sustainable commodity production. While the main benefit of these investments will be reduction in GHG emissions, it will also contribute to improved efficiency and productivity in the agriculture and forestry sectors in the face of a changing climate.

<sup>109</sup> NDF. 2020. Strategy 2025: Nordic Leadership addressing climate change. NDF.

<sup>110</sup> NDF. 2020. Strategy 2025: Nordic Leadership addressing climate change. NDF.

<sup>111</sup> <https://www.usaid.gov/>

### 1.3. Non-governmental and private sector organisations and partnerships

The private sector, and its role in adaptation finance, is wide-ranging. Private sector investments can take various forms, from soft to hard measures. In many cases, investments that do not have CCA as a main objective can also contribute to adaptation<sup>112</sup>. While private sector investments represent the majority of climate finance, private investments in adaptation are difficult to track, as they are often components within larger projects<sup>113</sup>. Moreover, while there is some private sector investment focused on adaptation and resilience challenges, it is not at the scale that experts project will be needed to address the challenge, and is not focused or coordinated at the same level of sophistication or scale as climate mitigation investments in renewable energy and energy efficiency, for example.

In 2007, ~82% of private financing of clean energy in developing countries was directed to China, India and Brazil<sup>114</sup>, indicating that many less developed countries will not have seen significant private finance. Future contributions of private finance to climate change will be heavily influenced by the success of public finance in leveraging private flows, as well as the emergence of investment markets that can attract commercial finance. Private investments are typically financed using the same instruments as traditional business instruments (Figure 7).

The private sector is a critical partner to bridge the existing adaptation finance gap, which was estimated to be USD11.3–25.6 billion for infrastructure, energy and built environment in 2014<sup>115</sup>. It is well-placed to implement activities in key industries that will require adaptation, and in sectors that can provide adaptation goods and services, such as infrastructure, agriculture and water management<sup>116</sup>. Climate change impacts and the need for adaptation and strengthened resilience are increasingly being recognised in the private sector as a major risk for future business. Mobilising the private sector is essential to ensure transformational and long-term impacts in developing countries.

The stakeholders presented under this section include for-profit and non-profit entities, non-governmental organisations (NGOs), private sector companies, investment groups and public-private partnerships (PPPs) involved in climate change adaptation, which will be elaborated on below.

#### 1.3.1. Bezos Earth Fund

Jeff Bezos, the world's richest man and head of the online retailer Amazon, pledged in 2020 USD10 billion to help fight climate change. The initiative is targeted at funding scientists, activists and NGOs that offer the possibility of contributing to preserving and protecting the environment. In November 2020, the first 16 recipients of the Fund were announced, totalling USD791 million in grants to established groups and NGOs, such as the Climate and Clean Energy Equity Fund (USD43 million), the ClimateWorks Foundation (USD50 million), the WRI (USD100 million), the World Wildlife Fund (USD100 million) and the Nature Conservancy (USD100 million).

#### 1.3.2. Bill and Melinda Gates Foundation<sup>117</sup>

The Foundation has provided grant payments of over USD55 billion since its inception, including USD5.1 billion in 2019. The Foundation has funded work in 135 countries. The Foundation covers a wide range of complex issues relating to global health, global development, policy and advocacy as well as gender equality. While it has not funded CCM efforts, its support contributes to CCA through global health and development grants. For example, its Agricultural Development initiative is supporting the development of drought and flood

<sup>112</sup> Micale V, Tonkonogy B, Mazza F. 2018. Understanding and Increasing Finance for Climate Adaptation in Developing Countries.

<sup>113</sup> Buchner B, Clark A, Falconer A, Macquarie R, Meattle C, Tolentino R, Wetherbee C. 2019. Global Landscape of Climate Finance 2019. Climate Policy Initiative.

<sup>114</sup> UNFCCC. 2009.

<sup>115</sup> Ward J, Caldwell E. 2016. Private Sector Investment in Climate Adaptation in Developing Countries: Landscape, Lessons Learned and Future Opportunities. Climate Investment Funds.

<sup>116</sup> Ward J, Caldwell E. 2016. Private Sector Investment in Climate Adaptation in Developing Countries: Landscape, Lessons Learned and Future Opportunities. Climate Investment Funds.

<sup>117</sup> <https://www.gatesfoundation.org/>

resistant crops, as well as improved irrigation systems. The Gates Foundation has also provided USD310 million to the Global Commission on Adaptation.

### 1.3.3. Climate Fund Managers<sup>118</sup>

Climate Fund Managers (CFM) is an investment manager in the fields of CCM and CCA in areas most affected by climate change. Using blended finance structuring to attract public and private capital, CFM invests in high-impact infrastructure sectors in emerging economies, such as renewable energy, sustainable cities and water sanitation. While CFM's Climate Investor One fund had a specific mitigation mandate to finance renewable energy projects — such as run-of-river hydro, onshore and near-shore wind and solar photovoltaic infrastructure — Climate Investor Two (CI2) focuses on CCA sectors, such as water, oceans and sanitation. CFM is planning two further climate finance facilities, namely Climate Investor Three and Four.

CI2 was established with EUR160 million funding from the Dutch Fund for Climate and Development by a consortium comprised of Dutch development bank FMO, SNV Netherlands Development Organisation and the World Wide Fund for Nature. CI2 will focus on themes such as: i) municipal and industrial water and wastewater supply; ii) desalination; iii) bulk water supply; iv) waste and wastewater to energy; and v) riverine and coastal ecosystem management and protection. Projects funded under CI2 have so far been located in Southeast Asia and Africa.

### 1.3.4. Earthshot Prize<sup>119</sup>

The Earthshot Prize was set up by the Royal Foundation of the Duke and Duchess of Cambridge and is supported by its Global Alliance<sup>120</sup>. Its goal is to provide solutions to the world's greatest problem. These Earthshots are simple but ambitious goals for the planet and are identified as: i) protecting and restoring nature; ii) cleaning the air; iii) reviving the oceans; iv) building a waste-free world; and v) fixing the climate. It is designed to incentivise change and contribute to 'repairing' the planet. The Prizes of GBP1 million will be awarded to five winners per year between 2021 and 2030 and is accessible to governments, cities, small and large businesses, as well as scientists, individual people and teams.

### 1.3.5. EIT Climate-KIC

EIT Climate-KIC is an international climate-focused accelerator that grew out of supporting European based start-ups. It defines itself as a knowledge and innovation community (KIC) and is working to accelerate the transition to a low-carbon, climate-resilient world. It is supported by the European Institute of Innovation and Technology to identify and support innovation that contributes to CCA and CCM. EIT Climate-KIC is a partnership of stakeholders from the private sector, academia, the public sector and non-profit organisations to create networks through which innovative solution to climate change can be developed and scaled-up for greater impact. EIT Climate-KIC is working along four areas of focus, consistent with the SDGs. These are: i) urban transitions, such as promoting decentralised energy and creating green and resilient cities; ii) sustainable land use, such as making agriculture climate-smart and resilient and transforming food systems; iii) sustainable production systems, such as recasting materials production and stimulating regional economies; and iv) decision metric and finance, such mainstreaming climate in financial markets and democratising climate risk information.

This KIC has attracted investments of up to EUR550 million for start-ups and leveraged EUR2.5 billion in climate funding. Accelerator, EIT Climate-KIC's incubator programme, provides funding and support to innovative start-ups and SMEs. Several entrepreneurship, research and innovation, and education programmes are also offered.

<sup>118</sup> <https://climatefundmanagers.com>

<sup>119</sup> <https://earthshotprize.org/>

<sup>120</sup> Global Alliance Partners are non-profit and international organisation committed to the environment and sustainable development, such as C40 Cities, Conservation International, Greenpeace, UNEP, WWF and Bloomberg Philanthropies.

### 1.3.6. Global Adaptation and Resilience Investment Working Group<sup>121</sup>

The Global Adaptation and Resilience Investment Working Group (GARI) is a group of over 300 private investors and other public and private stakeholders gathering to discuss the impacts and risks of climate change affecting investment portfolios as well as the opportunities for investing in climate adaptation and resilience solutions. Participants include leading pension funds, insurance companies, endowments and foundations, investment advisors and asset managers, family offices, global corporations, engineering consultancies, climate consultants and solutions companies, multilateral development banks, and NGOs. Participants have expressed the need for more data and analytical tools to assess potential climate-related risks and impacts and to incorporate a climate impact lens to investment decision-making.

### 1.3.7. Global Commission on Adaptation<sup>122</sup>

The Global Commission on Adaptation (GCA) is a PPP launched in 2018 by then Secretary General of the United Nations Ban Ki-Moon and established by the WBG and the leaders of 23 convening countries with the goal of accelerating CCA by promoting political awareness of CCA and focusing on concrete solutions. The GCA works as a solutions broker to accelerate action and support for CCA solutions. The GCA works in three pillars of activity: i) programmes and action; ii) knowledge acceleration; and iii) agenda-setting and advocacy, supported by cross-cutting activities. The organisation aims to add value to adaptation programmes and partners by encouraging collaboration between stakeholders to accelerate action, reduce risk and upscale innovative approaches, in addition to accessing finance and support. Current GCA programmes include climate finance, water, infrastructure and NBS, and food security. Some of GCA's more specific areas of focus in these programmes include: i) raising standards for climate-resilient investment; ii) mainstreaming NBS through system-based infrastructure planning; iii) mobilising finance for NBS in climate-resilient infrastructure; and iv) developing private sector value chains.

In January 2021, GCA announced a joint initiative with the African Development Bank to mobilise USD25 billion between 2020–2025 to scale up and accelerate CCA action across Africa. The Africa Adaptation Acceleration Program (AAP) aims to galvanise climate resilience actions, support countries scale up CCA and mobilise financing at scale for CCA in Africa. The programme will focus on agriculture, infrastructure, youth and innovative finance.

### 1.3.8. Global Innovation Lab for Climate Finance<sup>123</sup>

The Global Innovation Lab for Climate Finance was developed in 2014 by the UK, USA, and Germany in partnership with several climate finance donor governments — such as Denmark, France, Japan, the Netherlands, Norway — DFIs and key private sector actors to identify and develop innovative instruments that could drive private investments for CCA and CCM in development countries. Since its establishment, the Lab has mobilised over USD2 billion to address climate change. This public-private initiative aims to fast-track the development of innovative ideas for on-the-ground implementation by identifying, developing and piloting transformative climate finance instruments. The Lab mobilised USD2.3 billion to date in sustainable investment, through public-private collaboration, innovative and transformative solutions and catalytic finance.

The Lab operates worldwide but focuses on developing regions (such as in Africa, LAC and Asia) offering concessional or market-rate loans. For its 2021 cycle, there is a special call for projects focusing on: i) CCA and CCM; ii) sustainable energy access; and iii) sustainable cities. Past projects have focused on agriculture and livestock, from climate-smart agriculture to crop insurance and supply chains, as well as financial services, forestry, water and urban development. Successful projects will be selected based on criteria such as their potential to be actionable, innovative, catalytic and financially sustainable. These can be submitted by private and public organisations, as well as civil society.

<sup>121</sup> <https://garigroup.com/>

<sup>122</sup> <https://gca.org/>

<sup>123</sup> [www.climatefinancelab.org](http://www.climatefinancelab.org)



### 1.3.9. Global Resilience Partnership<sup>124</sup>

The Global Resilience Partnership (GRP) is a public-private initiative, notably established by the Rockefeller Foundation, USAID and the Swedish International Development Cooperation Agency. GRP has received contributions of USD160 million which it has committed to fostering resilience at large scale and transforming development assistance. GRP mostly focuses on strengthening resilience in Africa, in regions such as the Sahel and the Horn of Africa, as well as in South and Southeast Asia. GRP is committed to using innovative methods and solutions to build climatic resilience from traditional and new innovators. It is organised across the following four interrelated value additions:

1. Innovation and scalability. In order to test and scale disruptive ideas, GRP identifies and incubates new ideas by designing and running innovation challenges and supporting peer-to-peer learning on innovation.
2. Sharing and learning. GRP gathers, analyses and disseminates learning, best practices, experiences and evidence on resilience to accelerate learning across stakeholders and geographies.
3. Convening diverse voices. GRP works with a diverse body of organisation to raise the ambition on resilience and increase investments where they are most needed.
4. Advancing knowledge. GRP collaborates with its partners to advance knowledge and insights on resilience.

Innovation challenges organised by GRP include the: i) Global Resilience Challenge, which offered 10 projects up to USD1 million from USAID to implement and scale-up their solutions; ii) Water Window Challenge, backed by USD10 million in grants for innovative solutions to flood-related issues; and iii) GRP Innovation Challenge, in which 16 winners received mentorship support, technical advice and media coverage support for their innovative solutions to build resilience at the intersections between peace and stability, food and water security and disaster resilience.

### 1.3.10. The Lightsmith Group<sup>125</sup>

The Lightsmith Group is a private equity firm pursuing superior financial returns along with measurable social and environmental impacts by investing in companies that address major societal needs. Lightsmith partners with growth-stage companies and helps the companies scale their solutions globally. Lightsmith has previously received funding from NDF and GEF for the development of a climate resilient investment strategy.

The Adaptation SME Accelerator Project (ASAP) is a grant-funded initiative led by Lightsmith and supported by GEF, Conservation International and IDB that aims to enhance the availability and uptake of climate adaptation solutions by identifying, engaging and empowering SMEs providing these solutions in developing countries, seeking to build an ecosystem for small- to medium-sized companies in emerging markets that provide innovative technologies, products and services for CCA. ASAP focuses on developing countries across LAC, Africa and Asia.

The program includes: i) the identification of adaptation SMEs around the world operating in various sectors — such as food and agriculture, analytics and risk modelling, water, insurance and risk transfer, energy, transportation and infrastructure — to be aggregated into a publicly searchable database; ii) the development of a definition and eligibility criteria to define which types of products and services are considered climate resilience and adaptation solutions; and iii) a series of virtual convenings for Adaptation SMEs and other stakeholders, and partnerships with existing incubator and accelerator programs to develop adaptation-, resilience- and social impact-focused curriculum for Adaptation SMEs.

- **The Climate Resilience and Adaptation Finance and Technology Transfer Facility (2018–2019)**

CRAFT is the first private sector climate resilience and adaptation fund for developing countries. CRAFT focuses

<sup>124</sup> <https://www.globalresiliencepartnership.org/>

<sup>125</sup> <https://lightsmithgp.com/>



on expanding the availability of technologies and solutions for CCA and resilience. It is funded by GEF and NDF and implemented by CI, with execution support from the Lightsmith Group. As a growth equity fund, CRAFT will invest in 10–20 companies, located in both developed and developing countries, which have proven technologies and solutions for climate resilience and have demonstrated market demand and revenue. The Fund, together with an accompanying Technical Assistance Facility, helps companies — like weather analytics, catastrophe risk modelling services and drought resilient seed companies, among others — expand into new sectors and geographic markets.

CRAFT will target companies in countries already experiencing substantial economic losses from climate change. The intentional inclusion of technology transfer from developed to developing countries into the fund will help build capacity in developing countries. As demand builds, investee companies can also begin to expand into lower income countries.

For every one dollar of concessional financing and technical assistance grants, CRAFT will leverage an estimated 3.3 dollars of direct commercial investment to enhance the resilience of communities, businesses, and critical infrastructure. By making the business case for investment in climate resilience, the Fund will also help catalyse a global market for climate resilient products and services; promote climate resilient development; and contribute to rapidly evolving resilience standards and metrics.

The fund combines a standard growth equity investment fund structure with technical assistance to enable the deployment of climate resilience services and technologies in developing countries. The design includes the following:

- 1) Two legally and financially separate sleeves for developed and developing country investments. These enable a separation of risk profiles. While both sleeves target USD250 million each in total funding commitments, the developing country sleeve will target USD150 million of commercial funding and USD100 million of concessional funding to de-risk investments.
- 2) Technical support to help resilience companies expand in developing country markets.
- 3) A waterfall structure de-risks private investment, enabling 20-25% gross returns for commercial investors, in line with expectations for growth equity.

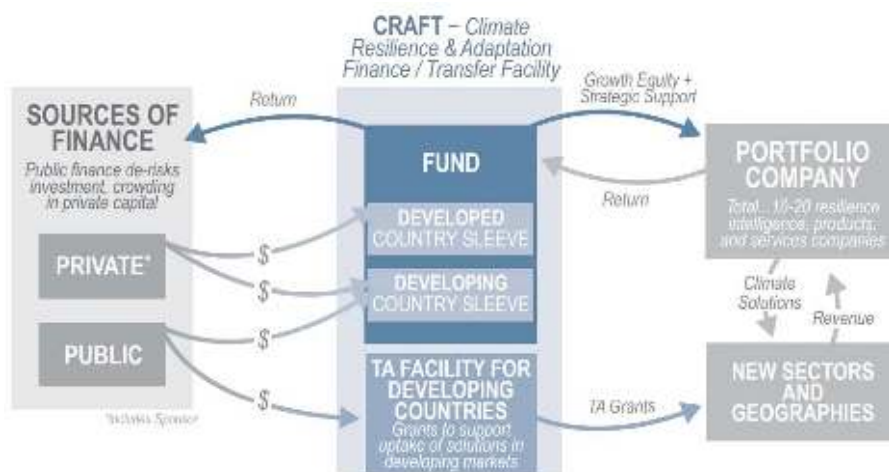


Figure 8. CRAFT model<sup>126</sup>.

<sup>126</sup> [https://www.climatefinancelab.org/wp-content/uploads/2017/04/170831\\_CRAFT.pdf](https://www.climatefinancelab.org/wp-content/uploads/2017/04/170831_CRAFT.pdf)

## Annex 2: Pipeline analysis of climate change adaptation projects

The following section includes a pipeline analysis of best-practice examples of climate change adaptation projects which align with four key themes: i) Adaptation Innovation and Technology Transfer (Theme 1); ii) Climate-proofing Infrastructure (Theme 2); iii) Cross-cutting projects involving energy and adaptation (Theme 3); and iv) Value Chains for Agriculture (Theme 4). As described in Section 1, these themes were chosen to group the expertise of the CTI, ESI and ETI divisions. The identified projects have been implemented in a range of different regions and countries globally and utilise a variety of different measures to drive greater climate change resilience among project beneficiaries. The project objective, key issues to be addressed, innovative elements of the project design and key lessons learned (as applicable) have been summarised below for projects under each of the four themes.

**Table 5.** Project Pipeline Review Summary Per EAE/ENE Division Themes.

Project	Implementing Agency	Funding Agency	Theme 1: Adaptation innovation and technology transfer	Theme 2: Climate-proofing infrastructure	Theme 3: Cross-cutting projects involving adaptation and energy	Theme 4: Value chains for agriculture
Climate technology transfer mechanisms and networks in Latin America and the Caribbean	Inter-American Development Bank (IDB); Instituto Nacional de Ecología y Cambio Climático (INECC); Fundación Bariloche (Bariloche); World Resources Institute (WRI); Centro Agronómico Tropical de Investigación y Enseñanza (CATIE)	Green Environmental Facility (GEF)	X			
Strengthening the resilience of smallholder farmers in the Dry Zone to climate variability and extreme events through an integrated approach to water management	Ministry of Mahaweli Development and Environment	Green Climate Fund (GCF)	X			
Resilience to hurricanes in the building sector in Antigua and Barbuda	Antigua and Barbuda Department of Environment	GCF		X		
Climate-Resilient Infrastructure Mainstreaming (CRIM) in Bangladesh	Kreditanstalt für Wiederaufbau (KfW)	GCF		X		
Enhancing the	United Nations	Adaptation Fund		X		

resilience inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Viet Nam	Human Settlements Programme (UN-Habitat)	(AF)				
Promoting Climate Resilience in the Cocoa and Rice Sectors as Adaptation Strategy in Sierra Leone	International Fund for Agricultural Development (IFAD)	AF	X	X		X
Climate change adaptation in vulnerable coastal cities and ecosystems of the Uruguay River	CAF — Development Bank of Latin America	AF		X		
Support energy for cooking and restoration of the environment in four refugee camps	UN High Commissioner for Refugees (UNHCR)	African Development Bank (AfDB)			X	
Niger Green Mini-Grid Country Programme	Niger Ministry of Energy and Petroleum	AfDB			X	
GEF Climate-Resilient Livestock Management Project (Zambia)	African Development Bank	GEF		X		X
Promotion of Sustainable Charcoal in Angola through a Value Chain Approach	UNDP	GEF	X			X
Promoting a Value Chain Approach to Climate Change in Agriculture (Ghana)	IFAD	GEF	X			X

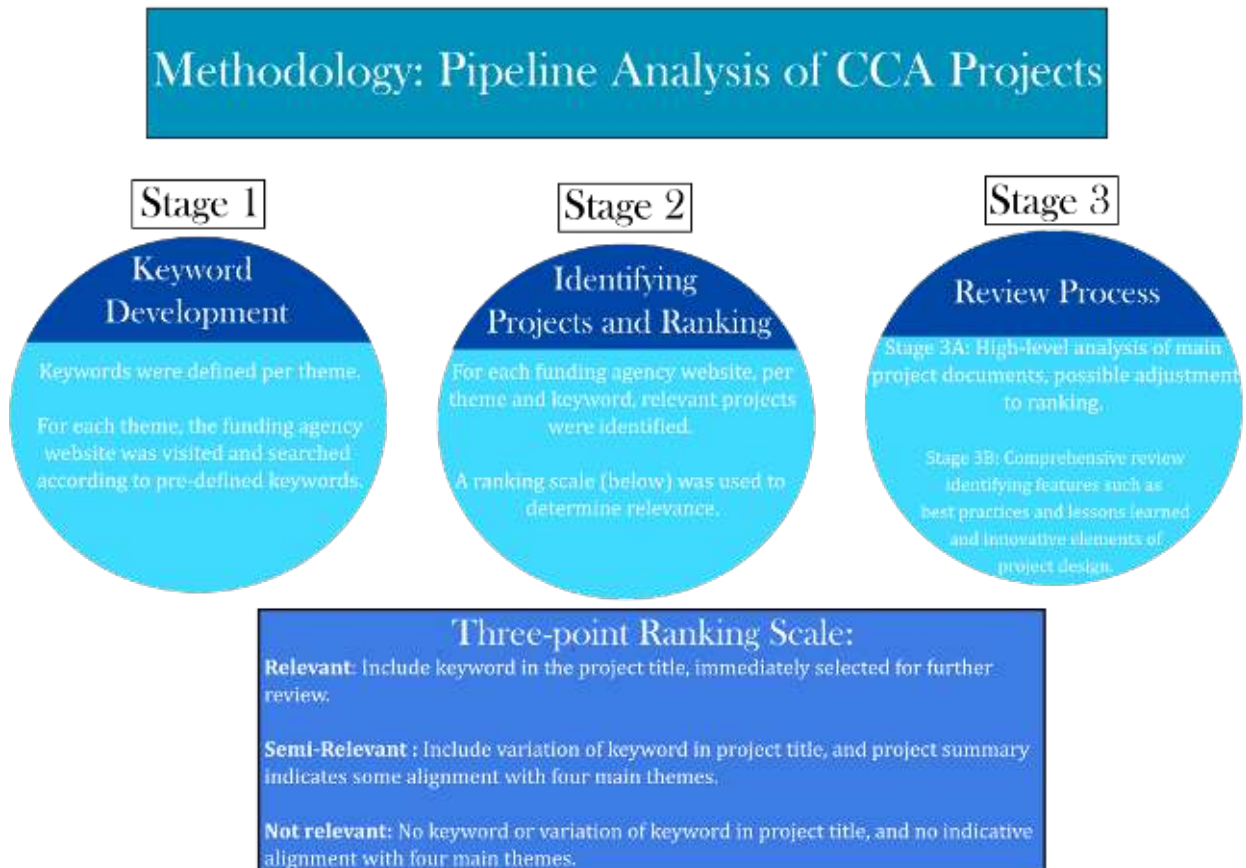
## 2.1. Methodology

The following sub-sections outline a pipeline of climate change adaptation projects, categorised under four themes of: i) Adaptation Innovation and Technology Transfer; ii) Climate-proofing infrastructure; iii) Cross-cutting projects involving adaptation and energy; and iv) Value chains for agriculture. The pipeline was developed using a three-stage methodology, which entailed keyword development (Stage 1), project identification and ranking (Stage 2) and undertaking a review of identified projects (Stage 3).

Stage 1: Keyword development. Projects were identified according to theme, and subsequently according to funding agency. For each theme, the website of a funding agency was visited, and their project database was searched according to keywords. The keywords used for each theme are as follows:

- Theme 1: 'technology transfer'
- Theme 2: 'climate-proof infrastructure'; 'infrastructure development'; 'infrastructure'
- Theme 3: 'cross-cutting'; 'energy adaptation'

- Theme 4: 'agricultural value chains'; 'value chain';



**Figure 9.** Project Pipeline Review Methodology.

The funding agencies reviewed include the: i) Green Climate Fund (GCF); ii) Green Environmental Facility (GEF); the iii) Adaptation Fund (AF); and the African Development Bank (AfDB). Potential collaboration partners were identified according to equivalent work in the themes supported by UNIDO ETI, ESI and CTI divisions.

Stage 2: Identifying projects and ranking. For every funding agency website visited, per theme, the results of a keyword-based search were reviewed, and relevant projects were identified. Project relevance was determined on the basis of a three-point ranking scale: not relevant, semi-relevant, and relevant. Projects with keywords in their project title were ranked as relevant and were immediately selected for further review. Semi-relevant projects were those which included a variation of the keyword in their title. The project summary provided on most funding agency websites would be briefly reviewed, and if it were determined that the project entailed some components which aligned with one or more of the four themes, the project would be selected for further review. Finally, projects that were listed in the keyword search results which contained no keywords or variations of keywords in their title, and did not appear to include any components which aligned with the four themes, were ranked as not relevant. Once the results of the keyword search for a project/programme had been reviewed and classified according to the ranking system, the next funding agency website would be reviewed and the same search process would be applied, using only the keyword relevant to the current theme.

Stage 3: Review Process. This stage encompasses two sub-stages, Stage 3a and Stage 3b, which have been applied to each project in the pipeline. This Stage was separated into two sub-stages in order to streamline the process of identifying projects to be included in the pipeline. In Stage 3a, all available project documents would be downloaded, and a high-level analysis of the main project document would be undertaken,

beginning with an assessment of project components and outputs. During this review, the ranking of a project was sometimes adjusted upward or downward if it was determined that the initial assessment of project relevancy to a theme(s) undertaken in Stage 2 was incorrect. The possible ranking adjustments were as follows: from relevant to semi-relevant (downward adjustment), from semi-relevant to not relevant (downward adjustment) or from semi-relevant to relevant (upward adjustment). Changes to rankings were based on whether components, and outputs within components, were deemed more or less well-aligned with a theme(s). Projects ranked as ‘relevant’ would be assessed first in Stage 3b, and ‘semi-relevant’ projects would be assessed last, to optimise the use of time dedicated to project pipeline development.

Once it had been determined that the project was relevant to one or more themes and the ranking had been finalised, Stage 3b would begin. Stage 3b included a more comprehensive review of each project, in order to identify the: i) objective; ii) strategy; iii) key issues to be addressed; iv) project components; v) innovative elements of the project design; and vi) best practices and lessons learned. In the following sub-sections, each of these six elements has been included in the project overviews. Once each of the six aforementioned elements had been identified for a project, this would conclude the review of Stage 3b, and a new project would be selected. Identified projects often aligned with multiple themes, with one theme being the priority focus area of the project and the other additional themes being addressed at a smaller scale. For example, the ‘Promoting Climate Resilience in the Cocoa and Rice Sectors as Adaptation Strategy in Sierra Leone’ project prioritises climate-proofing infrastructure (Theme 2), but also includes elements of strengthening value chains for agriculture (Theme 4) and adaptation innovation and technology transfer (Theme 1). In these cases, the ‘relevant theme’ which the project would be categorised under was determined based identifying which component had the most funding allocated to it.

## 2.2. Theme 1: Adaptation Innovation and Technology Transfer<sup>127</sup>

The following project demonstrates Theme 1: Adaptation Innovation and Technology Transfer.

Project Title	Climate technology transfer mechanisms and networks in Latin America and the Caribbean
Implementing Agency	Instituto Nacional de Ecología y Cambio Climático (INECC); Fundación Bariloche (Bariloche); World Resources Institute (WRI); Centro Agronómico Tropical de Investigación y Enseñanza (CATIE); Inter-American Development Bank (IDB)
Project Budget	USD 67.4 million (USD 10.9 million grant and USD 56.5 co-finance)
Funding Agency	GEF
Period	2014-2017
Location	Regional

**Objective:** To reduce greenhouse gas (GHG) emissions and enhance resilience to climate change in Latin America and the Caribbean (LAC) through the transfer of ‘environmentally sound technologies’<sup>128</sup> (EST).

**Strategy:** This will be achieved through piloting institutional frameworks which target: i) enhancing regional collaboration; ii) supporting policymaking processes at national and sectoral levels; iii) demonstrating successful policies and enabling strategies; and iv) mobilising financial and human resources. Priority sectors include renewable energy, energy efficiency, transportation, forestry and agriculture.

<sup>127</sup> UNIDO has initiated several projects involving technology transfer, including: i) Reducing vulnerability and increasing resilience to climate change through promoting innovation, transfer and large-scale deployment of adaptation-oriented technologies in priority agriculture value-chains and creating jobs (GEF); ii) Climate Change Related Technology Transfer for Cambodia: Using Agricultural Residue Biomass for Sustainable Energy Solutions

<sup>128</sup> Defined as ‘technologies that can reduce GHG emissions and/or reduce the vulnerability to climate change, while contributing to sustainable development objectives’.

**Key issues to be addressed** include a set of four interlinked barriers, outlined below.

- Policy and regulatory barriers, including ineffective enforcement of policy and regulations.
- Financial and economic barriers, including limited availability of financial resources and incentives for the adoption of EST, the absence of adequate risk management frameworks and a lack of experience with EST-specific business models.
- Technical and capacity barriers, including limited technical skills and experience and the absence of maintenance and technical support.
- Information and awareness barriers, including inadequate understanding of the cost, performance and market opportunities for EST, which is compounded by incomplete and outdated information on EST options.

**Project Components:** There are four interlinked project components which aim to address each of the four barriers identified above.

- Component 1: Development of national policy and institutional capacities
- Component 2: Strengthen technology networks and centres
- Component 3: Pilot technology transfer mechanisms
- Component 4: Leverage private and public investments

### **Innovative approaches of the project design**

The project focuses on the creation of an enabling environment to facilitate technology transfer, preserving country ownership over the project and ensuring that participants are empowered to engage in EST transfer over the long-term. Specific innovative approaches include the following elements.

- The development of four regional EST networks in Component 2, which will promote of regional partnerships and collaboration. Encouraging regional collaboration will improve the ease and rate of technology transfer, as well as promote the transfer of contextually appropriate technologies which have been successfully tested in neighbouring countries with similar environmental and economic characteristics.
- The use of technology roadmaps under Component 3, combined with an assessment of existing technical standards and regulations to identify any potential gaps and maximise the effectiveness of pilot EST transfer schemes, as well as to ensure that each transfer scheme is responsive to the local meaning-giving context.

<b>Project Title</b>	Strengthening the resilience of smallholder farmers in the Dry Zone to climate variability and extreme events through an integrated approach to water management
<b>Implementing Agency</b>	Ministry of Mahaweli Development and Environment
<b>Project Budget</b>	USD (USD million grant and USD co-finance)
<b>Funding Agency</b>	GCF
<b>Period</b>	2016–2023
<b>Location</b>	Sri Lanka
<b>Beneficiaries</b>	~770,500 direct, ~1,179,800 indirect

**Objective:** To ‘strengthen the resilience of smallholder farmers, particularly women, in the Dry Zone through improved water management to enhance lives and livelihoods’<sup>129</sup>.

**Strategy:** To introduce a holistic approach to water security which relies on increasing the resilience of current village irrigation systems to flooding, as well as enhancing the capacity of storage facilities to secure water availability during the dry season. This approach will be combined with the provision of training on climate-resilient agricultural practices and the introduction of household-level water harvesting technology.

<sup>129</sup> GCF. 2016. FP016: Strengthening the resilience of smallholder farmers in the Dry Zone to climate variability and extreme events through an integrated approach to water management.



**Key issues to be addressed** include water availability within the Dry Zone. Smallholder farmers in the Dry Zone rely on traditional village irrigation systems<sup>130</sup> developed over several generations to maintain consistent water supply in a context of high rainfall variability. In recent years, human- and climate-induced drivers have negatively impacted the ability of these systems to maintain an adequate level of water supply, undermining water availability in affected areas. Climate-induced drivers include: i) an increased frequency of high-intensity rainfall events which result in siltation of storage reservoirs and reduced carrying capacity; and ii) a rise in average annual temperatures and extended dry periods, which heighten the rate of evaporation.

#### Project Components:

- Output 1: Upgrading and enhancing resilience of village irrigation systems and scaling up climate-resilient farming practices in three river basins of the Dry Zone
- Output 2: Enhancing climate-resilient, decentralized water management solutions to provide safe year-round drinking water to drought vulnerable communities
- Output 3: Strengthening climate and hydrological observing and forecasting systems to enhance water management and adaptive capacity of smallholder farmers to droughts and floods

**Innovative approaches of the project design** include the climate-proofing of existing water storage and distribution systems, rather than the construction of new systems. This approach allows for the application of evidence-based approaches to upgrade the systems, while still utilising the indigenous knowledge that has informed the initial design of these systems and allowed it to function effectively in the unique context of the Dry Zone.

### 2.3. Theme 2: Climate-proofing Infrastructure

Five projects were identified under Theme 2: Climate-proofing Infrastructure, from five regions including the Caribbean, Bangladesh, Viet Nam, Sierra Leone, and Uruguay. Each of the following projects include climate-proofing measures which are responsive to the unique contexts for which they are designed. A common theme is the inclusion of an activity targeting institutional and/or capacity strengthening deemed necessary to create an enabling environment. This is in line with investment criteria from most funding agencies – such as the GCF – which require scalability, replicability and sustainability of project interventions.

Project Title	Resilience to hurricanes in the building sector in Antigua and Barbuda
Implementing Agency	Antigua and Barbuda Department of Environment
Project Budget	USD 46.1 million
Funding Agency	GCF
Period	2020–2026
Location	Antigua and Barbuda
Beneficiaries	Approx. 73,000 beneficiaries

**Objective:** ‘to enhance the resilience of Antigua and Barbuda’s building sector to extreme climate events such as hurricanes and tropical storms. The proposed transformative approach will shift the country’s building sector away from reactive development — involving costly recovery actions after an extreme climate event — towards a proactive approach in which buildings are adapted to withstand the increased frequency of high-intensity hurricanes.

**Strategy:** This project will enhance the climate-resilience of Antigua and Barbuda’s building sector through several complementary interventions: i) climate-proofing existing critical public buildings; ii) mainstreaming climate change into the legislative and policy framework for the building sector; and iii) strengthening climate information services and early warning systems. These are elaborated on in the following paragraphs.

<sup>130</sup> These systems are generally composed of storage reservoirs and water diversion systems to direct water flow to farming areas downstream.



**Key issues to be addressed** include the climate impact of an increased frequency in the incidence of high-intensity hurricanes<sup>131</sup>. For example, eight of the 11 high-intensity hurricanes recorded since 1850 occurring in the last 15 years<sup>132</sup>, and these trends are projected to continue under both the RCP4.5 and RCP 8.5 scenarios. Given the historic baseline of a limited number of these hurricanes, buildings in Antigua and Barbuda — including critical infrastructure such as hospitals and fire stations — are not equipped to withstand above a Category 3 hurricane. Resultantly, when Hurricane Irma — a 1-in-100-year Category 5 hurricane — made landfall on Barbuda in September 2017, approximately 95% of the infrastructure on the island was destroyed, including transportation infrastructure, the electricity generation and distribution network and water and sanitation facilities. The total damages of Hurricane Irma and Hurricane Maria — a second category 5 hurricane which impacted the SIDS two weeks later — was estimated to be USD136.1 million, while total recovery needs equated to USD222.2 million<sup>133</sup>.

#### **Project Components:**

- Output 1: Climate-proofing interventions implemented in critical public service and community buildings to improve resilience to, and recovery from, extreme climate events
- Output 2: Climate change adaptation mainstreamed into the building sector and relevant financial institutions
- Output 3: Climate information services strengthened to facilitate early action within the building sector to respond to extreme climate events

#### **Innovative approaches of the project design**

First, 54 priority public buildings — including police and fire stations, as well as public health infrastructure such as clinics and hospitals — will be climate-proofed in order to withstand Category 4 and Category 5 hurricanes. Specific interventions include: i) structural strengthening using hurricane shutters and hurricane straps to protect roofs; ii) decentralising power and water supplies to priority buildings through installing small-scale renewable energy systems with hurricane-proof clamps, providing battery packs that retain 24–48 hours of electricity, and fitting targeted buildings with climate-resilient rainwater harvesting solutions; and iii) flood risk mitigation through the construction of drainage gutters at 14 target sites to ensure that water from heavy rainfall events is effectively channelled into the existing drainage system. These interventions were developed based on best practices from the State of Florida technical protocols — considered the most advanced in the world — combined with site assessments to ensure interventions were responsive to site-specific requirements<sup>134</sup>.

Second, climate change considerations will be mainstreamed into existing legislative and policy frameworks for the building sector, which will be supported by technical capacity-building for public sector stakeholders and an awareness-raising campaign targeting the public and private sector with information on the benefits of adopting these climate adaptation measures. In particular, regulations will be developed for the Physical Planning Act (2003) to update the building code in line with the Florida Building Code, which includes provisions for Category 4 and 5 hurricanes. This will help ensure all new buildings will be able to withstand these high-intensity hurricanes, and past evidence has shown that these building standards have reduced hurricane-induced damage by ~72%<sup>135</sup>.

<sup>131</sup> High intensity hurricanes refer to those tropical cyclones which are ranked a Category 4 or Category 5 on the Saffir-Simpson scale.

<sup>132</sup> Antigua and Barbuda Meteorological Services. Antigua Tropical Cyclones 1851–2018. Available at:

[http://www.antiguamet.com/Climate/HURRICANE\\_SEASONS/AntiguanStorms.txt](http://www.antiguamet.com/Climate/HURRICANE_SEASONS/AntiguanStorms.txt)

<sup>133</sup> In this context, ‘damage’ refers to affected physical assets that may have been either damaged or destroyed, while ‘recovery needs’ include the cost of: i) reconstructing damaged physical infrastructure and physical assets; ii) resuming production, service delivery and access to goods and services; iii) restoring governance and institutional decision-making processes; and iv) reduction of risks. From: Government of Antigua and Barbuda (GoAB). 2018. *Hurricane Irma Recovery Needs Assessment: A Report by the Government of Antigua and Barbuda*. [online] Available: [https://www.gfdrr.org/sites/default/files/publication/Antigua%20and%20Barbuda%20executive%20summary\\_print\\_text%282%29.pdf](https://www.gfdrr.org/sites/default/files/publication/Antigua%20and%20Barbuda%20executive%20summary_print_text%282%29.pdf)

<sup>134</sup> GCF. 2020. FP133: Resilience to hurricanes in the building sector in Antigua and Barbuda. [online] Available:

<https://www.greenclimate.fund/document/resilience-hurricanes-building-sector-antigua-and-barbuda>

<sup>135</sup> Simmons, K. M., Czajkowski, J., and Done, J. M. 2018. Economic effectiveness of implementing a state-wide building code: the case of Florida. *Land Economics*, 94(2)

Finally, the climate information and early warning systems of Antigua and Barbuda will be strengthened through establishing a centralised online server to be housed within the Antigua and Barbuda Meteorological Services (ABMS) that will allow for real-time climate data generation, thereby improving the ability of the ABMS to reliably and timeously forecast extreme climate events. This activity will be strengthened by the establishment of communication and early action protocols between the ABMS and relevant government agencies to ensure effective and rapid information sharing and responses preceding an extreme climate event, such as a high-intensity hurricane.

Project Title	Climate-Resilient Infrastructure Mainstreaming (CRIM) in Bangladesh
Implementing Agency	Kreditanstalt für Wiederaufbau (KfW)
Project Budget	USD 55 million
Funding Agency	GCF
Period	2015–2021
Location	Bangladesh
Beneficiaries	134,000 direct and 10.4 million indirect

**Objective:** To improve the resilience of the most vulnerable people and communities, as well as infrastructure and the built environment, to the impacts of climate change.

**Strategy:** Climate change adaptation will be integrated into the decision-making processes on infrastructure, operation and maintenance at the local government level, and climate resilient infrastructure projects will be piloted in vulnerable districts to demonstrate their effectiveness.

#### Key Issues to be Addressed:

As a result of several baseline conditions, Bangladesh is extremely vulnerable to climate change, with the most notable climate changes projected to include an increase in the frequency and intensity of extreme climate events, including cyclones, floods and heat waves. These climate impacts are already generating annual damages equivalent per ~1% of national GDP. In this context, the two main issues the CRIM project will address are: i) the infrastructure gap in the districts of Bhola, Barguna and Satkhira, particularly regarding the lack of cyclone shelter coverage; and ii) the upgrading of existing infrastructure to withstand projected climate changes.

Climate impacts on infrastructure include: i) the overloading of urban drainage systems and increased stress on roads as a result of extended heat waves and high levels of precipitation; ii) degradation of bridge supports and road bases as a result of an increased frequency and intensity of floods and storm surges; iii) declining structural integrity of buildings caused by higher wind speeds associated with more intense tropical storms and cyclones<sup>136</sup>.

#### Project Components

- Component 1: Institutional Development, including establishing a dedicated think tank and knowledge hub w/in LGED to facilitate mainstreaming of climate change into their operations
- Component 2: Pilot Climate Resilient Rural Infrastructure, focussing on climate-proofing the existing road network including bridges and culverts, as well as maintaining and constructing Multipurpose Cyclone Shelters
- Component 3: Pilot Climate Resilient Urban Infrastructure, focussing on water and sanitation (including maintaining city drainage networks), flood mitigation and transport – priority is the improved adaptive capacity of the most vulnerable people living in slum areas
- Component 4: Project Management

<sup>136</sup> GCF. 2015. FP004: Climate-Resilient Infrastructure Mainstreaming in Bangladesh. [online] Available: <https://www.greenclimate.fund/sites/default/files/document/funding-proposal-fp004-kfw-bangladesh.pdf>

### Innovative approaches of the project design

Innovative elements of the project included mainstreaming of climate change adaptation into infrastructure planning supported through the establishment of a dedicated knowledge management institution, the Climate Resilience Local Infrastructure Centre (CRELIC).

Project Title	Enhancing the resilience inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Viet Nam
Implementing Agency	United Nations Human Settlements Programme (UN-Habitat)
Project Budget	USD6.3 million
Funding Agency	Adaptation Fund
Period	2020–2023
Location	Coastal regions of the Mekong Delta
Beneficiaries	Approx. 29,000

**Objective:** ‘To enhance the resilience, inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Viet Nam’.

**Strategy:** To use a combination of hard and soft interventions in vulnerable human settlements designed to increase the adaptive capacity and resilience to climate change among project beneficiaries.

**Key issues to be addressed** by this project are drought, saltwater intrusion and coastal erosion in the Mekong Delta as a result of sea-level rise (SLR), which — combined with declining surface and groundwater caused by increased demand for water — is undermining water availability for domestic, agricultural and industrial use within this region. These issues are exacerbated by inadequate water resource management in the Mekong Delta region, and existing management systems regulating the utilisation and protection of water resources are fragmented and poorly coordinated.

Given this regions importance as the largest producer of agricultural and aquacultural products in Viet Nam, with a labour force of ~10.3 million people and an annual contribution to 13% of the national GDP for the fishery industry, implementing climate change adaptation interventions will be necessary to preserve the livelihoods of these vulnerable communities over the long term, as well as ensuring national food security can be maintained.

#### Project Components

- Component 1: Institutional and community capacity building toward eco-human settlement development for supporting enhance local climate response actions
- Component 2: Action plan and strategy development for eco-human settlement, and integrating into planning and policy with participatory approach
- Component 3: Sustainability built through small-scale protective infrastructure
- Component 4: Awareness Raising and Knowledge Management

Relating to Component 3 which directly concerns infrastructure development, specific climate-proofing interventions include the: i) implementation of water treatment and rainwater harvesting systems to prevent saltwater intrusion (related to SLR) and protect groundwater; and ii) use of Elastocoast as a green erosion rehabilitation and control system to prevent coastal erosion.

**Innovative approaches of the project design** include the use of context-specific solutions for each project site, the blending of hard and soft interventions, a strong participatory element in project design, and the use of innovative adaptation technologies such as Elastocoast.

The project design was both context-specific and participatory, achieved through ensuring alignment with UN-Habitat's P4CC value system<sup>120</sup> in the project design. This ensures that stakeholders, specifically community

beneficiaries, can meaningfully participate in all stages of the project including training, planning, implementation and monitoring and evaluation. The result of this is a project design which is ultimately more responsive to the local context, with a higher chance of success and long-term sustainability.

The project document notes that a great deal of climate change-induced environmental degradation had already occurred in the project region, necessitating the use of both hard and soft interventions. Hard interventions include: i) rainwater harvesting systems and water treatment systems, focussing on increasing the diversity of available water resources and increasing the accessibility of potable water, respectively; and ii) coastal erosion prevention system.

Innovative adaptation technologies were also included in the project design in the form of Elastocoast or porous coast. This technology will be implemented along coastal zones between mangrove trees and the land to protect dikes and mitigate coastal erosion through absorbing the force of breaking waves and reducing the speed of water bodies. Figure 10 below demonstrates the layers of Elastocoast as it would be applied in the nine selected project sites.



Figure 13. Thematic design for the technology implementation

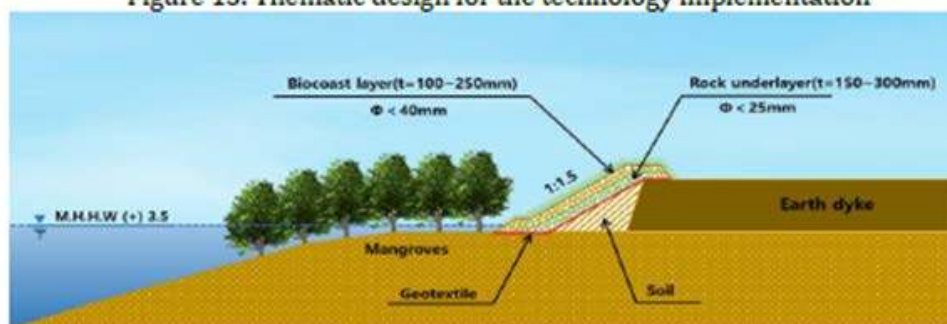


Figure 10. EbA/NBS section design example – Elastocoast.

Project Title	Promoting Climate Resilience in the Cocoa and Rice Sectors as Adaptation Strategy in Sierra Leone
Implementing Agency	International Fund for Agricultural Development (IFAD)
Project Budget	USD9.9 million
Funding Agency	Adaptation Fund
Period	2019–2025
Location	Sierra Leone
Beneficiaries	Direct beneficiaries include 35,000 smallholder farmers, 10,000 rice producers and 5,000 cocoa producers, focussing on women and youth.

**Objective:** ‘To reduce vulnerability and increase adaptive capacity to respond to the impacts of climate change, including variability at local and national levels as well as on natural resources critical for sustaining agricultural production and increasing food security and nutrition of vulnerable poor communities.’

**Strategy:** Targeting climate vulnerabilities in the agriculture sector and water resource management within the rice and cocoa value chain in Sierra Leone, through introducing climate-resilient agricultural practices,

encouraging livelihood diversification, and climate-proofing existing transportation and storage infrastructure.

**Key issues to be addressed** include: i) a declining climate suitability for the production of cocoa – by 2050, climate suitability is projected to decline by 20% and 40% in the southern and north-eastern districts, respectively; ii) a greater incidence of heat waves which undermine the yields of subsistence crops, particularly rice and cassava; iii) a higher frequency of high-intensity precipitation events causing more frequent floods; iv) shifting rainfall patterns characterised by delays in the onset of the wet season; and v) more intense thunderstorms as well as a greater frequency of landslides.

These climate changes are affecting the agricultural sector in particular, which presently contributes to ~59% of Sierra Leone's national GDP and is characterised as a high-risk sector given its exposure to climate change. Projected climate change impacts include a reduction in food security, economic growth, and agricultural livelihoods across Sierra Leone. Resultantly, the impact of climate change on agricultural livelihoods results in a greater incidence of poverty, creating a positive feedback loop in which higher poverty further increases future vulnerability to climate change and further reduces the viability of traditional agricultural livelihoods. This project will target affected smallholder farmers and rural communities which rely on agricultural livelihoods as a source of food security and income generation.

#### **Project Components:**

- Component 1: Climate-proofed agricultural production and post-harvest combined with livelihood diversification
- Component 2: Climate-resilient rural transportation and water infrastructure
- Component 3: Institutional capacity building and policy engagement

#### **Innovative approaches of the project design**

- Component 1: Climate-proofed agricultural production and post-harvest combined with livelihood diversification

This component targets improved climate resilience along the entire cocoa and rice agricultural value chain through two interlinked outputs which will improve climate-proofing production and post-production harvests in the cocoa and rice production chain, as well as introducing alternate agricultural livelihoods to promote livelihood diversification, respectively. Relevant best-practice proposed interventions which will be introduced under Output 1.1 include: i) cropping calendar and climate early warning systems; and ii) energy for production and post-harvest processing, water pumping. This is supported by Output 1.2, which will target the development of aquaculture through constructing earth dams and establishing fish farms. This Output will also support food security through implementing community-owned integrated vegetable farming using climate-resilient agricultural practices.

- Component 2: Climate-resilient rural infrastructure

This includes the rehabilitation and upgrading of rural **transportation** and **storage** infrastructures to withstand extreme climate events. Output 2.1 will target the improvement of transportation and storage infrastructure to withstand extreme weather events, and features context-responsive adaptation solutions including the inclusion of culverts along feeder roads which promote effective drainage of excess runoff and prevent waterlogging of adjacent fields during the wet season. Warehouses will also be targeted to be better able to maintain low humidity levels, which will be increasingly required under future climate change scenarios. Additional infrastructural interventions will include climate-proofing of equipment and processing units, and implementing phytosanitary control in post-harvest storage facilities.

Output 2.2 will increase the availability of potable water and build sanitation infrastructure to respond to current and projected climate change threats. Potential interventions include: i) watershed rehabilitation; ii) water efficiency and management; iii) training and extension; and iv) infrastructure rehabilitation and construction, specifically creating and improving small earth dams, irrigation systems, boreholes, toilets,

sanitation and drainage systems.

Project Title	Climate change adaptation in vulnerable coastal cities and ecosystems of the Uruguay River
Implementing Agency	Inter-American Development Bank
Project Budget	US\$14 million
Funding Agency	Adaptation Fund
Period	2019–2023
Location	Regional: Argentine Republic and the Oriental Republic of Uruguay
Beneficiaries	Approx. 250,000 residents in Uruguay and 410,000 residents in Argentina

**Objective:** ‘To build resilience in the vulnerable coastal cities and ecosystems of the Uruguay river, both in Argentinean and Uruguayan territories, by developing instruments, tools and experiences for adaptation planning and implementation as well as managing climate change and variability impacts and risks’.

**Strategy:** This project included flood management, institutional strengthening (mainstreaming of CC into public policies and planning instruments, introduction of EWS and integrated risk management. The strategy of the project is to increase the resilience of beneficiaries to climate-induced threats using a multi-faceted approach that blends structural and non-structural CCA interventions, including resettlement, re-signification of vacant flood-prone land and green spaces, and technical and financial assistance to mainstream CCA into urban policies and planning processes.

**Key Issues to be Addressed:** Climate change is driving an increased incidence of flooding and extreme precipitation events along the Uruguay River, which is negatively affecting vulnerable communities living in settlements adjacent to the river, in both the Argentine Republic and the Oriental Republic of Uruguay. Climate change impacts include: i) damage to infrastructure, particularly water and sanitation systems, and liquid waste management; ii) greater health risks caused by the increased spread of disease vectors and contamination of potable water; and iii) reduced economic activity in affected areas, specifically primary activities such as agriculture as well as tourism, driving livelihood disruption among affected communities.

Targeted cities, selected based their high vulnerability and exposure to increasing flood risks, have a total of ~660,000 residents, and in certain cities up to 20% of residents reside in high flood risk areas.

### Project Components

- Component 1: Territorial adaptation and flood risk management policies, plans and instruments
- Component 2: Priority measures to increase flood prone cities’ resilience
- Component 3: Priority measures for adaptive conservation of vulnerable coastal ecosystems
- Component 4: Priority measures for increasing social resilience

**Innovative approaches of the project design** include the: i) use of trans-boundary natural resource management; and ii) blending of environmental and social interventions, specifically Component 4 which includes Just Transition elements (promotion of assistance and labour reconversion strategies). Notable Outputs are detailed below.

- Output 8: Sustainable urban and public infrastructure has been implemented promoting climate change adaptation

Focus is on water and sanitation, including potable water supply systems, liquid waste (sewage system) and solid waste management. Activities include: i) flood mitigation through lamination measures (pipes) and redirecting flow; ii) protecting against coastal erosion through use of gabions and mattresses to support the concrete wall built along the Uruguay river; and iii) refurbishing access bridge.

- Output 9: Solutions have been defined and financial instruments have been implemented to promote CCA in medium-risk housing and commercial buildings in medium-risk areas



Activities include implementing financial instruments to adapt houses and commercial buildings with medium flood-risk, through the establishment of a revolving fund. Measures that will receive funding include the construction of entrance steps, flood locks on doors and waterproofing walls; upgrading structures to withstand pressure and under-pressure produced by water; ensuring floors of dwelling are above street level; flood-proofing the electrical wiring situation; and refurbishing and/or repairing homes after extreme events.

#### 2.4. Theme 3: Cross-cutting projects involving energy and adaptation

Project Title	Support energy for cooking and restoration of the environment in four refugee camps
Implementing Agency	UNHCR
Project Budget	USD 1,000,000
Funding Agency	AfDB
Period	2018–2020
Location	Burundi
Beneficiaries	43,296 refugees (approx. 50% women)

**Objective:** ‘To improve resilience and contribute to the economic stability and self-sufficiency of refugees, host populations and vulnerable Burundian returnees across Burundi in the areas where the refugee camps are located’.

**Strategy:** To improve the resilience of beneficiaries through providing the identified vulnerable groups — refugees, host populations and vulnerable Burundian returnees — with access to alternative energy for cooking.

**Key Issues to be Addressed** include increasing deforestation as a result of fuelwood collection near refugee camps, and the associated gender-based violence faced by women who are often responsible for this household task. The lack of energy security amongst both refugee camps and adjacent villages has not only exposed women and children to increasing risks of violence, but also created tension between refugees and host communities.

##### Project Components:

- Component 1: Access to clean energy for cooking in the camps
- Component 2: Reforestation around the camps
- Component 3: Peaceful co-habitation between refugees and host population through income-generating activities

**Innovative approaches of the project design:** It is not possible to elaborate innovative elements at this time given the limited public availability of project documents that are necessary to evaluate how the project was implemented.

Project Title	Niger Green Mini-Grid Country Programme
Implementing Agency	Ministry of Energy and Petroleum
Project Budget	USD 1,043,770
Funding Agency	AfDB
Period	2016–2018
Location	Republic of Niger

**Objective:** To ‘contribute to clean, sustainable, quality, equitable, and affordable access to basic energy for all Nigerien households.’

**Strategy:** Creating an enabling environment to encourage private sector adoption of GMG technology, through developing a GMG policy and institutional framework and supporting the capacity building of key stakeholders including private GMG developers.



**Key issues to be addressed** include limited examples of commercial businesses models for renewable energy distribution, a lack of accessible long-term finance, inadequate human and institutional capacity necessary to prepare projects, and low levels of policy commitment to renewable energy-powered mini grids.

**Project Components:**

- Component 1: Green mini-grid (GMG) policy, enabling framework and capacity building
- Component 2: Support for project preparation, capacity building of private GMG developers, identification of business cases, and feasibility studies.

**Innovative approaches of the project design**

Prioritising the development of the power sector to ensure socio-economic development and climate change adaptation. The project design and rationale recognises that extended energy access, particularly to rural areas, is an essential prerequisite for achieving higher economic growth rates and improvements in human development and wellbeing across Niger. GMGs are identified as an affordable tool to extend energy access to low-income communities, thereby addressing socio-economic development targets and promoting climate change adaptation. Greenhouse gas mitigation is one of three intended outcomes of the project, the other two being increased rural access to energy and the creation of renewable energy-sector jobs, respectively.



Figure 11. Nexus between off-grid renewable energy and livelihoods<sup>137</sup>.

## 2.5. Theme 4: Value Chains for Agriculture

There are two projects identified under Theme 4: Value Chains for Agriculture, from Zambia and Ghana. A common theme is the promotion of climate-resilient and diversified agricultural techniques in order to improve food security.

Project Title	Climate Resilient Livestock Management Project (CRLMP)
Implementing Agency	AfDB
Project Budget	USD 26.9 million (US\$6.2 million grant and US\$20.7 million co-finance)
Funding Agency	GEF
Period	2016–2021 (60 months)
Location	Zambia

Note: this project also has climate-proofing infrastructure elements (Outcome 1.3).

<sup>137</sup> Blechinger, P., Köhler, M., Juette, C., Berendes, S. and Nettersheim, C. 2019. Off-Grid Renewable Energy for Climate Action — Pathways for change. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). [online] Available: [https://energypedia.info/wiki/Publication - Off-Grid Renewable Energy for Climate Action: Pathways for Change](https://energypedia.info/wiki/Publication_-_Off-Grid_Renewable_Energy_for_Climate_Action:_Pathways_for_Change)

**Objective:** ‘To strengthen the adaptive capacity of Zambian livestock farmers to the impacts of climate change’

**Strategy:** This will be achieved through, *inter alia*, promoting climate-resilient agricultural practices and community-based natural resource management, as well as introducing alternative agricultural livelihood to encourage livelihood diversification. These interventions will be supported by the development and distribution of climate change information to smallholder farmers.

**Key Issues to be Addressed:**

Key climate changes affecting the project regions include an increased frequency and intensity of droughts and floods, as well as shifting rainfall patterns. An increased frequency and intensity of drought undermines agricultural production and results in declining yields, causing a reduced availability, quantity and quality of livestock feed. A greater incidence of floods results in greater mortality of livestock through drowning, while increased rainfall in certain project sites has exacerbated the spread of animal diseases. Inappropriate agricultural practices, including overgrazing and poor soil management, has also resulted in the degradation of rangelands, impacting livestock productivity at a landscape scale.

**Project Components**

- Component 1: Promoting climate resilient livestock investments and increasing climate change adaptive capacity of farmers;
- Component 2: Capacity building on climate change adaptation for stakeholders;
- Component 3: Knowledge, monitoring and evaluation

**Innovative approaches of the project design**

Component 1: Use of financing mechanism to allow farmers to obtain more climate-resilient livestock breeds – farmers supply 25% of the value in co-finance

Cattle livestock breeds are all indigenous breeds and are already disease- and drought-resistant. While less information is available on the genetic characteristics of indigenous goats, sheep, pigs and poultry is available, the project will enhance knowledge on these species to improve and restore indigenous knowledge of livestock.

- Implementation of community management of indigenous livestock breeds and grazing resources – including land-use plans

This is in recognition of communal land ownership, again reflecting that project design is responsive to the local meaning-giving context, strong elements of participation.

- Use of **climate resilient infrastructure** in combination with soft interventions (e.g., climate-resilient agricultural practices) to improve resilience – includes crush pens, dip tanks, slaughterhouses, milk collection centres, marketing infrastructure and feeder roads.

This will be achieved through reviewing and modifying LISP infrastructure designs, specifically focussing on minimising climate change risks such as increased incidence of fires, flooding and drought. LISP will then be constructed and maintained per the improved designs for climate change resilience established in previous activities.

- Early warning systems
- Index-based livestock insurance scheme – existing livestock insurance does not generally cover loss of livestock or reduced productivity as a result of droughts and/or floods, which are both projected to become more frequent in climate change scenarios.

**Component 2:**

- Technical training to government staff in climate risk assessment and adaptation skills for livestock farmers

- Community level training to artisans in manufacturing livestock-related material as a source of income diversification (value chain), which effectively targets youth in particular.

This training will target both qualified and new entrants into the artisan workforce within the livestock sector to promote livelihood diversification in the project sites. Specific activities include training carpenters and masons on the repair and maintenance of some LISP-installed facilities such as crushes and dip tanks. Activities to achieve this include: i) preparation of training materials for artisans in manufacturing livestock-related materials; ii) training artisans in manufacturing livestock-related materials; iii) awareness raising among livestock farmers of the existence of index-based livestock insurance providers; iv) linking livestock farmers with index-based insurance providers.

Project Title	Promoting a Value Chain Approach to Climate Change in Agriculture
Implementing Agency	IFAD
Project Budget	USD 11.4 million
Funding Agency	GEF
Location	Ghana

**Objective:** ‘Contribute to the reduction of climate-induced risks to the achievement of food security and income generation objectives for the rural communities in Ghana, by focusing on the improvement and adaptation of the cassava value chain in pilot areas of the country’.

**Strategy:** Creating and supporting a competitive, market-based root and tuber commodity chain in Ghana targeting poor communities and women.

**Key Issues to be Addressed:**

The production of cassava is predicted to be significantly impacted by climate change in Ghana, with current projections estimating a decline in yields of 3%, ~14% and 53% by 2020, 2050 and 2080, respectively. This will undermine economic development in the agricultural sector and food security, given that cassava production accounts for 22% of the agricultural GDP and 34% of national annual food consumption.

Cassava processing is also inefficient and characterised by high rates of soil and water pollution, health issues and high wastage of cassava as a result of inadequate processing technologies. Limited water availability further undermines the effectiveness of cassava processing and results in low-quality end-products, as well as sanitary issues during the production process. The outcome of these challenges is a cassava processing system which produces low revenues, constraining the ability of producers to invest in more efficient and effective processing technologies.

Markets for cassava products are limited, producers lack the bargaining power necessary to negotiate attractive prices, and many struggle to access existing markets. Low prices of cassava products further constrain the revenue generated by producers and the financial resources they have available to diversify their product range and establish new markets.

**Project Components**

- Component 1: Awareness raising to climate change and capacity to address impacts along the cassava value chain
- Component 2: Support adaptation of cassava production to climate change
- Component 3: Promote innovative adaptation solutions along the agriculture value chain, including establishing two bio-energy plants, new building w processing machinery, two cooling chambers, honey processing room.

**Innovative approaches of the project design**

- Targeting innovative land and water management practices, incorporating CCA criteria in the selection of crop varieties and cropping systems; establishing EWS for better agri and enterprise planning and decision-making.
- Encourages farmers to maintain a wider diversity of crops – key adaptation to food security
- Introduce adaptation technologies
- Landscape scale: collaborate with land planners to ‘plan, test and validate alternative crop varieties to increase yields under a climate change scenario, and adaptive land and water management practices to cope with changes in climate and enhance the agro-ecosystem's diversification and resilience’.
- Improve smallholders' access to innovative technologies, facilitate access to exciting and new markets. Technology can be considered cross-cutting, includes sustainable energy uses and improved food processing
- Focus on community participation, major technology transfer is SLWM and sustainable energies – way to integrate mitigation elements into an adaptation project
- Outcome includes, inter alia, improved food processing techniques based on sustainable energy sources
- Includes demonstration and promotion of environmental-friendly tech for energy production and use along the cassava value chain; installation of energy-operated water pumping system in cassava model-processing unit; creation of climate-resilient complementary income sources for cassava producing and processing communities.

Project Title	Promotion of Sustainable Charcoal in Angola through a Value Chain Approach
Implementing Agency	UNDP
Project Budget	USD 23.3 million
Funding Agency	GEF
Period	2016 – on-going
Location	Angola Miombo Woodlands
Beneficiaries	Charcoal producers

**Objective:** ‘To reduce the current unsustainable and GHG-intensive mode of charcoal production and utilization from Angola’s Miombo woodlands via an integrated set of interventions in the national charcoal value chain.’

**Project Components** include:

- **Component 1:** Information and strengthening of the policy framework for sustainable charcoal. Includes design of certification scheme for sustainable charcoal and incorporation of certified sustainable charcoal and energy-efficient stoves into poverty reduction and rural development programmes – recognition of necessary changes in policy landscape to support transformative change among local beneficiaries.

- **Component 2:** Transfer of sustainable charcoal technology to agents along the charcoal value chain. Will transfer sustainable charcoal tech to rural producers and (peri-urban) consumers, in the form of energy-efficient, low-emission kilns (thereby creating mitigation co-benefits). Activities under this component flow from introducing the tech to rural communities to facilitate the acceptance of sustainable charcoal production tech by a critical mass of producers. This will target peri-urban areas (charcoal retail and consumption) and demonstrate charcoal briquetting tech as a business opportunity. Second stage is disseminating charcoal kilns and briquetting machines to interested producers on a cost-shared basis. Third step is concerning enabling environment, utilising existing government programmes to trigger demand for sustainable charcoal using, *inter alia*, the application of certification criteria and promotion of energy-efficient charcoal stoves to low-income consumers. *Note: this also includes a technology transfer element.*

- Component 3: Strengthening of human capacities and institutions
- Component 4: Monitoring and Evaluation

**Innovative approaches of the project design** include the recognition of need to enhance awareness of the economic, social and environmental benefits of sustainable charcoal production among producers. Moreover, the utilisation of existing Ministry of Commerce programmes (PAPAGRO and Loja Kikuia) to delivery certified charcoal to existing markets is an effective and novel example of a public-private partnership, given that a 'green charcoal' market is premature. This method of facilitating market access was necessary particularly in light of the poorly developed market system characterised by a vertically integrated supply chain is used.

### Annex 3: CTI/ESI/ETI priority geographical areas

During the Adaptation Strategy development, each division highlighted their target geographies to develop and implement adaptation projects in the next 1-2 years to test the viability of the adaptation interventions. This Strategy is meant to be updated after 2 years in order to reflect changes in geographies and themes for priority adaptation interventions.

#### 3.1. CTI

Priority countries identified by CTI include: **i) Mozambique, Tanzania, DRC, Zambia, Sierra Leone ii) Cambodia, Pakistan, Armenia; and iii) Columbia, Fiji and Haiti.** Four themes were identified as priorities for CTI, which include: i) Adaptation entrepreneurship, innovation and technology transfer; ii) Climate-proofing infrastructure; iii) 3) Cross cutting projects involving energy and adaptation; and iv) Value chains for agriculture (industrial lens such as processing). Finally, transversal focus areas include the water energy food nexus (integrated solutions for water, energy and land), nature-based solutions and infrastructure, and enabling private sector engagement.

#### 3.2. ESI

Due to ESI's expertise with climate-proofing infrastructure and implementing renewable energy projects for self-sufficiency, their priority countries include Small Island Development States. With their connections in the Pacific and in Africa, they have identified the following priority countries for cross-cutting proposal development. **Priority countries include the Philippines, Fiji, Cabo Verde, Sao Tome and Tonga.** Two key themes identified include: i) climate-proofing infrastructure; and ii) Cross cutting projects involving energy and adaptation. Transversal focal areas include nature-based solutions and infrastructure, and enabling private sector engagement.

#### 3.3. ETI

Based on the technical expertise of ETI in developing small hydropower proposals as well as their good working relationships with local UNIDO offices, the following geographies and themes were defined as priority for ETI. **Priority countries include Nigeria, Kenya, Ghana, Tanzania, Zambia and China.** Two priority themes identified include: i) Adaptation innovation and technology transfer; and ii) Cross cutting projects involving energy and adaptation.

#### 3.4. Policy Profiles Relevant to Priority Themes for Priority Countries

Based on the feedback of the ESI/ETI/CTI divisions, each of the themes and a representative country was evaluated to see the alignment of the NDC, NAPs, and TNA documents with the proposed themes for CTI, ESI and ETI. The following countries were evaluated for each division:

Country	CTI	ESI	ETI
Tanzania	X		X
Zambia	X		X
Cambodia	X		
Fiji	X	X	
Philippines		X	
Sao Tome		X	
Nigeria			X
Ghana			X



**Table 6.** Alignment of Cambodia’s NDC, NAPA, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Cambodia				
Theme	Country Documents			
	NDC <sup>138</sup>	NAPA <sup>139</sup>	Country Programme	Technology Needs Assessment <sup>140</sup>
Overview	Strong focus on climate-resilient agriculture, with 17 proposed actions in the areas of agribusiness, animal health and production, agriculture/energy and agriculture/gender.	Priority sectors are agriculture, forestry, human health and coastal zone, as well as water resource sector.	Cambodia’s GCF Country Programme is still under development.	Cambodia’s TNA for adaptation identifies the water sector and coastal zone as priorities for adaptation. The primary technologies identified include: i) household safe water supply through introducing rooftop rainwater harvesting systems and wells, and establishing community water supply through the construction of small reservoirs, dams and micro-catchments (water sector); and ii) improving the management of mangroves (coastal zone).
Adaptation innovation and technology transfer	Proposed projects include: <ul style="list-style-type: none"> <li>• ‘Development of new technologies and increased yields by using new crop varieties which adapt to climate change’</li> <li>• ‘Improvement of animal breeding technology in Cambodia through AI which can adapt to climate change’</li> <li>• ‘Integrating climate change response measures onto the construction design for buildings and for rural housing (use of modern integration of technology)’</li> </ul>	N/A	N/A	N/A
Climate proofing infrastructure	Proposed projects include: <ul style="list-style-type: none"> <li>• ‘Improvement of support services and capacity building to crop production resilient to climate change by promoting research, trials and up-scaling climate-smart farming systems that increase resilience to CC and extreme weather events’</li> </ul>	Proposed projects include: <ul style="list-style-type: none"> <li>• Development of drainage systems for road protection</li> <li>• Development of community and household flood safe areas*</li> </ul>	N/A	Community and household flood-safe areas; drainage for roads; flood proofing coastal areas

<sup>138</sup> Royal Government of Cambodia. 2020. *Cambodia’s Updated Nationally Determined Contribution*.

<sup>139</sup> Royal Government of Cambodia. 2006. *National Adaptation Programme of Action to Climate Change (NAPA)*.

<sup>140</sup> Royal Government of Cambodia. 2013. *Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation*.

	<ul style="list-style-type: none"> <li>• ‘Conduct climate risk analysis for the existing electricity infrastructures and provide recommendations’</li> <li>• ‘Climate proofing existing and future solar/hydropower infrastructure’</li> <li>• ‘Integrating climate change response measures onto the construction design for buildings and for rural housing (use of modern integration of technology)’</li> <li>• Develop resilient infrastructure of school buildings in response to climate change</li> <li>• Implement climate change and disaster-resilient construction and infrastructure standards including for public health and community-focused buildings covering public health, education, WASH etc.</li> <li>• Development of building code with mainstreaming climate change into building designs</li> <li>• Develop national road construction and maintenance design standards for national and provincial roads, considering CC impacts, including developing an M&amp;E framework for climate-proofing and low-carbon technology roads</li> <li>• Repair and rehabilitate existing road infrastructure and ensure effective operation and maintenance systems, considering CC impact</li> <li>• Rural road rehabilitation and improvement for CC resilience</li> <li>• Building climate-resilient livelihood and public infrastructures in social land concession for vulnerable communities</li> </ul>			
Cross cutting projects involving energy and adaptation	<p>Proposed projects include:</p> <ul style="list-style-type: none"> <li>• Scaled up climate-resilient agricultural production through increased access to solar irrigation systems and other climate-resilient practices</li> <li>• Strengthen flood resiliency capacity of communities around lake Tonle Sap (access to clean water, off-grid renewable energy and waste management)</li> </ul>	N/A	N/A	N/A (energy)
Value chains for agriculture	<p>Proposed projects include:</p> <ul style="list-style-type: none"> <li>• Building climate change resilience on cassava production and processing</li> </ul>	N/A	N/A	N/A (value chain)

	<ul style="list-style-type: none"> <li>● Development of rice crops for increase production, improved quality-safety, harvesting and post-harvesting technique and agro-business enhancement</li> <li>● Development of Horticulture and other food crops for increased production, improved quality-safety, harvesting post-harvesting technique and agro-business enhancement</li> <li>● Development of industry crops for increased production, improved quality-safety, harvesting post-harvesting technique and agro-business enhancement</li> </ul>			
Nature based Infrastructure - EbA	<p>Proposed projects include:</p> <ul style="list-style-type: none"> <li>● 'Effective management and protection of ecological systems of marine and coastal zones to avoid adverse impacts from various factors, build their resilience and restore its functions for productive and health oceans</li> <li>● Building resilience of biodiversity conservation and restoration to adapt to CC</li> </ul>	<p>Proposed projects include:</p> <ul style="list-style-type: none"> <li>● Community mangrove restoration and sustainable use of natural resources</li> <li>● Community agroforestry in coastal areas</li> <li>● Assessment of needs for setbacks, vegetation buffers and protection structures in coastal areas</li> <li>● Community agroforestry in deforested watersheds</li> <li>● Introduction of short-period rice varieties in areas affected by saltwater intrusion and drought*</li> </ul>	N/A	Coastal areas: mangrove management (conservation, restoration, sustainable use); vegetation buffer; beach nourishment
Water Energy Food Nexus	N/A	N/A	N/A	N/A
Entrepreneurship innovations, business support and SMEs	<p>Proposed projects include:</p> <ul style="list-style-type: none"> <li>● Provide capacity building and support for climate change innovation at the provincial along Tonle Sap river</li> <li>● Raising public awareness on climate change innovation at all levels</li> </ul>	N/A	N/A	'Training of local entrepreneurs to follow risk management approach to rainwater harvesting can help them develop their own business'.

**Table 7.** Alignment of Fiji’s NDC, NAP, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Fiji				
Theme	Country Documents			
	NDC	NAP <sup>141</sup>	Country Programme	Technology Needs Assessment <sup>142</sup>
Overview	Identify need to ‘increase the resourcing of adaptation and mitigation measures’. Priority adaptation areas have not been affected. Major climate hazards include increased droughts, floods and extreme events such as cyclones.	Priority is ensuring food security. Priority sectors include agriculture, fisheries, health, human settlements, infrastructure <sup>143</sup> and biodiversity and the natural environment.	Two Country Programmes were reviewed, released by the Asian Development Bank and the World Bank, respectively. Although neither of these programmes are explicitly focussed on climate change adaptation and mitigation, both include provisions for enhancing climate resilience, particularly through promoting the development of climate-resilient infrastructure.  Fiji’s GCF Country Programme is still under development.	The TNA identifies the following sectors as vulnerable to climate change: i) water resources and water infrastructure; ii) tourism; iii) urban development and housing; iv) agriculture and forestry; and v) health. The two priority sectors reviewed in the TNA were agriculture and coastal zones.
Adaptation innovation and technology transfer	N/A	<ul style="list-style-type: none"> <li>Use of, <i>inter alia</i>, GIS mapping and crop modelling to improve understanding of climate risks to production, distribution, processing and use of models.</li> <li>Use of bio-security (border controls, early warning systems, on-site visits, breeding programmes) to enhance protection and action against invasive species, pests and diseases<sup>144</sup>.</li> </ul>	The World Bank’s Country Partnership Framework (2021–2024) prioritises the fostering of private sector-led growth and inclusive economic opportunities, through <i>inter alia</i> : <ul style="list-style-type: none"> <li>Providing better infrastructure, better digital services and more clean energy<sup>145</sup></li> </ul>	Several technologies were identified within the agricultural sector to improve climate resilience, including: <ul style="list-style-type: none"> <li>Drip irrigation</li> <li>Integrated pest management, which uses ‘the diversity of crops, conservation of soil fertility and protection of beneficiary insects and predators’</li> <li>Integrated nutrient management, which incorporates organic supplements (compost, biochar) to increase soil nutrient and moisture retention</li> <li>Climate Index Insurance</li> </ul>
Climate proofing infrastructure	‘Need to ensure that buildings constructed in urban and rural	<ul style="list-style-type: none"> <li>Improving the resilience of crop and livestock breeding</li> </ul>	The Asian Development Bank’s (ADB) Country Partnership Strategy prioritises the	N/A

<sup>141</sup> Government of Fiji. 2018. *Republic of Fiji National Adaptation Plan: A pathway towards climate resilience*. [online] Available: [https://www4.unfccc.int/sites/NAPC/Documents/Parties/National%20Adaptation%20Plan\\_Fiji.pdf](https://www4.unfccc.int/sites/NAPC/Documents/Parties/National%20Adaptation%20Plan_Fiji.pdf)

<sup>142</sup> Government of Fiji. 2020. *Fiji: Technology Needs Assessment Report Adaptation*. [online] Available: <https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2020/05/tna-adaptation-report-fiji.pdf>

<sup>143</sup> Priorities are water, energy, transport and hazard management

<sup>144</sup> This has considerable overlap with nature-infrastructure and ‘value chains for agriculture’

<sup>145</sup> This has overlap with ‘entrepreneurship innovations, business support and SMMEs’

	<p>areas are cyclone resistant’</p> <ul style="list-style-type: none"> <li>● Review the National Building Code by 2016 end</li> <li>● Provide incentives to support compliance by 2017</li> </ul> <p>Activities already undertaken that could be expanded on include:</p> <ul style="list-style-type: none"> <li>● Construction of cyclone proof homes in most affected areas</li> </ul>	<p>infrastructure and supply systems, as well as seed and food storage facilities<sup>146</sup> (agri).</p> <ul style="list-style-type: none"> <li>● Maintain, adapt and construct sea wall and drainage infrastructure to reduce saltwater intrusion on agricultural land due to SLR, increased tidal surges (agri).</li> <li>● Retrofit the existing and installed innovative structures, energy and water supplies; medicines and equipment efficiency...to prevent vulnerability to CC impacts (health).</li> <li>● Scale-up efforts to upgrade existing informal settlements (settlements)</li> <li>● Develop and support the construction of cost-effective and context-relevant disaster resilient model homesteads for both rural and urban communities (settlements)</li> <li>● Upgrade, repair, relocate and build new water and sanitation infrastructure that is appropriate for the future needs of all community members and able to withstand predicted future climate risks (infrastructure)</li> <li>● Develop climate-resilient jetties and landings on outer islands where needed as well as supporting road infrastructure (infrastructure)</li> <li>● Strengthen and upgrade existing ports so that they are climate-</li> </ul>	<p>following:</p> <ul style="list-style-type: none"> <li>● Strategic Objective to build resilience and reduce economic volatility, achieved through the climate proofing of new infrastructure, and the reduction of flood risk in areas with key economic infrastructure.</li> </ul> <p>The World Bank’s Country Partnership Framework (2021–2024) prioritises building resilience, including climate resilience, through:</p> <ul style="list-style-type: none"> <li>● Strengthening the resilience of key transport infrastructure</li> <li>● Delivering affordable climate resilient homes for low income earners</li> <li>● Enhance delivery of productivity-enabling resilient infrastructure</li> </ul>	
--	--	---	--	--

<sup>146</sup> This has overlap with ‘value chains for agriculture’

		<p>and disaster-resilient, as well as meet international standards (infrastructure)</p> <ul style="list-style-type: none"> <li>• Replace and upgrade existing jetties as well as supporting road infrastructure so they are climate- and disaster-resilient (infrastructure)</li> <li>• Review the renewal and upgrading of water crossings on road infrastructure to ensure they can withstand current and future environmental and climate risks (infrastructure)</li> <li>• Renew, upgrade and strengthen road infrastructure including bridges ensuring that current and future environmental and climate risks are incorporated into their design (infrastructure)</li> <li>• Review and upgrade airport and airstrip infrastructure so that it is climate- and disaster-resilient as well as meeting international standards (infrastructure)</li> <li>• Ensure every rural community and every rural school has at least one building resilient to a Category 4 cyclone (hazard management)</li> </ul>		
Cross cutting projects involving energy and adaptation	<ul style="list-style-type: none"> <li>• Energy efficiency is identified as a mitigation priority that has yet to be fully explored, with potential adaptation benefits.</li> </ul>	N/A	N/A	N/A (cross-cutting, adaptation)
Value chains for agriculture	N/A	Focus on enhancing agricultural value chains, in particular through encouraging the diversification of farmers for subsistence consumption	N/A (value chain)	N/A (value chain)



Nature based Infrastructure - EbA	<p>Activities already undertaken that could be expanded on include:</p> <ul style="list-style-type: none"> <li>● Planting of mangroves</li> <li>● Planting of traditional tree and root crops to minimize soil erosion and land degradation and desertification</li> <li>● Construction of inland retention dams</li> <li>● Dredging of river mouths</li> </ul>	<p>and market sales<sup>147</sup>.</p> <p>EbA is recognised as a priority for CCA. Overarching strategy is to conserve and restore flora, fauna and habitats to enhance adaptive capacity.</p> <ul style="list-style-type: none"> <li>● Adopt nature-based and urban solutions were possible to improve climate resilience of agriculture<sup>148</sup></li> <li>● Increase use of sustainable soil and land management techniques to address soil erosion, desertification and other threats (agri)</li> <li>● Support restoration, enhancement and conservation of coastal ecosystems (fisheries)</li> <li>● Scale up efforts to strengthen coastal boundaries of urban centres and rural communities through hybrid or nature-based solutions<sup>149</sup> (settlements).</li> <li>● Promote the development and implementation of IWRM (infrastructure)</li> <li>● Integrate EbA-based measures into considerations regarding the construction of sea walls and riverbanks, including mangrove planting (hazard management).</li> <li>● Implementation of riverbank protection activities which integrate EbA-based approaches with hard infrastructure (hazard management)</li> </ul>	N/A	<p>Several technologies were identified within the agricultural sector to improve climate resilience, including:</p> <ul style="list-style-type: none"> <li>● The introduction of agro-forestry</li> </ul> <p>Several technologies were identified within the coastal zone to improve climate resilience, including:</p> <ul style="list-style-type: none"> <li>● Sand dune rehabilitation</li> <li>● Restoration of coastal vegetation</li> <li>● Replanting of corals</li> <li>● Mangrove rehabilitation</li> </ul>
-----------------------------------	---	---	-----	---

<sup>147</sup> This has implications for 'entrepreneurship innovations, business support and SMMEs'

<sup>148</sup> This has implications for 'value chains for agriculture'

<sup>149</sup> This has overlap with 'climate-proofing infrastructure'

		<ul style="list-style-type: none"> <li>• Create flood risk and management action plans for all human settlements which operate at the catchment scale and involve either hybrid or nature-based solutions and payments for ecosystem services (hazard management)</li> <li>• Gain endorsement of mangrove management plan, implement mangrove rehabilitation projects and strengthen the regulations regarding mangrove removal and conversion (biodiversity)</li> <li>• Implement ecosystem-based approaches to adaptation to protect, maintain, and restore degraded habitats with active community, NGO and private sector engagement in particular the restoration of critical watersheds, riparian and coastal zones (biodiversity)</li> </ul>		
Water Energy Food Nexus	N/A	N/A	N/A	N/A (water)
Entrepreneurship innovations, business support and SMEs	<ul style="list-style-type: none"> <li>•</li> </ul>	<ul style="list-style-type: none"> <li>• Intensify collaboration with development partners (land and marine) to strengthen community-based fisheries management (fisheries)</li> <li>• Promote sustainable fisheries management and the replenishment of fish stocks through management tools (fisheries)</li> <li>• Upgrade existing aquaculture facilities and develop pond aquaculture to boost brood and seed stock production (fisheries)</li> </ul>	<p>ADB's Country Partnership Strategy prioritises the following:</p> <ul style="list-style-type: none"> <li>• Strategic Objective to broaden access to quality services and economic opportunities, achieved through, <i>inter alia</i>, improving access to finance and creating employment opportunities.</li> </ul> <p>The World Bank's Country Partnership Framework prioritises the fostering of private sector-led growth and inclusive economic opportunities, through <i>inter alia</i>:</p> <ul style="list-style-type: none"> <li>• Improve access to financing</li> </ul>	<p>Several technologies were identified within the coastal zone which will support entrepreneurship, including:</p> <ul style="list-style-type: none"> <li>• The construction of sea walls, dikes and barriers, which will allow small and medium scale entrepreneurs to establish new industries within the coastal belt because of the reduced risk to infrastructure from coastal erosion and inundation</li> </ul>

		<ul style="list-style-type: none"><li>• Strengthen research collaborations with farmers, communities and national research institutions...to create a community of practice and support knowledge networks which facilitate innovative and climate-adaptive farming practices</li></ul>		
--	--	---	--	--

**Table 8.** Alignment of Ghana’s NDC, NAP, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Ghana				
Theme	Country Documents			
	INDC <sup>150</sup>	NAP	Country Programme	Technology Needs Assessment
Overview	Ghana’s INDC identifies seven priority economic sectors, which are: i) sustainable land use and food security; ii) climate-proof infrastructure; iii) equitable social development; iv) sustainable mass transportation; v) sustainable energy security; vi) sustainable forest management; and vii) alternative urban waste management. The INDC has developed 20 mitigation and 11 adaptation programmes to be implemented across the seven economic sectors between 2020–2030.	Ghana’s NAP is still under development. CCA in Ghana is currently guided by the National Climate Change Adaptation Strategy. Several CCA strategies have been developed in this proposal for priority areas, including: i) livelihoods; ii) energy; iii) agriculture; iv) health; v) early warning; vi) fisheries management; vii) land use; and viii) water.	The African Development Bank’s Country Strategy Paper (CSP) for Ghana (2019–2023) has two key pillars for investment in Ghana: i) Support Ghana’s industrialization and private sector development (Pillar I); and ii) support infrastructure that are enablers of domestic, regional and global trade (Pillar II) <sup>151</sup> .  Activities of the Japan International Coordination Agency in Ghana are targeted in the following sectors: i) education; ii) health; iii) governance; iv) transportation; v) natural resources and energy; vi) private sector development; vii) agriculture and rural development; and viii) natural environment conservation.	The TNA for CCA in Ghana identified two priority sectors: water and agriculture <sup>152</sup> .
Adaptation innovation and technology transfer	<ul style="list-style-type: none"> <li>Scale up penetration of climate-smart technologies to increase livestock and fisheries productivity by 10% (sustainable land use)<sup>153</sup></li> </ul>	N/A	<ul style="list-style-type: none"> <li>The <i>Study on Upper West Integrated Agriculture Development</i> project will, <i>inter alia</i>, develop guidelines for the transfer of appropriate agricultural and rural development techniques designed to improve the productivity</li> </ul>	The TNA identified 15 potential technologies to introduce in the water sector <sup>155</sup> that are designed to enhance climate resilience, and 19 technologies within the agricultural sector <sup>156</sup> .

<sup>150</sup> Republic of Ghana. 2015. Ghana’s Intended Nationally Determined Contribution

<sup>151</sup> African Development Bank. 2019. Republic of Ghana Country Strategy Paper (CSP) 2019–2023

<sup>152</sup> GEF. 2015. Ghana Technology Needs Assessment Report

<sup>153</sup> This has overlap with the ‘value chains for agriculture’ theme

<sup>155</sup> These include: i) sub-surface storage and use; ii) household water treatment and safe storage; iii) improving resilience of protected wells to flooding; iv) increasing the use of water-efficient fixtures and appliances; v) leakage management, detection and repair in piped systems; vi) post-construction support for community-managed water systems; vii) rainwater collection from ground surfaces (small dams); viii) rainwater harvesting from roofs; ix) water reclamation and reuse (waste-water recycling); x) water safety plans; xi) desalination; xii) demarcation and protection of buffer zones for water bodies; xiii) flood warning systems; xiv) flood-proofing; and xv) climate change monitoring system

<sup>156</sup> These include: i) integrated national climate change monitoring and early warning system; ii) climate insurance; iii) sprinkler and dripping irrigation; iv) rainwater harvesting; v) slow-forming terraces; vi) conservation tillage; vii) integrated soil nutrient management; viii) crop diversification and new varieties; ix) new varieties through biotechnology; x) ecological pest management; xi) seed and grain storage; xii) selective breeding via controlled mating; xiii) integrated livestock disease management; xiv) mixed farming; xv) agro-forestry; xvi) farmer field schools; xvii) community trained extension agents; xviii) community

			<p>of the agricultural and agro-processing industries within the project region<sup>154</sup>.</p>	<p>Project ideas which were focussed on for the water sector include:</p> <ul style="list-style-type: none"> <li>● Rainwater collection from ground surface, which would include the provision of 100 run-off storage facilities with 1 million m<sup>3</sup> of maximum storage potential; and</li> <li>● Diffusing post-construction support for community managed water systems technology; in the form of, <i>inter alia</i>, technical training for water system operators, technical and engineering support, financial and accounting assistance, help with maintenance, repairs and finding spare parts, assistance in finding funding for O&amp;M, expansion or repairs, and start-up capital for emergency system repairs.</li> </ul> <p>Project ideas which were focussed on for the agriculture sector include:</p> <ul style="list-style-type: none"> <li>● Integrated nutrient management technology, which uses a combination of synthetic and natural plant nutrients to improve soil fertility. This project will target ~100,000 farmers.</li> <li>● Community-based Extension Agents, which will provide targeted technical training to select beneficiaries, to allow them to distribute various agricultural technologies to their communities.</li> </ul>
--	--	--	--	---

forest management groups; and xix) water user associations

<sup>154</sup> JICA. N.d. Study on Upper West Integrated Agriculture Development. [online] Available: <https://www.iica.go.jp/ghana/english/activities/activity06.html>

Climate proofing infrastructure	<ul style="list-style-type: none"> <li>● City-wide resilient infrastructure planning, including facilitating the adoption of building standards for strategic infrastructure in housing, transport, coastal, waste management, telecommunications and energy (climate-proof infrastructure)</li> </ul>	N/A	N/A	<ul style="list-style-type: none"> <li>● Improving resilience of protected wells to flooding (water)</li> <li>● Flood proofing (water)</li> </ul>
Cross cutting projects involving energy and adaptation	N/A	<ul style="list-style-type: none"> <li>● Increase the use of off-grid alternative energy resources (energy)</li> <li>● Increase the use of efficient domestic appliances (energy)</li> <li>● Develop low-head run on river hydroelectric schemes (energy)</li> <li>● Encourage large-scale energy conservation (energy)</li> </ul>	N/A	N/A
Value chains for agriculture	<ul style="list-style-type: none"> <li>● Promote innovations in post-harvest storage and food processing and forest products in 43 administrative districts (sustainable land use)</li> </ul>	<ul style="list-style-type: none"> <li>● Train trainers to promote post-harvest technologies to minimize losses of farm produce (agriculture)</li> <li>● Promote farming technologies that enhance the productivity of agricultural lands (land use)<sup>157</sup></li> </ul>	<ul style="list-style-type: none"> <li>● Outcome 1 (Pillar I), Enhanced business framework and critical infrastructure for industrialization, will target investment in agricultural infrastructure to improve productivity and value addition, as well as incentivise agro-industrialisation<sup>158</sup>.</li> <li>● Outcome 2 (Pillar I), increased private investment in value-adding sectors for job creation, will encourage, <i>inter alia</i>, projects such as the Staple Crop Processing Zone (Agro-Industrial Park) as well as a cocoa sector productivity enhancement project<sup>159</sup>.</li> <li>● Outcome 3 (Pillar II) will support investments in roads to improve regional connectivity, access to agricultural and other markets, and trade. This outcome will also</li> </ul>	<ul style="list-style-type: none"> <li>● Seed and grain storage (agriculture)</li> </ul>

<sup>157</sup> This has overlap with the 'adaptation innovation and technology transfer' theme

<sup>158</sup> African Development Bank. 2019. Republic of Ghana Country Strategy Paper (CSP) 2019–2023

<sup>159</sup> African Development Bank. 2019. Republic of Ghana Country Strategy Paper (CSP) 2019–2023



			<p>facilitate investment in creating sub-regional markets to encourage the trade of processed agricultural goods and manufactured products, as well as the development of Agro-industrial zones<sup>160,161</sup>.</p> <ul style="list-style-type: none"> <li>● The <i>Project for Sustainable Development of Rain-fed Lowland Rice Production in the Republic of Ghana</i> has facilitated the introduction of post-harvest processing technologies and encouraged the development of a value chain network through the establishment of Quality Rice Promotion Forums<sup>162</sup>.</li> </ul>	
Nature based Solutions - Nature based Infrastructure - EbA	<ul style="list-style-type: none"> <li>● Manage 413,000 ha of fragile, ecologically sensitive and culturally significant sites in 22 administrative districts in the forest and savannah areas (sustainable land use)</li> <li>● Integrated water resources management (equitable social development)</li> </ul>	<ul style="list-style-type: none"> <li>● Protect the environment through the promotion of agricultural biodiversity (agriculture)</li> </ul>	N/A	<ul style="list-style-type: none"> <li>● Demarcation and protection of buffer zones for water bodies (water)</li> <li>● Mixed farming (agriculture)</li> <li>● Agro-forestry (agriculture)</li> </ul>
Water Energy Food Nexus	N/A	N/A	N/A	N/A
Entrepreneurship innovations, business support and SMEs	<ul style="list-style-type: none"> <li>● Implementation of community-led adaptation and livelihood diversification for vulnerable groups (equitable social development)</li> </ul>	<ul style="list-style-type: none"> <li>● Sensitize beneficiaries on the need to adopt new and appropriate technologies on economic and non-economic livelihoods (livelihoods)<sup>163</sup></li> <li>● Improve access to credit facilities (livelihoods)</li> <li>● Build technical and financial capacities on alternative</li> </ul>	N/A	<ul style="list-style-type: none"> <li>● Ecological pest management (agriculture)</li> </ul>

<sup>160</sup> This has overlap with the 'Entrepreneurship innovations, business support and SMEs' theme.

<sup>161</sup> African Development Bank. 2019. Republic of Ghana Country Strategy Paper (CSP) 2019–2023.

<sup>162</sup> JICA. N.d. Project for Sustainable Development of Rain-fed Lowland Rice Production in the Republic of Ghana. [online] Available: <https://www.jica.go.jp/ghana/english/activities/c8h0vm00004bps0w-att/activity01.pdf>

<sup>163</sup> This has overlap with the 'adaptation innovation and technology transfer' theme.

		<p>livelihood mechanisms (livelihoods)</p> <ul style="list-style-type: none"><li>● Enhance living standards of vulnerable groups through acquisition of alternative livelihoods skills (agriculture)</li><li>● Develop alternative sources of livelihoods for fisherfolks (fisheries management)</li></ul>		
--	--	--	--	--

**Table 9.** Alignment of Nigeria's NDC, NAP, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Nigeria				
Theme	Country Documents			
	NDC	NAP	Country Programme	Technology Needs Assessment
Adaptation innovation and technology transfer	N/A	<ul style="list-style-type: none"> <li>• Testing of adaptation strategies prior to implementation</li> <li>• Improved mechanisms for climate change knowledge sharing</li> </ul>	N/A	<ul style="list-style-type: none"> <li>• There is a need for climate finance for technology development through enhancing private sector involvement</li> <li>• No appropriate climate technology has been identified and prioritized</li> <li>• Lack of data on key technologies needed to implement NDC priorities</li> <li>• The goal is to identify key technologies required through a multi criteria analysis which considers natural resources, capabilities, the NDC focus and sectoral plans</li> </ul>
Climate proofing infrastructure	N/A	N/A	N/A	N/A
Cross cutting projects involving energy and adaptation	<ul style="list-style-type: none"> <li>• Completion of risk assessments and risk reduction measures to ensure the resilience of the energy sector</li> <li>• The expansion of sustainable energy sources, decentralization of transmission to reduce vulnerability of energy infrastructure to climate change impacts</li> </ul>	<ul style="list-style-type: none"> <li>• Energizing education project funded by Nigeria's First Sovereign Green Bond to develop clean off grid independent power plant</li> </ul>	<ul style="list-style-type: none"> <li>• UNDP will work with relevant partners to facilitate access and investment in clean energy for community development and to stimulate local economies</li> </ul>	<ul style="list-style-type: none"> <li>• Implementation and expansion of sustainable energy sources to reduce vulnerability of energy infrastructure</li> </ul>
Value chains for agriculture	<ul style="list-style-type: none"> <li>• The implementation and use of climate smart agriculture (CSA)</li> </ul>	<ul style="list-style-type: none"> <li>• Diversification of livestock, increase of access to drought resistant crops, improved soil management practices,</li> </ul>	<ul style="list-style-type: none"> <li>• UNDP will target small-scale farmers in the production, storage, and marketing of staple crops for local consumption and export based on</li> </ul>	<ul style="list-style-type: none"> <li>• Capacity development for mechanized planters and enhanced crop production techniques</li> </ul>

		provide early warning systems and meteorological forecasts	lessons learned from the ongoing Agribusiness Supplier Development Programme.	
Nature based Solutions - Nature based Infrastructure - EbA	<ul style="list-style-type: none"> <li>Support the implementation of the National Biodiversity Strategies and Action Plans (NBSAP)</li> </ul>	<ul style="list-style-type: none"> <li>UNDP sponsored Ecosystem-Based Adaptation for Food Security Assembly (EBAFOSA) has the goal to drive climate change adaptation, food security and zero hunger SDG 2 and agenda 2030 (this can also be included in the value chains for agriculture section)</li> </ul>	N/A	N/A
Water Energy Food Nexus	N/A	<ul style="list-style-type: none"> <li>Adaptation will focus on specific water challenges of each sector and sub sector such as agriculture and forestry. Joint action is foreseen to promote efficiency in water use</li> </ul>	N/A	N/A
Entrepreneurship innovations, business support and SMEs	N/A	<ul style="list-style-type: none"> <li>Women in Nigeria have indigenous cooperative systems that make it possible to run small businesses</li> <li>The aim is to target women farmers to encourage adaptation action</li> </ul>	<ul style="list-style-type: none"> <li>UNDP will support all levels of government in advocacy for ground-breaking approaches in entrepreneurial development</li> <li>UNDP will promote local economic diversification by stimulating skills development and improving market services</li> <li>Sourcing of partners for entrepreneurial programmes</li> </ul>	<ul style="list-style-type: none"> <li>SMEs and entrepreneurs strengthened through targeted scheme providing assessments of energy use and advice on energy management.</li> </ul>

**Table 10.** Alignment of the Philippines' NDC, NAP, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Philippines				
Theme	Country Documents			
	NDC <sup>164</sup>	NAP	Country Programme	Technology Needs Assessment
Overview	Priority sectors for adaptation are: i) agriculture; ii) forestry; iii) coastal and marine ecosystems and biodiversity; iv) health; and v) human security.	The Republic of the Philippines envisions the National Climate Change Action Plan (NCCAP, 2011-2018) as '[their] very own National Adaptation Plan', which identifies four priority areas for CCA interventions. These are: i) food security; ii) water sufficiency; iii) ecosystem and environmental stability; iv) human security; v) climate-smart industries and services; vi) sustainable energy; and vii) knowledge and capacity development <sup>165</sup> .	The Asian Development Bank Country Operations Business Plan for the Philippines (2020–2022) outlines seven country assistance results areas: i) transport; ii) public sector management; iii) finance; iv) agriculture, natural resources, and rural development; v) water and other urban infrastructure and services; vi) education; and vii) health <sup>166</sup> .  The Japan International Cooperation Agencies' Country Assistance Policy for the Philippines identifies three priority areas: i) strengthening a foundation for sustainable economic growth; ii) ensuring human security for inclusive growth; and iii) peace and development in Mindanao <sup>167</sup> .	A technology needs assessment for climate change adaptation in the Philippines has not been developed.
Adaptation innovation and technology transfer	N/A	<ul style="list-style-type: none"> <li>● Implement water harvesting technologies (water sufficiency)</li> <li>● Establish ecosystem towns or ecotowns in protected areas and key biodiversity areas (ecosystem and environmental stability)<sup>168</sup></li> </ul>	N/A	N/A
Climate proofing infrastructure	N/A	<ul style="list-style-type: none"> <li>● Implement climate-proofing of local infrastructure, including in established ecotowns (climate-smart industries and services)</li> <li>● Implement green building principles in community development (climate-smart industries and services)</li> </ul>	<ul style="list-style-type: none"> <li>● Urban flood protection, sanitation, water supply, sewerage and solid waste management are key areas of assistance for the 'local CCA and disaster risk reduction measures strengthened' development outcome (water and other urban infrastructure and services)<sup>169</sup></li> </ul>	N/A

<sup>164</sup> Government of the Philippines. 2021. Nationally Determined Contribution.

<sup>165</sup> National Integrated Climate Change Database and Information Exchange System. N.d. National Adaptation Plan. [online] Available: <https://niccdies.climate.gov.ph/climate-reports/national-adaptation-plan>

<sup>166</sup> Asian Development Bank. 2019. Country Operations Business Plan: Philippines 2020–2022. [online] Available: <https://www.adb.org/sites/default/files/institutional-document/533741/cobp-phi-2020-2022.pdf>

<sup>167</sup> Japan International Cooperation Agency. 2018. Country Development Cooperation Policy for the Republic of the Philippines. [online] Available: <https://www.ph.emb-japan.go.jp/files/000393849.pdf>

<sup>168</sup> This has overlap with the 'nature-based solutions' theme.

<sup>169</sup> Asian Development Bank. 2019. Country Operations Business Plan: Philippines 2020–2022. [online] Available: <https://www.adb.org/sites/default/files/institutional-document/533741/cobp-phi-2020-2022.pdf>

Cross cutting projects involving energy and adaptation	N/A	<ul style="list-style-type: none"> <li>● Implement program for climate-proofing energy and transport systems infrastructures (sustainable energy)<sup>170</sup></li> <li>● Increase financing for poverty reduction and conservation in RE host communities (sustainable energy)</li> </ul>	N/A	N/A
Value chains for agriculture	N/A	<p>Within the 'food security' priority, the NCCAP identifies two priorities:</p> <ul style="list-style-type: none"> <li>● Enhanced CC resilience of agriculture and fisheries production and distribution systems, which will include the formulation of climate-sensitive agriculture and fisheries plans, policies and programmes; and</li> <li>● Enhanced resilience of agriculture and fishing communities from climate change.</li> </ul>	<ul style="list-style-type: none"> <li>● The improvement of agricultural production and expansion of the agro-industry, marketing and trade are key areas of assistance for the 'local CCA and disaster risk reduction measures strengthened' development outcome (agriculture, natural resources and rural development). Planned programmes include support for agrifood system competitiveness programme (2020)<sup>171</sup></li> </ul>	N/A
Nature based Solutions - Nature based Infrastructure - EbA	CCA interventions included in the NDC are forest protection, restoration and reforestation.	<ul style="list-style-type: none"> <li>● Develop and implement a policy for the reversion of abandoned fishponds to mangroves (food security)</li> <li>● Rehabilitate degraded watersheds and river basins and protect new ones (water sufficiency)</li> <li>● Develop and implement CCA plans for priority watersheds and river basins (water sufficiency)</li> <li>● Increase knowledge and capacity for integrated ecosystem-based management at the national, local and community levels (ecosystem and environmental stability)</li> <li>● Implement climate-smart ridge-to-reef sustainability plan for cities and municipalities (climate-smart industries and services)<sup>172</sup></li> </ul>	<ul style="list-style-type: none"> <li>● The JICA Country Development Cooperation Policy promotes watershed management as a key tool to mitigate flood risk and damages, which includes flood risk management projects for several large rivers (ensuring human security for inclusive growth)<sup>173</sup>.</li> </ul>	N/A
Water Energy Food Nexus	N/A	N/A	N/A	N/A

<sup>170</sup> This has overlap with the 'climate-proofing infrastructure' theme.

<sup>171</sup> Asian Development Bank. 2019. Country Operations Business Plan: Philippines 2020–2022. [online] Available: <https://www.adb.org/sites/default/files/institutional-document/533741/cobp-phi-2020-2022.pdf>

<sup>172</sup> This has overlap with the 'adaptation innovation and technology transfer' theme.

<sup>173</sup> Asian Development Bank. 2019. Country Operations Business Plan: Philippines 2020–2022. Annex: Rolling Plan for the Republic of the Philippines. [online] Available: <https://www.ph.emb-japan.go.jp/files/000393854.pdf>



<p>Entrepreneurship innovations, business support and SMEs</p>	<p>The NDC identifies the facilitation of access to results-based finance in forest conservation as a priority. The NDC further ‘recognises the private sector as the country’s main engine of economic growth and transformation, and promotes its full engagement in climate change adaptation and mitigation’.</p>	<ul style="list-style-type: none"> <li>● Design gender-fair innovative financing mechanisms and a bundle of CCA assistance for ecotowns communities (ecosystem and environmental stability)<sup>174</sup></li> <li>● Enhance public-private partnership climate-smart investment promotion<sup>175</sup> (climate-smart industries and services)</li> <li>● Enhance tourism policies and strategies to promote green tourism (climate-smart industries and services)</li> <li>● Implement policies that provide incentives to business practices that incorporate eco-efficiency within their core business operation (climate-smart industries and services)</li> <li>● Assist SMMEs in developing capacity for eco-efficient production (climate-smart industries and services)</li> <li>● Develop and improve matching labour force skills to climate-smart industry demand (climate-smart industries and services)</li> <li>● Review and develop innovative financing mechanisms for sustainable livelihood in rural and climate change vulnerable areas (climate-smart industries and services)</li> </ul>	<ul style="list-style-type: none"> <li>● Access to inclusive finance and money and capital markets are identified as key areas of assistance for the development outcome ‘local CCA and disaster risk reduction measures strengthened’ (finance)<sup>176</sup></li> </ul>	<p>N/A</p>
--	---	---	---	------------

<sup>174</sup> This has overlap with the ‘adaptation innovation and technology transfer’ theme

<sup>175</sup> This has overlap with the ‘adaptation innovation and technology transfer’ theme

<sup>176</sup> Asian Development Bank. 2019. Country Operations Business Plan: Philippines 2020–2022. [online] Available: <https://www.adb.org/sites/default/files/institutional-document/533741/cobp-phi-2020-2022.pdf>

**Table 11.** Alignment of Sao Tome and Principe’s NDC, NAP, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Sao Tome and Principe				
Theme	Country Documents			
	NDC	NAPA <sup>177</sup>	Country Programme	Technology Needs Assessment
Overview	The INDC includes short- to medium-term, and medium- to long-term recommendations for CCA. Recommendations are high-level and the NDC refers to the 17 CCA projects included in the NAPA for substantive adaptation interventions.	Priority sectors for CCA identified in the NAPA are: i) agriculture and forestry; ii) water and energy; iii) infrastructure, public works and tourism; iv) public safety and civil protection; v) health; and vi) fisheries. The NAPA includes specific CCA projects as well as high-level sector-based recommendations for adaptation interventions, both of which will be elaborated on in the following sectors.	<p>The African Development Bank’s (AfDB) Country Strategic Paper (CSP, 2018–2022) for Sao Tome and Principe has the overall objective of supporting agricultural development, encouraging export diversification and widening the manufacturing base to facilitate the increased production of value-added goods, and the creation of manufacturing jobs. To this end, the two supporting pillars are: i) Supporting agricultural value chains development (Pillar I); and ii) Improving the quality of life of the population through strengthened economic and financial management (Pillar II). Priority sectors include agriculture, the blue economy and tourism.</p> <p>The World Bank Group’s Country Partnership Strategy (2014–2018)<sup>178</sup> included two main themes: i) Supporting macroeconomic stability and national competitiveness (Theme 1); and ii) reducing vulnerability and strengthening human capacity (Theme 2). Both themes will be supported by several outcomes<sup>179</sup>.</p>	The technology needs assessment for Sao Tome and Principe is still under development; however, priority sectors have been identified. For adaptation, the two priority sectors are: i) water; and ii) agriculture and forestry <sup>180</sup> .
Adaptation innovation and	<ul style="list-style-type: none"> <li>• Within the fisheries sector, suggested technology transfers</li> </ul>	<ul style="list-style-type: none"> <li>• The <i>Introduction of new technologies for firewood use and to make charcoal project</i></li> </ul>	N/A	N/A

<sup>177</sup> Ministry of Natural Resources and Environment. 2006. National Adaptation Programmes of Action on Climate Change

<sup>178</sup> World Bank Group. 2014. Country Partnership Strategy for the Democratic Republic of Sao Tome and Principe for the period FY14–FY18

<sup>179</sup> Outcomes include: i) Outcome 1: Strengthened public financial and natural resource management (Theme 1); ii) Outcome 2: Enhanced statistical system (Theme 1); iii) Outcome 3: Improved private sector capacity with a focus on tourism and SMEs (Theme 1); iv) Outcome 4: Improved business environment and trade regulations (Theme 1); v) Outcome 5: Better targeting of energy subsidies (Theme 1); vi) Outcome 6: Improved regional broadband connectivity (Theme 1); vii) Outcome 7: Improved poverty targeting (Theme 2); viii) Outcome 8: Increased adaptive capacity of coastal communities and reduced potential loss of assets and lives (Theme 2); ix) Outcome 9: Improved training of teachers in primary education (Theme 2); and x) Outcome 10: Increased access to skills development (Theme 2)

<sup>180</sup> Technology Needs Assessment. N.d. Sao Tome and Principe. [online] Available: <https://tech-action.unepdtu.org/country/sao-tome-and-principe/>

technology transfer	include: i) radar reflectors, to improve navigation and reduce accidents at sea; and ii) better fishing equipment (short- to medium-term intervention)	<p>will encourage the adoption of fuel-efficient stoves as well as facilitate the transfer of innovative technologies to improve the production of firewood coal, in order to prevent the ongoing deforestation and degradation of forest resources for charcoal production.</p> <ul style="list-style-type: none"> <li>• The <i>Integrated project of construction and installation of device for fish concentration and signalling coastal zone</i> project aims to improve the livelihoods of fishing communities in Sao Tome and Principe through the installation of devices that will encourage the concentration of fish in accessible areas along the coast, preventing the current need for fisherman to travel far distances offshore and face exposure to coastal storms and associated strong winds and rainfall<sup>181</sup>.</li> <li>• The <i>Training and readapt project of the new navigation technologies and fishing equipment for fisherman</i> project aims to transfer critical navigation equipment to ~200 fisherfolk across Sao Tome and Principe. Fisherfolk have historically relied on traditional navigation systems (such as celestial navigation) to guide them back to the island once offshore; however, an increasing frequency of intense coastal storms accompanied by torrential rainfall and strong wind speeds are disorienting fisherfolk and resulting in accidents, damages and even loss of life in extreme circumstances<sup>182</sup>.</li> </ul>		
Climate proofing infrastructure	<ul style="list-style-type: none"> <li>• The INDC recommends implementing coastal protection measures to improve resilience</li> </ul>	<ul style="list-style-type: none"> <li>• The <i>Displacement of local communities</i> project will improve the climate resilience of vulnerable coastal communities through,</li> </ul>	N/A	N/A

<sup>181</sup> This has overlap with the 'Entrepreneurship innovations, business support and SMEs' theme

<sup>182</sup> This has overlap with the 'Entrepreneurship innovations, business support and SMEs' theme

	to climate change hazards such as an increased incidence of coastal storms, coastal and riverine flooding and coastal erosion (medium- to long-term intervention).	<i>inter alia</i> , developing climate-resilient housing and supplying electrical energy and water to newly constructed houses <sup>183</sup> . <ul style="list-style-type: none"> <li>The <i>Construction of infrastructures for protection of vulnerable communities</i> project aims to enhance the resilience of coastal communities to the effects of sea-level rise and associated coastal erosion and flooding. This will involve the climate-proofing of landing sites for canoes, the development of harbors, and the limiting of further coastal degradation through the construction of protective barriers.</li> </ul>		
Cross cutting projects involving energy and adaptation	N/A	<ul style="list-style-type: none"> <li>The <i>Construction of two hydro-power stations</i> project aims to facilitate increased rural electrification through the development of hydroelectric power stations in key areas.</li> </ul>	N/A	N/A
Value chains for agriculture	N/A	N/A	<ul style="list-style-type: none"> <li>Under CSP Outcome 1, additional soft measures include land reforms to support the expansion of the agricultural sector, the provision of training and advisory services to agricultural entrepreneurs, and facilitating access to credit to agricultural businesses<sup>184</sup> (AfDB).</li> </ul>	N/A
Nature based Solutions - Nature based Infrastructure - EbA	<ul style="list-style-type: none"> <li>The planting of drought-resilient species is suggested, in combination with reforestation of degraded areas (medium- to long-term intervention)</li> <li>A national programme of sustainable management of forest- and agro-ecosystems should be developed by 2025 (short- to medium-term intervention)</li> </ul>	<ul style="list-style-type: none"> <li>The <i>Sustainable management of forest resources</i> project will aim to restore forest resources in the country, as well as to implement regulations on the illegal exploration of forest resources.</li> <li>Additional recommendations include the: i) development of an awareness campaign against deforestation; ii) restoration and rehabilitation of degraded forest areas; iii) establishment of community forests in specific areas; iv) plantation of coconut</li> </ul>	N/A	N/A

<sup>183</sup> This has overlap with the 'cross-cutting projects involving energy and adaptation' theme

<sup>184</sup> This has overlap with the 'Entrepreneurship innovations, business support and SMEs' theme

		and bamboo forests; and v) rehabilitation of beaches.		
Water Energy Food Nexus	N/A	N/A	CSP Outcome 1 will facilitate ‘increased access to affordable and reliable energy and water supply in support of agricultural value chains development’ (AfDB). <ul style="list-style-type: none"> <li>• The <i>Mini-Hydro Promotion for Clean Energy and Water Management project</i> will include the rehabilitation of existing and construction of new mini-hydropower sites, to provide clean energy to rural areas. The project will include the construction of multipurpose water storage facilities to increase water access, as well as water irrigation canals to increase agricultural production activities<sup>185</sup> (CSP Outcome 1, Pillar I).</li> </ul>	N/A
Entrepreneurship innovations, business support and SMEs	N/A	<ul style="list-style-type: none"> <li>• The <i>Establishing the agro-tourist complexes at Monte Café and Porto Real</i> project will encourage the development of the agro-tourism industry in the project area to achieve poverty reduction and greater resilience to drought amongst beneficiaries<sup>186</sup>.</li> <li>• Additional recommendations include the establishment of agricultural and livestock subsidies for small producers to improve their income and wellbeing.</li> </ul>	<ul style="list-style-type: none"> <li>• Outcome 3, ‘Improved private sector capacity with a focus on the tourism sector and SMEs’ will target, <i>inter alia</i>, an increase in the: i) number of entrepreneurs receiving business development services; ii) number of micro-enterprises and SMEs benefitting from access to finance as a result of business plan development; and iii) number of private sector employees benefitting from training (Theme 1)<sup>187</sup>.</li> </ul>	N/A

<sup>185</sup> This has overlap with the ‘cross cutting projects involving energy and adaptation’ theme, as well as the ‘value chains for agriculture’ theme

<sup>186</sup> This has overlap with the ‘value chains for agriculture’ theme

<sup>187</sup> World Bank Group. 2014. Country Partnership Strategy for the Democratic Republic of Sao Tome and Principe for the period FY14–FY18

**Table 12.** Alignment of Tanzania's NDC, NAPA, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Tanzania				
Theme	Country Documents			
	NDC	NAPA <sup>188</sup>	Country Programme	Technology Needs Assessment <sup>189,190</sup>
Overview	Priority sectors for CCA interventions include: i) agriculture; ii) livestock; iii) forestry; iv) energy; v) coastal, marine environment and fisheries; vi) water resources; vii) tourism; viii) human settlements; and ix) health.	Priority sectors include: i) agriculture and food security (including livestock); ii) water; iii) energy; iv) forestry; v) health; vi) wildlife; vii) tourism; viii) industry; ix) coastal and marine resources; x) human settlements; and xi) wetlands.	Tanzania's GCF Country Programme is still under development .	<p>The two prioritised sectors in the adaptation TNA were agriculture and water. Major recommended technologies were: i) improved variety seeds, system of rice intensification and drip irrigation for agriculture; and ii) rainwater harvesting from rooftops, water leakage reduction programme and water recycling and reuse for the water sector.</p> <p>In the mitigation TNA, energy and forestry were prioritised sectors. Recommended technologies included: i) mini and micro hydro, sustainable use of biomass fuel and solar PV for the energy sector; and ii) sustainable forest management, agroforestry and mangrove conservation, rehabilitation and restoration for the forestry sector.</p>
Adaptation innovation and technology transfer	N/A	<p>Several relevant priority projects were identified in the NAPA, detailed below.</p> <ul style="list-style-type: none"> <li>● 'Improving water availability to drought-stricken communities in central part of the country', with a focus on improving water harvesting techniques and storage facilities.</li> </ul> <p>Additional proposed project activities include:</p> <ul style="list-style-type: none"> <li>● Develop alternative water storage programs and technology for communities (water)</li> <li>● Develop new water-saving technologies in irrigation (water)</li> </ul>	N/A	<p>Major technology transfer for the agricultural sector includes the following:</p> <ul style="list-style-type: none"> <li>● Farmyard manure and compost, to enhance nutrient availability for ensuring high yields</li> <li>● Water pumping technology</li> <li>● Water harvesting and storage structures</li> <li>● Improved irrigation systems, such as drip irrigation</li> <li>● Introduction of terracing</li> </ul> <p>Major technology transfer for the water sector includes the following:</p> <ul style="list-style-type: none"> <li>● Water re-claim and reuse</li> <li>● Rainwater harvesting from roofs and ground surfaces</li> </ul>

<sup>188</sup> United Republic of Tanzania. 2007. *National Adaptation Programme of Action*

<sup>189</sup> United Republic of Tanzania. 2016. *Technology Needs Assessment Report: Climate Change Adaptation*

<sup>190</sup> United Republic of Tanzania. 2016. *Technology Needs Assessment Report: Climate Change Mitigation*

		<ul style="list-style-type: none"> <li>Promotion of appropriate and efficient technologies to reduce use of wood (forestry)</li> </ul>		
Climate proofing infrastructure	<ul style="list-style-type: none"> <li>Facilitating provision of, and access to, adequate, affordable and climate-sensitive shelter to all income groups (human settlements)</li> <li>Construction and rehabilitation of drainage systems in response to frequent and high-intensity floods (human settlements)</li> </ul>	N/A	N/A	N/A
Cross cutting projects involving energy and adaptation	<ul style="list-style-type: none"> <li>Enhancing efficiency in wood fuel utilization (forestry)</li> <li>Exploring and investing in energy diversification system (energy)</li> <li>Promoting use of energy efficient technologies and behaviour (energy)</li> <li>Enhancing integrated basin catchment and upstream land management for hydro sources (energy)</li> <li>Enhancing the use of renewable energy potential across the country (energy)</li> </ul>	<p>Several relevant priority projects were identified in the NAPA, detailed below.</p> <ul style="list-style-type: none"> <li>'Community based mini-hydro for economic diversification as a result of climate change in the same district', focussed on Luguru village. The project aims to improve climate resilience of beneficiaries through providing a more predictable source of energy<sup>191</sup>.</li> </ul> <p>Additional proposed project activities include:</p> <ul style="list-style-type: none"> <li>Improve biomass to energy conversion efficiency (energy)</li> <li>Promotion of alternative sources of energy for both domestic and industrial use (forestry)</li> <li>Improve energy efficiency in industrial energy consumption (industry)</li> <li>Promote use of renewable energy sources (industry)</li> </ul>	N/A	<p>Several priority technologies were identified in the Mitigation TNA, including:</p> <ul style="list-style-type: none"> <li>Sustainable charcoal production methods (forestry sector)</li> </ul>
Value chains for agriculture	N/A	N/A	N/A	N/A
Nature based Infrastructure - EbA	<ul style="list-style-type: none"> <li>Mangrove and shoreline restoration programme (coastal, marine environment and fisheries)</li> </ul>	<p>Several relevant priority projects were identified in the NAPA, detailed below.</p> <ul style="list-style-type: none"> <li>'Climate change adaptation through participatory reforestation in Kilimanjaro</li> </ul>	N/A	<p>Several priority technologies were identified in the Mitigation TNA, including:</p> <ul style="list-style-type: none"> <li>Forest and landscape restoration (forestry)</li> </ul>

<sup>191</sup> This project also will encourage both 'entrepreneurship innovations, business support and SMMEs' as well as 'agricultural value chains', through supporting alternative sources of livelihood, particularly in the form of entrepreneurship in small-scale agro-processing industries, services like battery charging stations, refrigeration and water pumping.



	<ul style="list-style-type: none"> <li>● Enhancing conservation and fishery resource management (coastal, marine environment and fisheries)</li> </ul>	<p>Mountain', which specifically focusses on restoring degraded areas by establishing nurseries and replanting trees<sup>192</sup>.</p> <p>Additional proposed project activities include:</p> <ul style="list-style-type: none"> <li>● Range management for livestock production (agriculture)</li> <li>● Afforestation programmes in degraded lands using more adaptive and fast-growing tree species (forestry)</li> <li>● Restoration of degraded habitats (coastal and marine resources)</li> </ul>		<ul style="list-style-type: none"> <li>● Mangrove conservation, restoration and rehabilitation (forestry)</li> </ul>
Water Energy Food Nexus	N/A	N/A	N/A	N/A
Entrepreneurship innovations, business support and SMEs	<ul style="list-style-type: none"> <li>● Promoting livelihood diversification of livestock keepers (livestock)</li> <li>● Promoting development of livestock insurance strategies (livestock)</li> <li>● Promoting livelihood diversification for coastal communities (coastal, marine environment and fisheries)</li> <li>● Promoting sustainable tourism to consolidate growth and ensure climate-resilient tourism (tourism)</li> </ul>	<p>Several relevant priority projects were identified in the NAPA, detailed below.</p> <ul style="list-style-type: none"> <li>● 'Shifting of shallow water wells affected by inundation on the coastal regions of Tanzania Mainland and Zanzibar', with an activity dedicated to promoting alternative income generating opportunities to reduce pressure on coastal resources. <p>Additional proposed project activities include:</p> <ul style="list-style-type: none"> <li>● Establish alternative source of income for the community in the tourist area (tourism)</li> </ul> </li></ul>	N/A	<p>Several priority technologies were identified in the Mitigation TNA, including:</p> <ul style="list-style-type: none"> <li>● Introduction of Mini and Micro Hydropower (energy), which would rely on incentivising and encouraging local entrepreneurs and businesses to invest in rural electrification.</li> </ul>

<sup>192</sup> This project also will encourage 'entrepreneurship innovations, business support and SMMEs' through supporting alternative sources of livelihoods.

**Table 13.** Alignment of Zambia’s NDC, NAPA, Country Programme and TNA with proposed themes for CTI, ESI and ETI.

Country: Zambia				
Theme	Country Documents			
	NDC	NAPA <sup>193,194</sup>	Country Programme <sup>195</sup>	Technology Needs Assessment <sup>196</sup>
Overview	Major climate change impacts experienced in Zambia include ‘drought and dry spells, seasonal and flash floods and extreme temperatures’. The priority sectors which are affected by these climate impacts include water, agriculture, forestry, wildlife, tourism, mining, energy, infrastructure and health <sup>197</sup> .	The key adaptation priorities are: i) agriculture and food security; ii) human health; iii) water and energy sector; and iv) natural resources — wildlife and forest sector.	The African Development Bank’s (AfDB) Country Strategy Paper for Zambia (CSP, 2017–2021) has the overall objective to ‘reduce poverty and malnutrition, and lessen vulnerability through a dynamic and sustainable private sector that creates jobs’. This is achieved through two pillars: i) support to infrastructure development (Pillar I) <sup>198</sup> ; and ii) support to private sector development (Pillar II) <sup>199</sup> .	Priority sectors identified for climate change adaptation in the technology needs assessment (TNA) include: i) agriculture and food security; and ii) water.
Adaptation innovation and technology transfer	The adaptation contribution of Zambia’s NDC includes the following targets. <ul style="list-style-type: none"> <li>• The introduction of water technologies for saving, recycling, irrigation and sustainable management for household, agriculture and industrial purposes.</li> </ul>	<ul style="list-style-type: none"> <li>• Use of technologies for fertility improvement and moisture storage (agriculture and food security)</li> <li>• Application of GIS/remote sensing in the mapping of flood-prone areas (agriculture and food security)</li> <li>• Use of insecticide-treated nets and other vector-control measures to prevent malaria, combined with climate-based early warning systems and GIS-mapping</li> </ul>	N/A	Within the water sector, several technologies were suggested to improve water availability and water quality in Zambia. In order of priority, these include the following: i) rainwater collection from ground surfaces; ii) boreholes/tube wells for domestic water supply during drought; iii) improving the resilience of protected wells to flooding; iv) increasing the use of water-efficient fixture and appliances; v) household drinking water treatment and safe storage; vi) leakage management, detection and repair in piped systems; vii) post-construction support for community-managed water supplies;

<sup>193</sup> The Zambia NAP is currently under development, and is being funded by GCF Readiness Funds which were awarded in 2020.

<sup>194</sup> Ministry of Tourism, Environment and Natural Resources. 2007. *Formulation of the National Adaptation Programme of Action on Climate Change*.

<sup>195</sup> African Development Bank Group. 2017. Zambia Country Strategy Paper 2017–2021 combined with the 2017 Country Portfolio Performance Review.

<sup>196</sup> Republic of Zambia. 2012. Technology Needs Assessment for Climate Change Adaptation. [online] Available: <https://tech-action.unepdtu.org/wp-content/uploads/sites/2/2013/12/technologyneedsassessment-adaptation-zambia-13.pdf>

<sup>197</sup> Government of Zambia. 2016. *Intended Nationally Determined Contributions*.

<sup>198</sup> Priority infrastructure includes energy, transportation and water and sanitation.

<sup>199</sup> Priority activities include enterprise development and agriculture.

		of vulnerable localities (human health)		<p>viii) water reclamation and reuse; ix) water safety plans; x) rainwater harvesting from rooftops; and xi) ground and surface water monitoring systems.</p> <p>Within the agriculture and food security sector, several technologies were identified. In order of priority, technologies include: i) conservation tillage and land husbandry; ii) mixed farming; iii) agro-forestry; iv) crop diversification and new varieties; v) establishment of water rights that are supportive of sustainable agriculture development; vi) rainwater harvesting; vii) promotion of treadle pumps for irrigation; viii) farmer field schools; ix) use of legitimate and legal fishing gears; x) participatory extension system; xi) promotion of community fish ponds; xii) national climate change monitoring system; xiii) decentralised community-run early warning systems; xiv) introduction of chorkor smoking kilns for fishers in all viable fisheries; xv) construction of improved granaries for small scale farmers; xvi) livestock disease management; xvii) promotion of feed conservation practices during dry season for livestock farmers; xviii) promotion of food and nutrition management; and xix) selective breeding via controlled mating.</p>
Climate proofing infrastructure	<p>The adaptation contribution of Zambia's NDC includes the following targets.</p> <ul style="list-style-type: none"> <li>Development of an insurance market for climate-induced risks on, <i>inter alia</i>, infrastructure.</li> </ul>	<ul style="list-style-type: none"> <li>Water treatment for quality control and climate-proofing sanitation infrastructure (human health)</li> </ul>	<ul style="list-style-type: none"> <li>The CSP will facilitate investment in the development of climate-resilient small and medium 'multipurpose surface water storage dams and</li> </ul>	<ul style="list-style-type: none"> <li>Improving the resilience of protected wells to flooding (water)</li> </ul>

			reservoirs to mitigate the effects of drought' (Pillar I)	
Cross cutting projects involving energy and adaptation	<p>The mitigation contribution of Zambia's INDC includes the following targets, which have cross-cutting elements of adaptation.</p> <ul style="list-style-type: none"> <li>● Sustainable agriculture, including, <i>inter alia</i>, the introduction of smart/conservation agriculture, the establishment of rural biogas plants and biomass electricity generating facilities. The adaptation co-benefits of this activity include improved adaptive capacity through energy security as well as greater climate-resilience of subsistence based farmers and the diversification of livelihoods.</li> </ul>	<ul style="list-style-type: none"> <li>● Inter-basin water transfers<sup>200</sup> (water and energy sector)</li> <li>● Regional integration of electricity infrastructure from biomass sources (water and energy sector)</li> <li>● Efficient use of charcoal and expanded use of ethanol stoves (water and energy sector)</li> <li>● Improving energy access and security as a way to adapt to drought and high temperatures (natural resources — wildlife and forest sector)</li> </ul>	N/A	N/A
Value chains for agriculture	N/A	<ul style="list-style-type: none"> <li>● Improvement of post-harvest storage and marketing of produce (agriculture and food security)</li> </ul>	<ul style="list-style-type: none"> <li>● The CSP will 'improve water usage for irrigation to boost agricultural productivity and generate rural employment opportunities (Pillar I)</li> <li>● Moreover, the agricultural sector will be supported through interventions which 'address issues along selected value chains to enhance productivity and production, while supporting the establishment of rural agricultural enterprises' (Pillar II)</li> </ul>	<ul style="list-style-type: none"> <li>● Introduction of chorkor smoking kilns for fishers in all viable fisheries (agriculture and food security)</li> <li>● Construction of improved granaries for small scale farmers (agriculture and food security)</li> <li>● Farmer field schools (agriculture and food security)</li> </ul>
Nature based Solutions - Nature based Infrastructure - EbA	<p>The mitigation contribution of Zambia's INDC includes the following targets, which have cross-cutting elements of adaptation.</p> <ul style="list-style-type: none"> <li>● Sustainable forest management, including, <i>inter alia</i>, regeneration and afforestation, sustainable charcoal production and</li> </ul>	<ul style="list-style-type: none"> <li>● Targeting afforestation and reforestation programmes to control siltation of streams and rivers as well as to provide fuelwood to minimize encroachment into forests</li> </ul>	N/A	<ul style="list-style-type: none"> <li>● Conservation tillage and land husbandry (agriculture and food security)</li> <li>● Mixed farming (agriculture and food security)</li> <li>● Agro-forestry (agriculture and food security)</li> </ul>

<sup>200</sup> This has overlap with the theme 'adaptation innovation and technology transfer'.

	<p>improved cooking devices<sup>201</sup>. This will create adaptation co-benefits including enhanced adaptive capacity of beneficiary communities, which will be realized through greater energy security, improved job opportunities and alternative livelihoods, and improved production of ecosystem services.</p> <p>The adaptation contribution of Zambia's NDC includes the following targets.</p> <ul style="list-style-type: none"> <li>● Climate smart agriculture practices for crop, livestock and fisheries production, the benefits of which will include enhanced soil fertility and conservation, agro-biodiversity conservation, and the enhanced resilience of crop, livestock and fishery systems.</li> </ul>	(natural resources — wildlife and forest sector)		
Water Energy Food Nexus	<p>The adaptation contribution of Zambia's NDC includes the following targets.</p> <ul style="list-style-type: none"> <li>● Protection and conservation of water catchment areas and enhanced investment in water capture, storage and transfer<sup>202</sup>. Proposed interventions include enhancing water storage infrastructure, investing in rainwater harvesting, implementing catchment-level restoration schemes and developing integrated water management plans. These will have overlap with, <i>inter alia</i>, the agriculture and energy sectors.</li> </ul>	N/A	N/A	N/A
Entrepreneurship innovations, business support and SMEs	<p>The adaptation contribution of Zambia's NDC includes the following targets.</p> <ul style="list-style-type: none"> <li>● Capacity building in the areas of, <i>inter alia</i>, climate-smart agriculture, sustainable forest management, sustainable fisheries and aquaculture, renewable energy</li> </ul>	<ul style="list-style-type: none"> <li>● Promotion of community woodlots for the provision of fuelwood and as sources of alternative cash income (natural resources — wildlife and forest sector)</li> </ul>	N/A	<ul style="list-style-type: none"> <li>● Farmer field schools (agriculture and food security)</li> </ul>

<sup>201</sup> These interventions have overlap with the theme 'cross-cutting projects involving energy and adaptation'

<sup>202</sup> These interventions overlap with the theme 'adaptation innovation and technology transfer'

	<p>technologies and climate change planning. These will include the provision of training to farmers, extension and technical staff on the aforementioned topics, as well as the dissemination of essential climate change information.</p>	<ul style="list-style-type: none"><li>• Community-based ranching to protect vulnerable species (natural resources — wildlife and forest sector)</li></ul>		
--	---	---	--	--

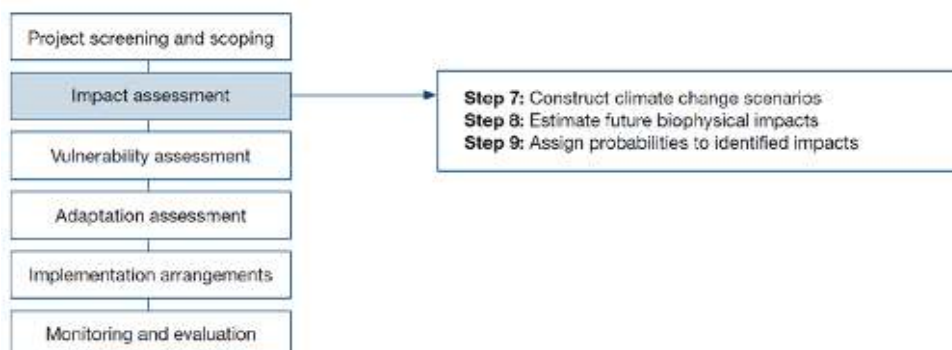
## Annex 4: CTI/ESI/ETI linkages with national programming/planning documents

### 4.1. Climate-proofing infrastructure

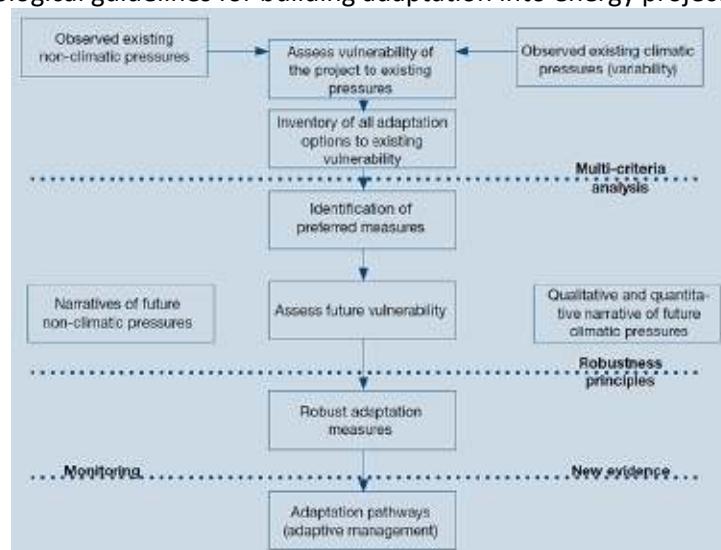
Climate-proofing infrastructure is a type of climate change adaptation (CCA) intervention which can be critical to improving the resilience of beneficiaries to extreme climate events, such as tropical cyclones, flooding or drought. Two of the most relevant definitions for climate-proofing are detailed below.

UNDP (2011): Climate proofing refers to the explicit consideration and internalization of the risks and opportunities that alternative climate change scenarios are likely to imply for the design, operation, and maintenance of infrastructure. In other words, integrating climate change risks and opportunities into the design, operation, and maintenance of infrastructure.

Ebinger and Vergara (2011): Climate Proofing: Actions taken to lessen, or perhaps eliminate, the potential negative impacts of weather and climate variability and of climate change through the life cycle of a project (p. 75). The methodological approach presented in this Guidelines for building adaptation into energy investment projects is divided into six different sets of activities (Figure 12). The process begins with scoping the project and defining the assessment and its objectives. The core activities related to project design fall under impact assessment, vulnerability assessment, and adaptation assessment.



**Figure 12.** Methodological guidelines for building adaptation into energy projects.



**Figure 13.** Integrating evidence-based assessments in order to define adaptation pathways. The specific manner in which climate-proofing infrastructure is implemented will depend on the

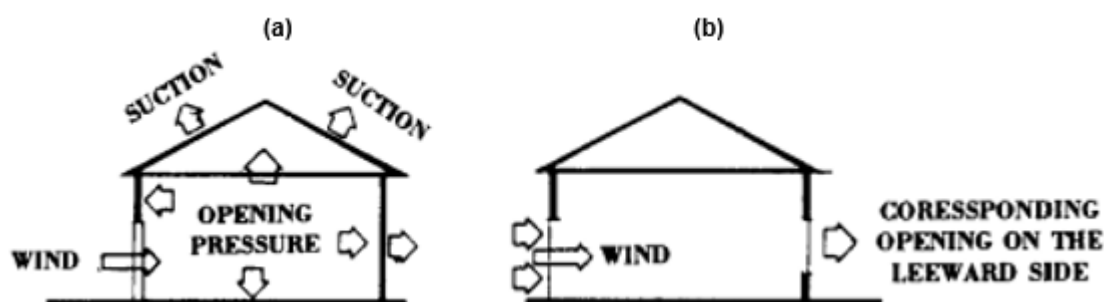


unique context to which it is responding. The most common climate change impacts which require the climate-proofing of infrastructure include hurricanes/cyclones, floods, coastal erosion and droughts.

#### 4.1.1. Hurricanes/Cyclones

In Antigua and Barbuda, one significant climate change impact is an increased frequency of high-intensity hurricanes, and the return rate of Category 4 hurricanes has shortened from 1 in 50 years (1900–1950) to 1 in 10 years (1950–2000). Two Category 5 hurricanes — Hurricane Irma and Hurricane Maria — made landfall in the country in 2017 for the first time in recorded history, generating a combined US\$136 million in damages and US\$19 million in post-hurricane economic losses<sup>203</sup>. In particular, the transportation, electricity, telecommunications and water and sanitation sectors recorded significant losses of ~US\$21.1 million in damage and losses, and ~US\$38.3 million in recovery needs. Approximately 117 km and ~8km of roads across Antigua and Barbuda, respectively, required restoration, and ports and the Codrington airport on Barbuda were forced to close caused by extensive damages. The entire electricity generation and distribution network on Barbuda was heavily damaged, and Hurricane Irma caused the contamination of all water sources on the island<sup>204</sup>. The potential impact of a Category 5 hurricane includes the disruption of electricity provision for 3–24 months, and the disruption of access to transportation and telecommunications infrastructure for up to 6 months<sup>205</sup>. This series of high-intensity climate events prompted the development of a funding proposal, approved by the GCF in 2020, to implement climate-proofing interventions in the building sector. Interventions are targeted at reducing wind damage and optimal designs for wooden and concrete structures.

Interventions to reduce wind damage — such as the explosion of internal walls or collapse of a roof as a result of a build-up of pressure on internal surfaces of a building — include creating parallel openings in a building to allow wind to pass easily through the building (Figure 14). The roofs of buildings can also be made more hurricane-resilient through ensuring the pitch of a roof is at least 25° to prevent a roof from being lifted upward from beneath (Figure 16). Ensuring the pitch is between 25°–40° is considered most wind resistant (Figure 15). Best practices for improving the climate resilience of wooden structures include securely bracing the corners and intersections of the structure (Figure 17), as well as ensuring the foundations are well anchored (Figure 18). Finally, when enhancing the climate resilience of concrete structures, best practices include, *inter alia*, ensuring that walls are anchored to the floor (Figure 19), and reinforcing walls both horizontally and vertically (Figure 20).



**Figure 14.** (a) Pressure on internal surfaces from wind entering through openings on the windward side; (b) Relieving pressure exerted on the internal surfaces of a building<sup>206</sup>.

<sup>203</sup> GCF. 2020. FP133: Resilience to hurricanes in the building sector in Antigua and Barbuda.

<sup>204</sup> Government of Antigua and Barbuda. 2018. Hurricane Irma Recovery Needs Assessment: A Report by the Government of Antigua and Barbuda.

<sup>205</sup> GCF. 2020. FP133: Resilience to hurricanes in the building sector in Antigua and Barbuda.

<sup>206</sup> DOE. 2019. Guide on Best Construction Practices

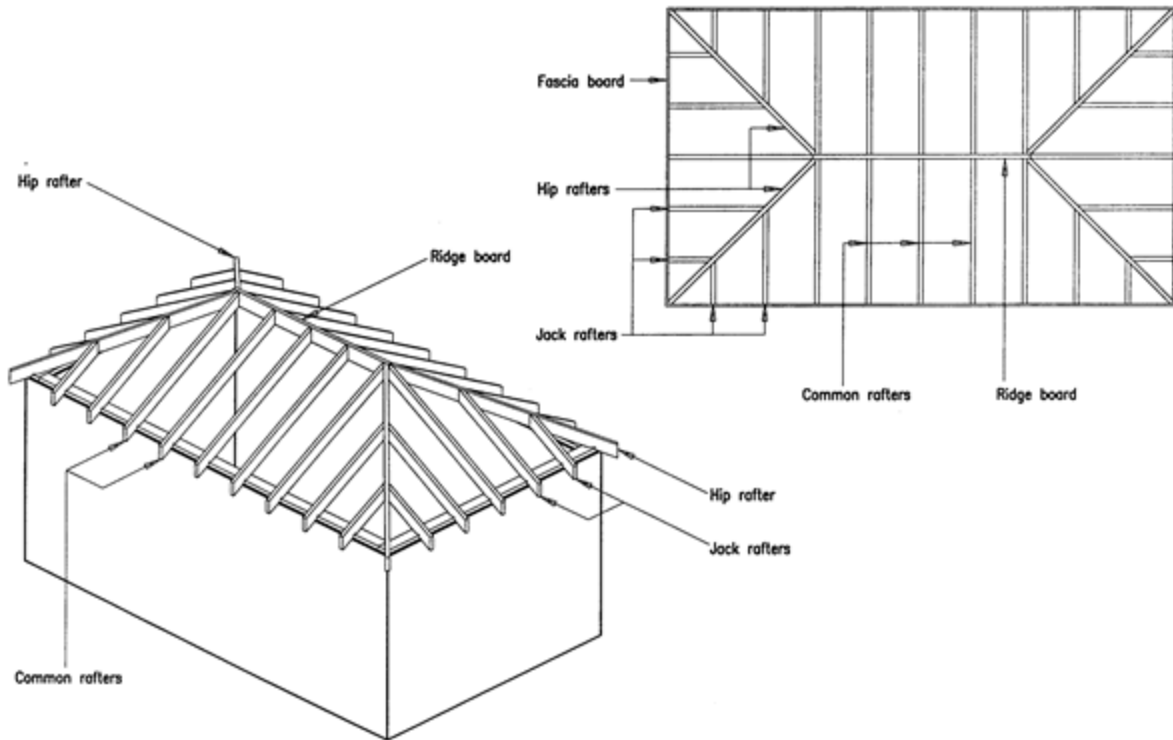


Figure 15. Hip roof configuration with a pitch of 25–40°<sup>207</sup>.

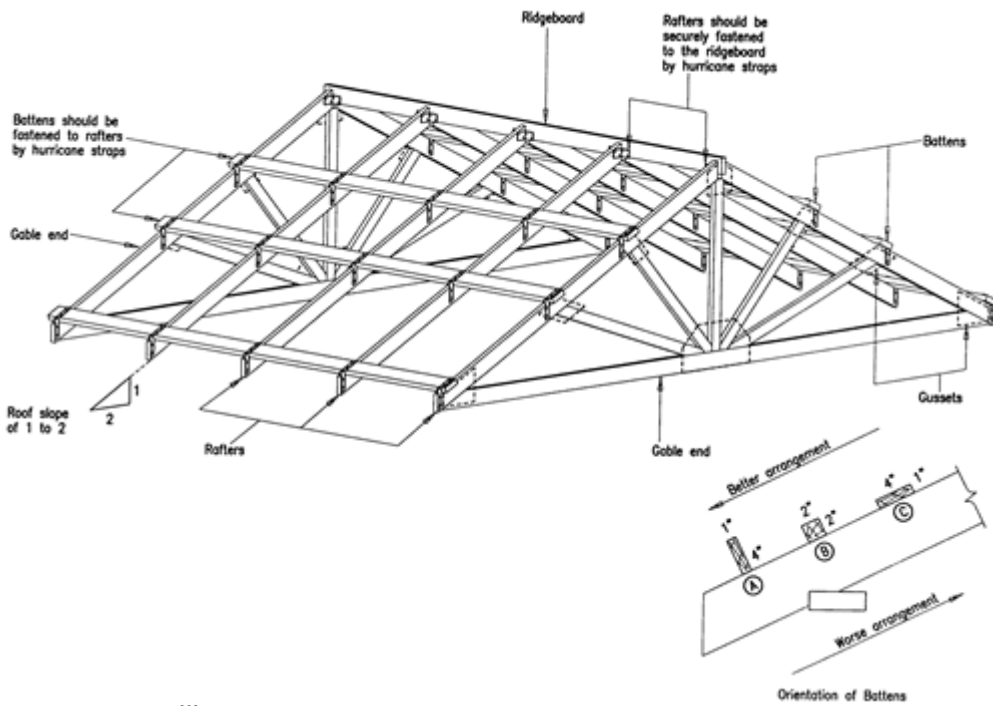


Figure 16. Gable roof<sup>208</sup>.

<sup>207</sup> DOE. 2019. Guide on Best Construction Practices

<sup>208</sup> DOE. 2019. Guide on Best Construction Practices

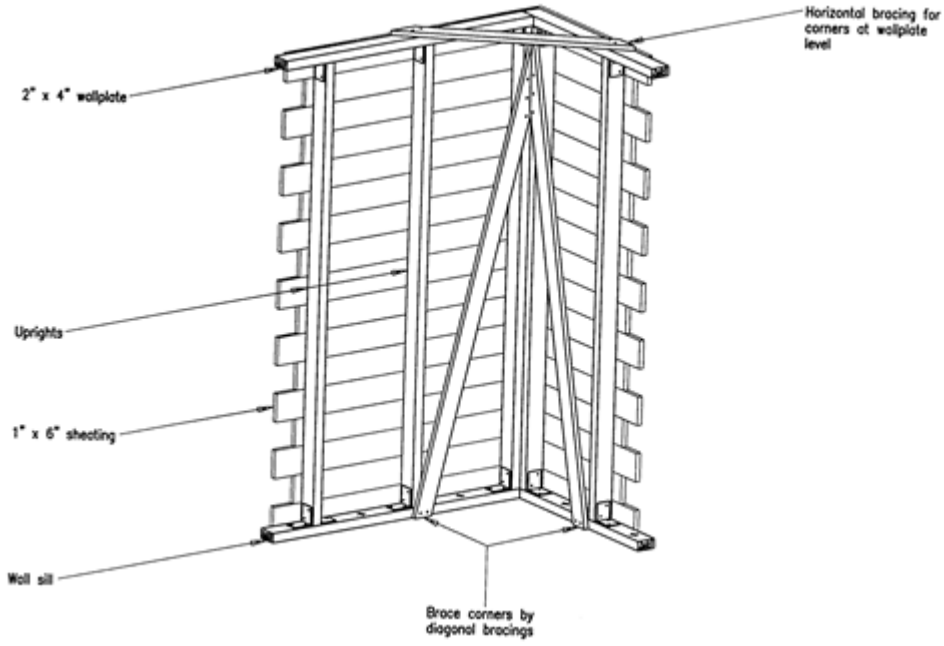


Figure 17. Details of timber frame corner brace<sup>209</sup>.

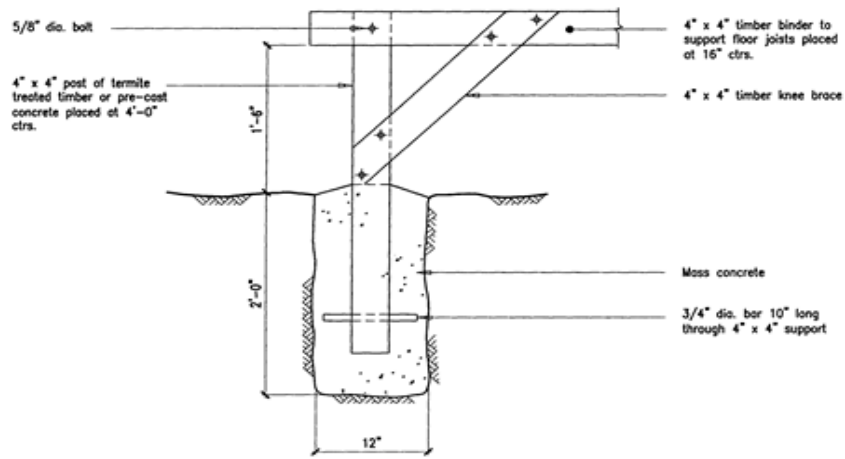


Figure 18. Details of wooden post anchorage<sup>210</sup>.

<sup>209</sup> DOE. 2019. Guide on Best Construction Practices

<sup>210</sup> DOE. 2019. Guide on Best Construction Practices

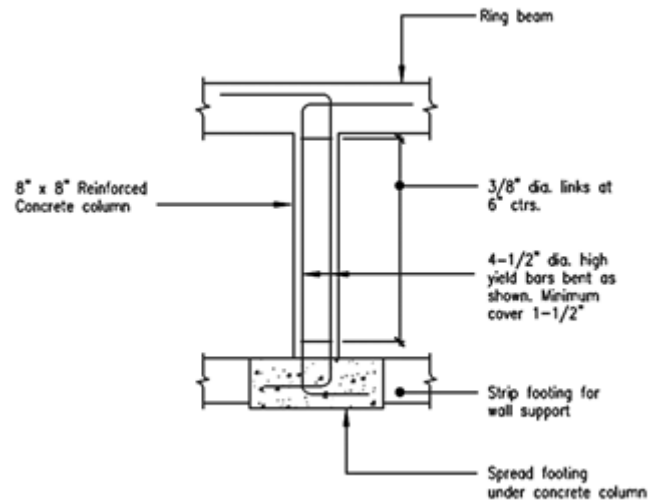


Figure 19. Column Anchorage Detail<sup>211</sup>.

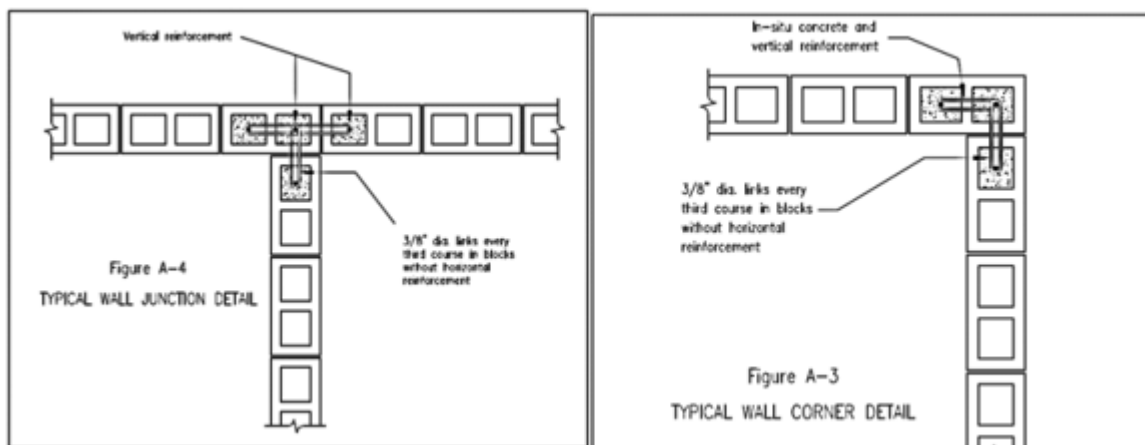


Figure 20. Wall junction and corner reinforcement<sup>212</sup>.

#### 4.1.2. Flooding

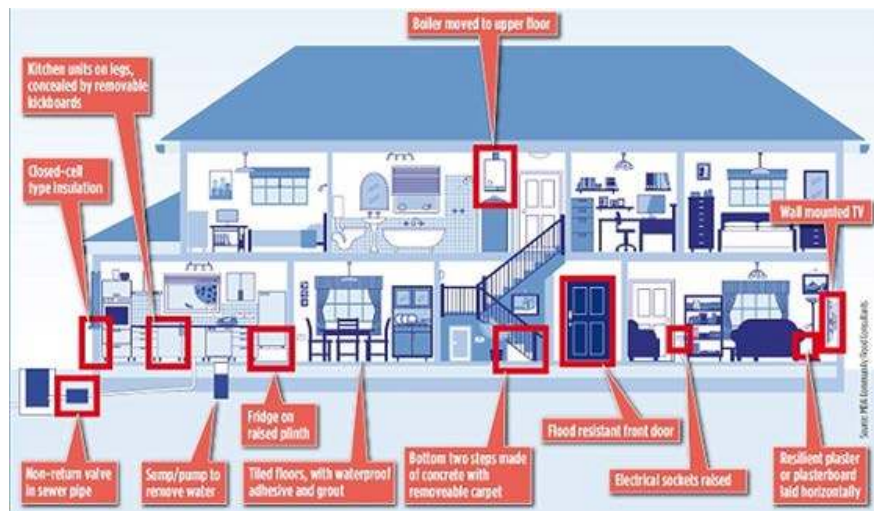
The *Climate change adaptation in vulnerable coastal cities and ecosystems of the Uruguay River project* is implementing a variety of hard interventions to mitigate against flooding, including the: i) refurbishing the access bridge in Rio Negro Department, Uruguay through structural improvements and enhanced accessibility; ii) construction of a multifunctional emergency services centre to provide long-term shelter for displaced flood victims in the city of Bella Union (Uruguay); iii) creation of a Revolving Fund for residents in medium flood-risk areas in Paysandu (Uruguay) to upgrade their homes to withstand regular flooding. The Revolving Fund will provide interest-free loans, subsidies and technical advice to flood-proofing measures. Specific upgrades which will be funded include constructing entrance steps and raising the floor level above the street level, increasing the structural integrity of buildings to withstand the pressure and under-pressure exerted by flood water, adapting the electrical and internal sanitary systems to withstand flooding situations, waterproofing walls, installing flood locks on doors, and repairing the home after flood events (Figure 21). The use of these micro-loans to construct basements is strictly prohibited<sup>213</sup>. In combination with flood prevention measures, flood mitigation interventions are additionally used to reduce flooding wherever possible,

<sup>211</sup> DOE. 2019. Guide on Best Construction Practices

<sup>212</sup> DOE. 2019. Guide on Best Construction Practices

<sup>213</sup> Adaptation Fund. Climate change adaptation in vulnerable coastal cities and ecosystems of the Uruguay River Part I: Program Information. [online] Available: <https://www.adaptation-fund.org/wp-content/uploads/2019/01/6320RioUruguayProjectFullProposal17022019CLEAN.pdf>

and preventative measures have been designed such as the resignification of flood-prone areas as conservation sites to prevent the development of informal settlements.



**Figure 21.** Examples of flood-proofing measures in a residential home<sup>214</sup>.

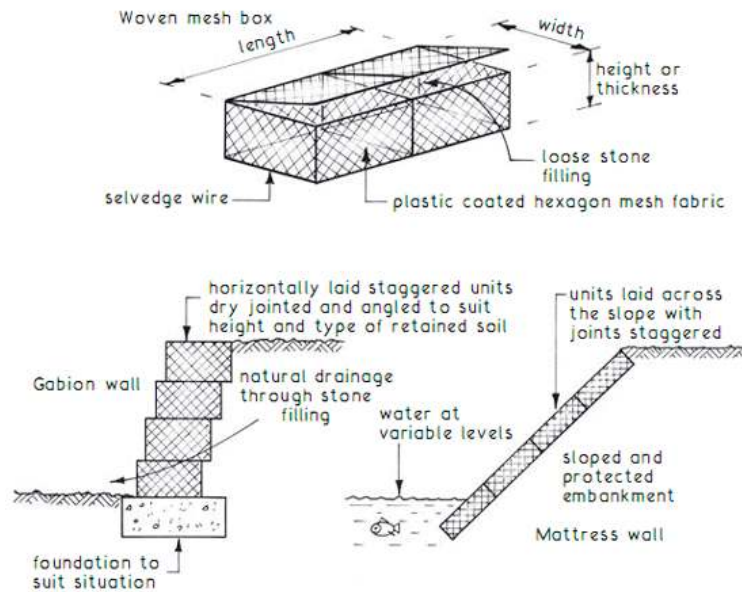
The Enhance community, local and national-level urban climate change resilience to water scarcity, caused by floods and droughts in Rawalpindi and Nowshera, Pakistan project will improve community and household resilience to water insecurity caused by both flooding and droughts, within urban areas. This aims to install rainwater harvesting systems across public buildings and individual houses to act as storage facilities.

#### 4.1.3. Coastal erosion

The *Climate change adaptation in vulnerable coastal cities and ecosystems of the Uruguay River project* is addressing coastal erosion through measures including hard infrastructure (gabions and mattresses) to support an existing concrete wall (Figure 22). Gabions are a preferred hard infrastructure intervention as the porous structure allows a freer flow of water through the walls<sup>215</sup>.

<sup>214</sup> Metropolis Surveying Services. 2017. How to flood proof your home: We visit 'Resilient House' with latest defences to help protect against expensive water damage. [online] Available: <https://www.metropolis-surveyors.com/blog/how-to-flood-proof-your-home-we-visit-resilient-house-with-latest-defences-to-help-protect-against-expensive-water-damage>

<sup>215</sup> Gabion Baskets. N.d. Gabions and River or Reno Mattresses. [online] Available: <https://www.gabionbaskets.co.za/gabions-and-river-mattresses/>

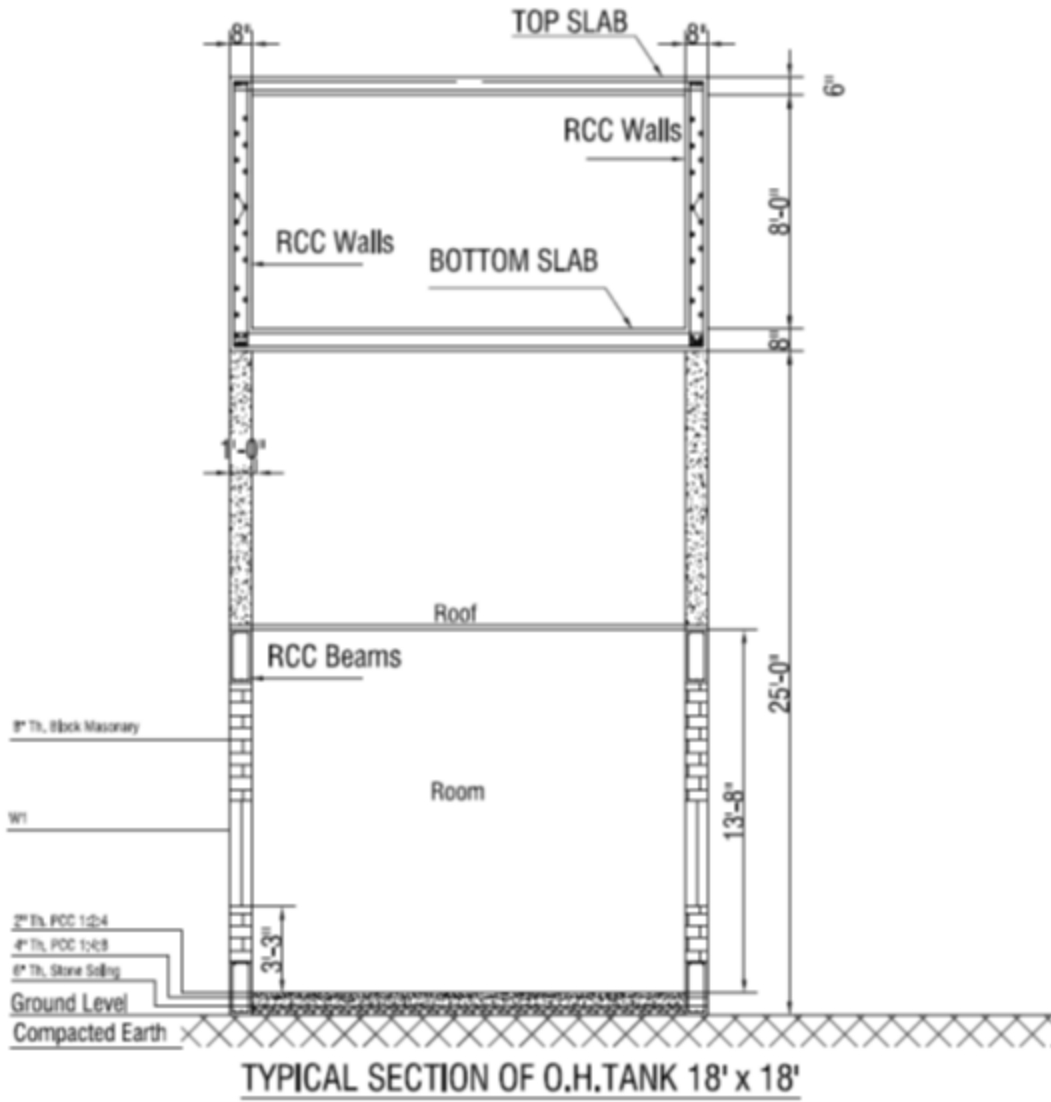


**Figure 22.** Gabion and mattress walls<sup>216</sup>.

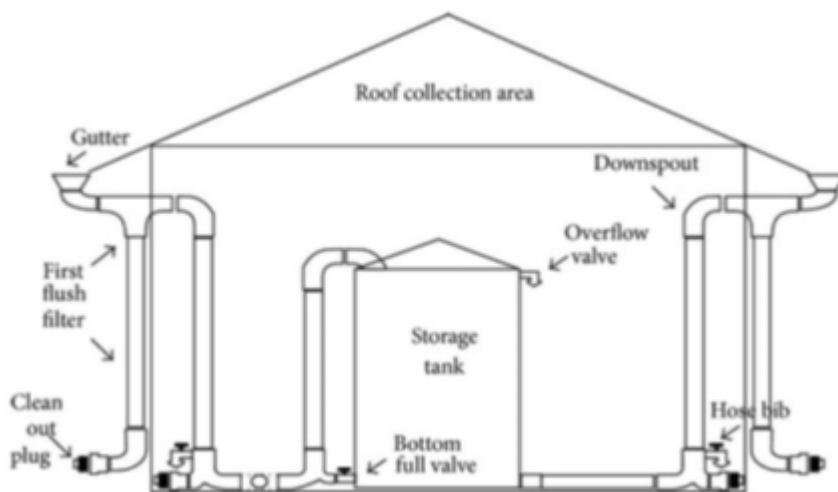
The *Enhancing the resilience inclusive and sustainable eco-human settlement development through small scale infrastructure interventions in the coastal regions of the Mekong Delta in Viet Nam project* will also be climate-proofing infrastructure against sea-level rise (SLR) and associated coastal erosion, through specific interventions including the: i) implementation of water treatment and rainwater harvesting systems to prevent saltwater intrusion (related to SLR) and protect groundwater; and ii) use of Elastocoast as a green erosion rehabilitation and control system to prevent coastal erosion. The project document notes that a great deal of climate change-induced environmental degradation had already occurred in the project region, necessitating the use of both hard and soft interventions. Hard interventions include: i) rainwater harvesting systems and water treatment systems, focussing on increasing the diversity of available water resources and increasing the accessibility of potable water, respectively; and ii) coastal erosion prevention system.

There are several options available for installing rainwater harvesting systems in both private houses as well as larger (commercial or mixed-use) buildings. These include the installation of rainwater harvesting tanks on the roof of the building, which requires a flat-roof building that is reinforced to withstand the weight of the tank (Figure 23). Alternate designs have been developed to implement in low-income and/or rural areas, where structural integrity of buildings may not be able to withstand this force (Figure 24). It is also possible to use underground tanks for water storage, which is common either when it is not possible to install a rainwater tank on the roof, or when there is a space shortage in the building (Figure 25). Underground tanks are not commonly found in residential buildings, but are rather reserved for use with larger, public buildings.

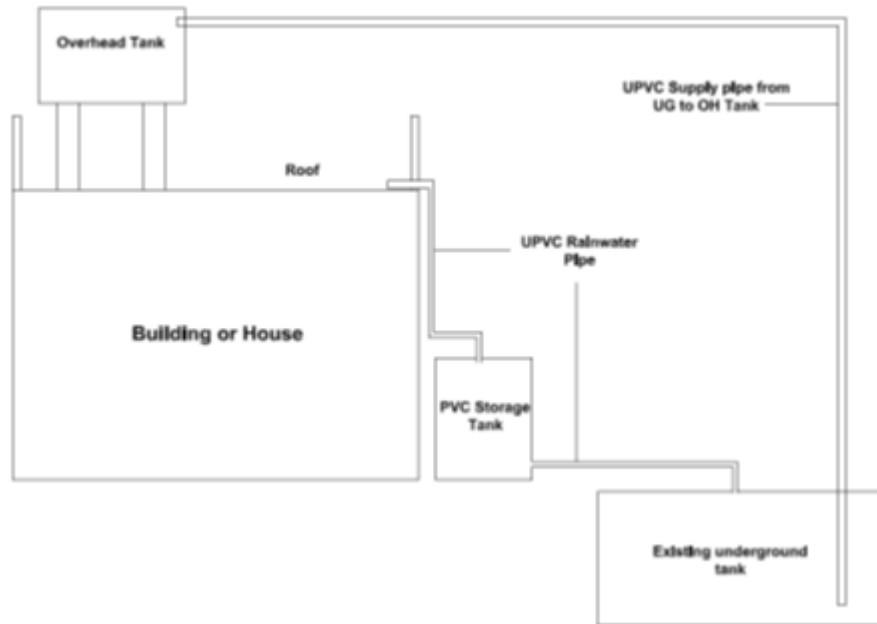
<sup>216</sup> Builders Engineer. 2015. Gabions and Mattresses. [online] Available: <http://www.buildersengineer.info/2015/10/gabions-and-mattresses.html>



**Figure 23.** Standard rooftop rainwater harvesting system.

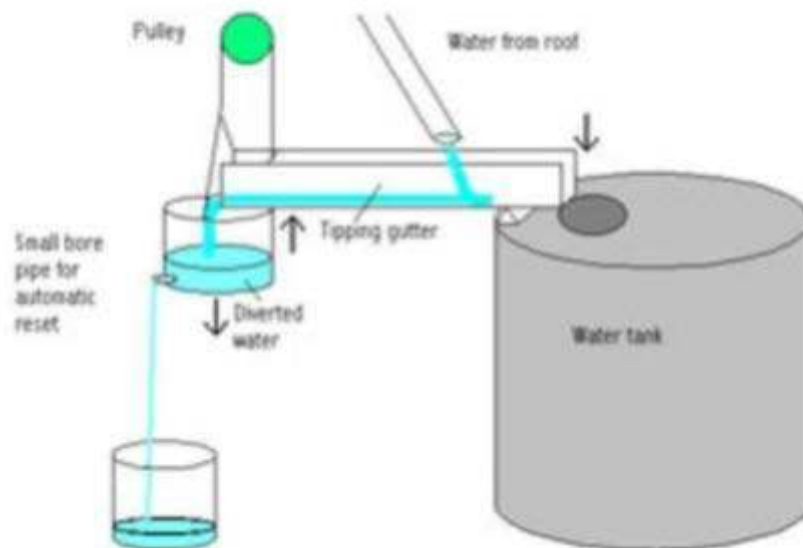


**Figure 24.** Alternate design of a rainwater harvesting system.



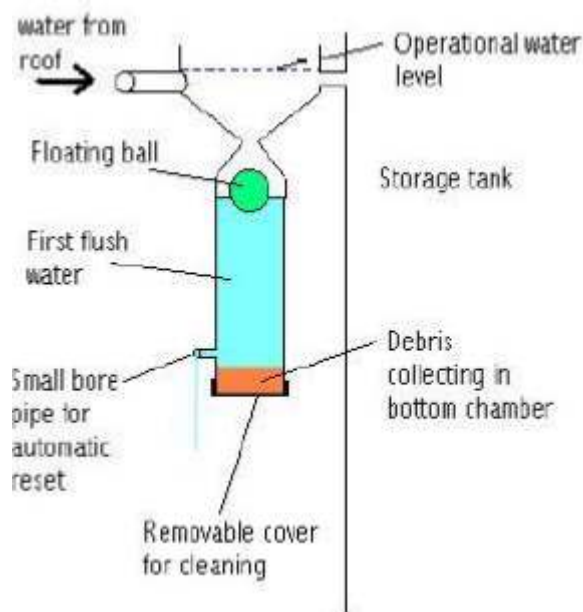
**Figure 25.** Example of an underground design.

It must be noted that the rainwater harvesting systems outlined above do not generally include provisions for water filtration to ensure that the water is potable. Debris and other contaminants are, however, prevented from entering the system which will help avoid any blockages. Common filtration systems, which can be integrated with the systems described above, include the: i) tipping gutter flush first system (Figure 26); and ii) floating ball flush first system (Figure 27).



**Figure 26.** Tipping gutter flush first filtration system.





**Figure 27.** Floating ball flush first filtration system.

Innovative adaptation technologies were also included in the project design in the form of Elastocoast or porous coast. This technology will be implemented along coastal zones between mangrove trees and the land to protect dikes and mitigate coastal erosion through absorbing the force of breaking waves and reducing the speed of water bodies. Figure XX above demonstrates the layers of Elastocoast as it would be applied in the nine selected project sites.

#### 4.1.4. Adaptive management

Adaptation management consists of putting in place incremental adaptation options over the project's lifetime. There are three types of decision stages for climate proofing infrastructure: i) Invest now in climate-proofing (Type 1); ii) Do not invest now in climate proofing but ensure that the project is designed in such a way as to be amenable to be climate proofed in the future if and when circumstances indicate this to be a better option than not climate proofing (Type 2); and iii) Make no changes to project design, monitor changes in climate variables and their impacts on the infrastructure assets, and invest in climate proofing if and when needed at a later point in time (Type 3).

## 4.2. Sustainable Port Design

Ports are the lifelines of Small Island Development States (SIDS) and require resiliency. The climate risks that threaten ports include strong waves and winds, sea level rise, extreme rainfall and temperatures. Ports are also a type of infrastructure that enables significant cross-cutting benefits; They require energy self-sufficiency so that countries do not depend on imported and heavily polluting diesel as an energy source. Most importantly, ports are one area of infrastructure that can enable a paradigm shift for SIDS and other developing countries: Reliable maritime connectivity brings a sustainable supply of essential goods (water, food, health) and an enhanced fishing sector.

Based on worldwide port designs in regions such as the Mediterranean, the following measures enable sustainable services<sup>217,218,219</sup>:

<sup>217</sup> <https://www.docksthefuture.eu/docks-the-future-dtf-defining-the-concept-of-the-sustainable-future-ports/>

<sup>218</sup> <https://nqbp.com.au/sustainability/sustainability-plan-2015/sustainability-review-2017>

<sup>219</sup> <https://supair.adrioninterreg.eu/library/supair-project-factsheets>

- Green design of the port-city — landscaping of port area with trees and green spaces to absorb noise and air pollution and reduce wind/dust impacts
- Policies and regulatory framework for reduction of the emissions of harmful substances
- Utilization of renewable energy sources in port operations and activities
- Circular Economy - Resource, Reduction, Reuse and Recovery Program
- Establishment of Energy Management and/or Environmental Management Systems
- Certification as EcoPorts initiative
- Digitalization and automation of port operations and activities.



**Figure 28.** GCF accepted proposal on climate-proofing the Nauru port.

Figure 28 above shows measures to climate proof ports. These measures include:

- Construction of a wharf structure dredged into the reef to create an area for berthing, loading, discharging cargo and passengers protected from CC
- Construction of a long breakwater for protection from waves
- Dredging of a navigable canal between the ocean and the wharf (without barges will remain exposed offshore to the mounting weather and wave hazards due to climate change)
- Mitigation: ships spend considerably less time at sea whilst being unloaded/loaded, thereby leading to significant reduction in CO<sub>2</sub> emissions

#### 4.3. Robust Transport Infrastructure

##### 4.3.1. Impact of climate change on transportation infrastructure

There are several observed and projected climate change impacts which undermine the integrity and efficiency of transport networks, including: i) shifts in temperature, rainfall, wind and visibility on road networks; and ii) sea level rise, particularly the threat of increased flooding events and associated damages. Paved roads are affected by increasing temperatures and shifting rainfall patterns including increased incidences of flooding, while unpaved roads and bridges are exposed to increased incidences of flooding. Extreme temperatures and an increased incidence of storms have been

demonstrated to affect railway networks<sup>220</sup>. Resultantly, CCA projects in the transport sector are focussed on reducing the exposure and increasing the resilience of transport networks to climate change impacts and hazards.

Climate impacts on transport networks can be further divided into direct physical impacts, and direct non-physical impacts. Direct physical impacts affect the transport system itself, and include the effects outlined above. For example, a 2017 drought in California which was followed immediately by a high-intensity rainfall event caused flooding and mudslides along major highways. Direct non-physical impacts affect transportation networks by impacting the decision-making processes and behaviour of its users<sup>221</sup>.

#### 4.3.2. Partnerships for upscaling investment in low-carbon transportation infrastructure

An important consideration when facilitating a transition in the transportation sector toward electronic vehicles (EVs) is how to encourage private sector investment in upscaling pilot projects to a regional and national level. Studies have shown that initial public investment in public charging infrastructure is a prerequisite to stimulating a transition from internal combustion engine (ICE) vehicles to EVs<sup>222</sup>. The availability of public charging infrastructure contributes to reducing range anxiety<sup>223</sup> among consumers and creates an enabling environment to demonstrate the viability of the EV market to potential private investors. This public investment should be supported by the development of policies to encourage the commercialization of charging infrastructure. Potential policies include: i) offering tax credits, rebates, priority parking and high occupancy vehicle lane access to encourage consumer adoption of EVs<sup>224</sup>; and ii) creating incentives for private sector investment such as providing dedicated subsidies, convening regular bids for projects, and creating public-private partnerships<sup>225,226</sup>. A variety of innovative best practices can be drawn from regions including Europe and Asia. In Amsterdam (Netherlands), a demand-driven policy has been implemented to reduce range anxiety. This policy allows EV users to request the construction of public charging infrastructure within their area, which has successfully encouraged greater consumer adoption of EVs. The federal government has also initiated public-private partnerships to promote the expansion of public charging infrastructure in the form of, *inter alia*, tenders for the construction of ~2,000 smart charging stations across the country. In Germany, the government offers grants to businesses which cover up to 60% of the cost of hardware and network connections required in charging stations. Finally, the Development Bank of Japan has collaborated with private automobile companies including Nissan, Toyota, Honda, Mitsubishi and an electricity company — TEPCO — to develop a national network of public charging stations. This project has resulted in the construction of ~7,500 charging stations across the country<sup>227</sup>.

## 4.4. Cross-cutting renewable energy projects

<sup>220</sup> Huizenga *et al.* 2015. Expanding Efforts on Climate Change Adaptation and Resilience in the Transport Sector

<sup>221</sup> Markolf, S. A., Hoehne, C., Fraser, A., Chester, M. V., and Underwood, B. S. 2019. Transportation resilience to climate change and extreme weather events — Beyond risk and robustness. *Transport Policy*, 74, pp. 174–186

<sup>222</sup> Interreg Europe. 2019. E-mobility: A Policy Brief from the Policy Learning Platform on Low-carbon economy. [online] Available: [https://www.interregeurope.eu/fileadmin/user\\_upload/plp\\_uploads/policy\\_briefs/FINAL\\_PolicyBrief\\_e-mobility\\_TO4\\_v4.pdf](https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/FINAL_PolicyBrief_e-mobility_TO4_v4.pdf)

<sup>223</sup> Range anxiety refers to ‘the fear of being unable to complete a trip due to a depleted battery’. From: Greene, D. L., Kontou, E., Borlaug, B., Brooker, A., and Muratori, M. 2020. Public charging infrastructure for plug-in electric vehicles: What is it worth? *Transportation Research Part D*, 78

<sup>224</sup> Greene, D. L. *et al.* 2020. Public charging infrastructure for plug-in electric vehicles: What is it worth? *Transportation Research Part D*, 78

<sup>225</sup> Interreg Europe. 2019. E-mobility: A Policy Brief from the Policy Learning Platform on Low-carbon economy. [online] Available: [https://www.interregeurope.eu/fileadmin/user\\_upload/plp\\_uploads/policy\\_briefs/FINAL\\_PolicyBrief\\_e-mobility\\_TO4\\_v4.pdf](https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/FINAL_PolicyBrief_e-mobility_TO4_v4.pdf)

<sup>226</sup> Hall, D., and Lutsey, N. 2017. Emerging best practices for electric vehicle charging infrastructure. [online] Available: [https://theicct.org/sites/default/files/publications/EV-charging-best-practices\\_ICCT-white-paper\\_04102017\\_vF.pdf](https://theicct.org/sites/default/files/publications/EV-charging-best-practices_ICCT-white-paper_04102017_vF.pdf)

<sup>227</sup> Interreg Europe. 2019. E-mobility: A Policy Brief from the Policy Learning Platform on Low-carbon economy. [online] Available: [https://www.interregeurope.eu/fileadmin/user\\_upload/plp\\_uploads/policy\\_briefs/FINAL\\_PolicyBrief\\_e-mobility\\_TO4\\_v4.pdf](https://www.interregeurope.eu/fileadmin/user_upload/plp_uploads/policy_briefs/FINAL_PolicyBrief_e-mobility_TO4_v4.pdf)

The power sector is generally viewed in the context of greenhouse gas mitigation. However, it is also the case that the sector is itself significantly vulnerable to projected changes in climate.

The power sector's vulnerability to projected climate changes includes the following:

- Increases in water temperature are likely to reduce generation efficiency, especially where water availability is also affected.
- Increases in air temperature will reduce generation efficiency and output as well as increase customers' cooling demands, stressing the capacity of generation and grid networks.
- Changes in precipitation patterns and surface water discharge, as well as an increasing frequency and/or intensity of droughts, may adversely impact hydropower generation and reduce water availability for cooling purposes to thermal (including nuclear) power plants.
- Extreme weather events, such as stronger and/ or more frequent storms, can reduce the supply and potentially the quality of fuel (coal, oil, gas), reduce the input of energy (water, wind, sun, biomass), damage generation and grid infrastructure, reduce output, and affect security of supply. This may be of particular significance in countries where projects are located or planned in water-stressed areas or where water is scarce.
- Rapid changes in cloud cover or wind speed (which may occur even in the absence of climate change) can affect the stability of those grids with a sizable input of renewable energy, and longer-term changes in these and precipitation patterns can affect the viability of a range of renewable energy systems.
- Sea level rise can affect energy infrastructure in general and limit areas appropriate for the location of power plants and grids.

Engineering adaptation measures include the following:

- In general, more robust design specifications will allow structures to withstand more extreme conditions (such as higher wind or water velocity) and function effectively under higher air and/ or water temperatures. In some circumstances, it may also be necessary to consider relocating or retrofitting extremely vulnerable existing infrastructure. Furthermore, decentralized generation systems may reduce the need for large facilities in high-risk areas and minimize climate risk. Finally, the reliability of control systems and information and communications technology components may improve from redundancy in their design and from being certified as resilient to higher temperatures and humidity.

#### 4.4.1. Hydropower

*Engineering:* For hydropower facilities, where discharge is expected to change over the life of the system, it may be necessary to consider diverting upstream tributaries, building new storage reservoirs, modifying spillways, and installing turbines that are better suited to expected conditions. Greater discharge (whether from glacial melting or increased precipitation) may require higher and more robust dams and/or small upstream dams.

*Non-engineering:* Hydro infrastructure, localized climate modelling might suggest operational changes to optimize reservoir management and improve energy output by adapting to changes in rainfall or river flow patterns. Integrated water resource management strategies that consider the full range of downstream environmental and human water uses may prove necessary. Restored and better-managed upper catchments, including afforestation to reduce floods, erosion, silting and mudslides, may provide useful protection to existing infrastructure.

#### 4.4.2. Wind

*Engineering:* Where wind speeds are likely to increase, it may be possible to capture greater wind energy with taller towers, or to design new systems better able to capture the energy of increased wind speeds.

*Non-engineering:* Choose sites considering expected changes in wind speeds, storm surges, sea level rise, and river flooding during the lifetime of the turbines. Wind power can be improved with better climate projections.

#### 4.4.3. Solar

*Engineering:* For solar photovoltaic systems, where temperature increases or significant heat waves are expected, it will be useful to consider solar modules with a higher temperature coefficient. String or micro inverters should be included in the design since they are easy to cool down.

For solar-concentrating or sun-tracking systems, where higher wind speeds, more intense storms, and gusts are likely, it may be necessary to consider more robust structures, tracking motors, and mountings, and to consider air or waterless cooling in water-restricted areas.

*Non-engineering:* For solar concentrating or tracking systems, avoiding locations with high, gusting winds or expectations of increased cyclones/extreme events may be an option. For solar photovoltaic power, it may be possible to select locations where expected changes in cloud cover, airborne grit, snowfall, and turbidity are relatively low. Solar power can be improved with better climate projections.

#### 4.4.4. Biofuels

*Engineering:* For biomass and biofuels, in addition to adaptations for thermal systems in general, more robust feedstock may be designed (e.g., tolerant to heat, salt, or water), and it may be possible to expand or introduce more efficient irrigation systems, depending on expected climatic changes.

*Non-engineering:* For biomass/biofuels, early warning systems for rainfall and temperature anomalies, emergency harvesting arrangements for an imminent extreme event, and provision of crop insurance can be appropriate options.

#### 4.4.5. Electricity generation

*Engineering:* For electricity end use, adaptation measures to cope with increased demand with temperature rises are of three types: (i) increasing generation (megawatt-hours) and capacity (megawatts) to meet the higher demand (business as usual approach); (ii) improving the efficiency of power supply (generation, transmission, distribution system improvements); and (iii) improving end-use efficiency for buildings, facilities, and energy intensive appliances and machinery, thus requiring less investment in generation and distribution (and yielding lower carbon dioxide emissions).

*Non-engineering:* Initiatives to improve electricity generation can include rezoning land use so future power infrastructure is in less vulnerable areas, decentralized local planning and generation, integration of adaptation and mitigation planning, integration of climate change and disaster management planning, improving forecasting of demand changes and supply–demand balance with climate change, integrating power sector planning with that of other sectors (including water supply), and improving localized models used to predict storms and flood hazards.

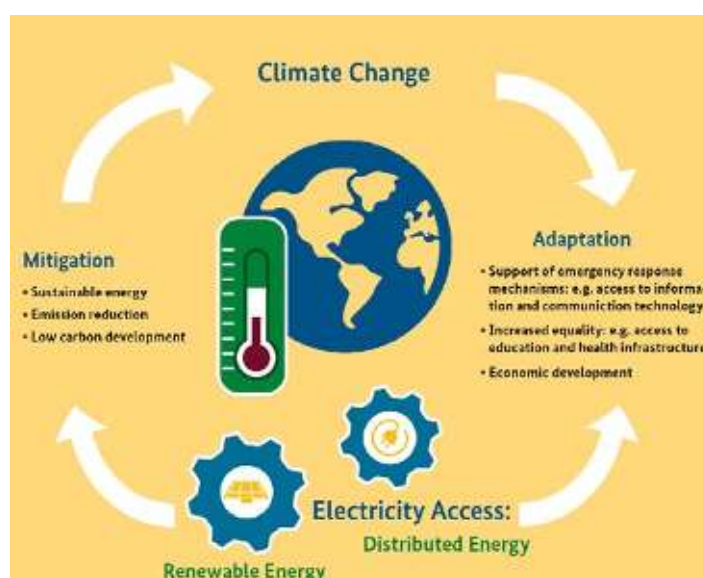
### 4.5. Off-grid Renewables and Adaptation

Off grid energy supplies provide both adaptation and mitigation benefits. Distributed energy can 1) improve livelihoods, particularly for vulnerable populations, such as by better exploiting the full spectrum of agriculture value chains 2) catalyse economic development such as for SMEs who can have more automated operations and 3) support access to Information Communication and Technology (ICT) and more resilient energy access. This can have multiplier effects in enabling better



education and healthcare.

Access to electricity for irrigation, processing equipment or early warning systems entails significant benefits to increase the resilience of farmers, particularly smallholders. A typical example of productive use to improve crop yields and shield against global warming hazards is electric-powered farming equipment such as water pumps, fodder choppers, threshers, grinders, and dryers (EUEI 2015, p. 5). Nowadays, this equipment is often provided with solar-based off-grid power supply. But power access also allows an increased productivity of other existing commercial services through e.g., extended operation hours, mechanization, and preservation of products or enhanced communication. Typical examples of such productive uses are lightning, cooling, grinding, milling, drying, smoking, expelling, transportation or access to information via mobile devices and internet (Lecoque and Wiemann 2015, p. 5). It also enables diversification of activities moving beyond traditional structures and ideally leverages other kinds of investments in various business activities. Consequently, electrification can stimulate employment and generate additional income (Cook 2013, p. 25). Particularly beneficial are off grid RE solutions for Small & Medium Enterprises (SMEs) that can generate increased productivity, income and business development with enabled productive uses. Regarding future activities, they can scale up, diversify and expand their production. Several case studies have explored the impact of SME electrification through off-grid RE solutions, demonstrating the ability to scale up their business by expanding their production and staff.



**Figure 29.** Relation of Energy with Adaptation and Mitigation<sup>228</sup>.

**Table 14.** Income-generating activities that can come from having off-grid energy supplies<sup>229</sup>.

Energy Services	Income-generating value	Applicable energy technology
Irrigation	Better crop yields, higher value crops, greater reliability of irrigation systems, enabling of crop growth during periods when market prices are higher	SHS, Mini-grids
Illumination	Reading, extended operating hours	SHS, Mini-grids
Grinding, milling, husking	Creation of value-added products from raw agricultural commodities	Mini-grids
Drying, smoking (preserving with process heat)	Creation of value-added products, preservation of products that enables sale in higher-value markets	SHS, Mini-grid in combination with solar heat

<sup>228</sup> GIZ: Off-Grid Renewable Energy for Climate Action *Pathways for change*

<sup>229</sup> GIZ: Off-Grid Renewable Energy for Climate Action *Pathways for change*

Expelling	Production of refined oil from seeds	SHS, Mini-grid in combination with solar heat
Transport	Reaching new markets	Mini-grids for e-mobility charging
TV, radio, computer, internet, telephone	Support of entertainment business, education, access to market news, co-ordination with suppliers and distributors	SHS, Mini-grids
Battery Charging	Wide-range of services for end-users (e.g. phone charging business)	SHS, Mini-grids
Refrigeration	Selling cooled products, increasing the durability of products	SHS, Mini-grids

**Table 15.** Ways to climate-proof off-grid solar<sup>230</sup>.

Temperature increases	<ul style="list-style-type: none"> <li>● Improve airflow beneath mounting structure to reduce heat gain and increase outputs</li> <li>● Specify heat-resistant PV cells and module components designed to withstand short peaks of very high temperature</li> </ul>
Precipitation Increases	<ul style="list-style-type: none"> <li>● Select appropriate tilt panel to clean dust</li> <li>● Select module surface conducive to self-cleaning</li> <li>● Choose locations with lower probability of dust, grit, snow if practical</li> </ul>
Wind speed, turbidity	<ul style="list-style-type: none"> <li>● Design structures to withstand higher winds</li> <li>● Assure free space (panels and mounting) so snow can slide off panel</li> <li>● In dry areas, consider panel rinsing system to remove dust and grit</li> </ul>
Cloud cover	<ul style="list-style-type: none"> <li>● Consider distributed systems (rather than feeding power into single part of the grid) to ameliorate cloud impact</li> <li>● Site PV systems where expected changes in cloud cover are relatively low</li> <li>● Consider micro-inverters for each panel (in place of small numbers of large, centralized inverters) to improve stability and increase power output</li> </ul>
Extreme events	<ul style="list-style-type: none"> <li>● Specify stronger mounting structure</li> <li>● Specify cabling and components that can deal with high moisture content and flooding</li> </ul>

#### 4.6. Digitalization

Digital technology and big data can be used to develop tools and methods for improved infrastructures and city management, with three main objectives:

- Drive a cultural shift in the construction industry towards greener, low-impact design methods
- Turn data into knowledge that can inform sustainable infrastructure-management policy
- Add new simulation layers to digital twins to support the design, operation and maintenance of physical infrastructures

#### 4.7. Water Energy Food (Integrated Solutions for Water, Energy and Land) Nexus

Water, energy and food are the basis for economic activities and closely interrelated:<sup>231</sup> Agriculture, forestry and the energy sector simultaneously depend heavily on and affect water resources. Energy is essential for water management, but also for agricultural production, processing and marketing. Land is needed for the production of food, fodder and renewable energy as well as for water resource protection. Many aspects of the nexus concept are not entirely new and borrow from existing approaches such as Integrated Water Resources Management (IWRM) and Sustainable Natural Resources Management (SNRM).

Demographic trends – such as population growth, progressive urbanization and globalization – are increasing pressure on already limited natural resources. Demand for water, food and energy is expected to rise by 30-50 percent in the next two decades.<sup>232</sup> Climate change will raise pressure on natural resources and make both people and ecosystems more vulnerable. If ecosystems are jeopardized, the climate effects can be intensified because events such as flooding, and droughts can

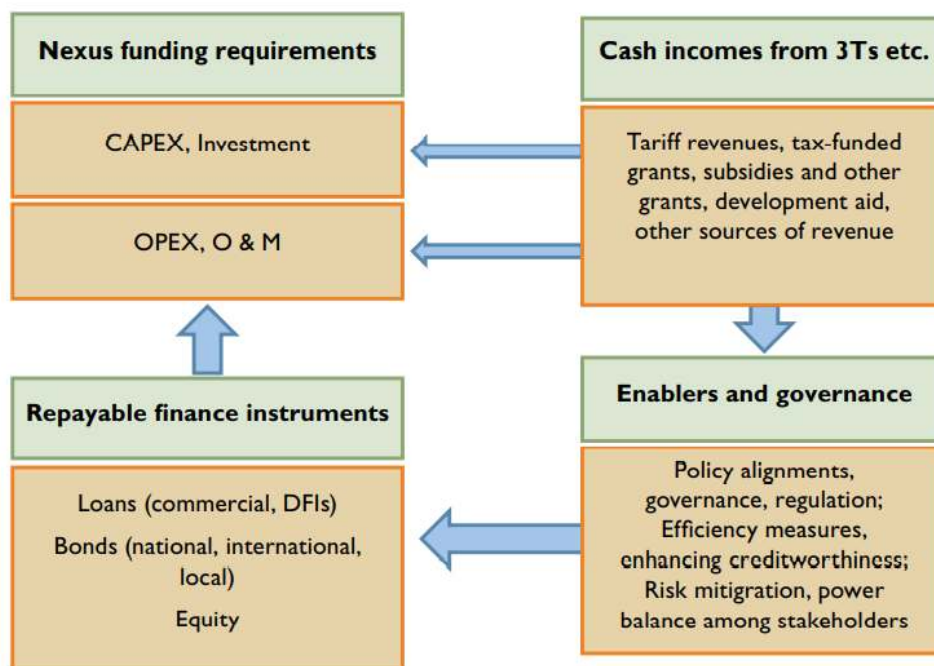
<sup>230</sup> GIZ: Off-Grid Renewable Energy for Climate Action

<sup>231</sup> Austrian Development Bank: Water – Energy – Food Security Nexus June 2015

<sup>232</sup> IEA: World Energy Outlook 2012 and WEF: Global Risks 2011

cause large-scale destruction such as harvest failure or landslides.

The CTI and ETI divisions are focusing on providing solutions to WEF problems. Both divisions are looking for more energy efficient solutions. Energy often accounts for more than half the operating costs of water and sanitation services in developing countries. Also, efficient energy and water use can make agricultural products more competitive and sustainable in local markets. Agricultural projects should use water management and consider reuse of treated wastewater. Using innovations such as more resilient plant species and improved storage can greatly improve production. Furthermore, UNIDO divisions support the required framework for successful WEF by supporting policy updates at the government level and capturing of evidence-based results at the grassroots level.



**Figure 30.** A Framework for Financing Nexus Investments<sup>233</sup>.

**Table 16.** Sources of finance for Nexus Investment.

3TS	Loan and bond finance	Equity finance
Tariffs and user charges	Commercial banks	Individual shareholders
Taxes/subsidies	Institutional investors	Institutional investors
Transfers (grants etc.)	Sovereign wealth funds	Sovereign wealth funds
	DFIs	Public-private partnerships
	Project bond	

#### 4.7.1. WEF Nexus Projects

- **SADC WEF Nexus Project**<sup>234</sup>

<sup>233</sup> Siala, F., Al-Soof, N., and Mazraati, M. 2017. The energy-water-food nexus: Managing key resources for sustainable development. Ofid Pamphlet Series 41. OFID, Vienna.

<sup>234</sup> Global Water Partnership. N.d. The SADC WEF Nexus Project. [online] Available: <https://www.gwp.org/en/GWP-SouthernAfrica/WEF-nexus/wef-in-sadc/sadc-wef-nexus-projec/>



This two-phase project is aimed at identifying ‘concrete investment projects – with a focus on multipurpose water infrastructure’ (Phase II) to be funded (Phase II). Phase I was implemented between 2017–2019, and received EU700,000 in funding. The major expected outputs are:

- SADC Regional WEF Nexus Operational Framework
- Prioritised WEF Nexus Investment Projects

Current progress includes:

- Fifteen potential projects have been identified, which will apply the WEF nexus approach in the region
- A draft SADC WEF Nexus investment project screening and appraisal tool has been developed
- A draft discussion paper has been developed

- **Renewable Energy and Energy Efficiency Partnership (REEEP) – Making the case: How Agrifood Firms are Building New Business Cases in the WEF Nexus**<sup>235</sup>

The REEEP is a study that was commissioned by the FAO to investigate the potential of the WEF nexus – specifically the use of clean energy in the food production industry – within countries in Asia, Africa and Latin America. Specific case studies were investigated in South Africa, Colombia, Kenya, Ethiopia and Indonesia. Notable actions included:

- Contributing to a water fund, supporting a payments-for-ecosystem services scheme led by the Nature Conservancy
- Establishing a multi-stakeholder platform alongside the nature conservancy, the national parks system and the sewage company of Bogota
- Investing in restoration of 60,000 ha of cloud forests in 10 years, which will prevent 2 million metric tons of sediment per year from entering the water catchment, leading to USD 35 million water treatment cost savings over the next 10 years

These activities stem from long-term recognition of resource dependency as well as potential for conflict with other water users.

- **Water Futures Partnership - SAB South Africa**

This project found that ~98% of its water footprint was related to the production of barley, maize and hops. Three main risks to SAB were identified: i) climate change (potential increase of USD200,000 per year in additional costs); ii) invasive species (USD700,000 per year) and iii) competition. Actions taken included creating a water user association to implement integrated landscape management approaches, improving water efficiency in their operations and restoring the hydrological functionality of the catchment by removing alien vegetation.

- **Feed the Future Innovation Lab for Small Scale Irrigation (ILSSI)**

This is a research-for-development project targeting small-scale farmers in Ethiopia, Ghana, Mali and Tanzania, with the aim of promoting ‘sustainable, profitable and gender-sensitive irrigation systems’, ultimately ensuring ‘agricultural growth, resilient food systems and better nutrition and health’<sup>236</sup>. This project is led by the **Norman Borlaug Institute for International Development** and is funded by USAID. Other partners include International Water Management Institute, International Livestock Research Institute, HWISE-RCN, World Vegetable Centre and International Food Policy Research Institute.

The project was initiated in 2013 and composes two\* phases spanning a ten-year period, with Phase I concluding in 2018. Phase II (2019 – 2023) is targeting the sustainable expansion of small-scale irrigation. The project has extensive data available including, *inter alia*: i) description of the farmer

<sup>235</sup> Zahner, A. 2014. Making the case: How Agrifood Firms are Building New Business Cases in the WEF Nexus. [online] Available: [https://www.reeep.org/sites/default/files/REEEP\\_Making\\_The\\_Case\\_0.pdf](https://www.reeep.org/sites/default/files/REEEP_Making_The_Case_0.pdf)

<sup>236</sup> Feed the Future. N.d. About. [online] Available: <https://ilssi.tamu.edu/about/>

selection process; ii) experimental designs for Tanzania, Ghana and Ethiopia; and iii) Ex Ante Analysis of small-scale irrigation interventions in several different sites<sup>237</sup>.

- **Africa RISING – Africa research in Sustainable Intensification for the Next Generation**

Also supported by USAID, being implemented in six countries: Ethiopia (highlands), Ghana, Mali, Tanzania, Malawi and Zambia. Phase I focused on deploying innovative farming technologies to communities for sustainable intensification, Phase II will upscale this to at least 1.1 million people by 2021.

#### 4.8. Nature-based Solutions - Ecosystem-based Adaptation (EbA)

EbA interventions generally focus on restoration of wetlands, and reforestation on surrounding slopes. These interventions are designed to reduce flooding and improve ecosystem service provision. Often, restoration of streams is implemented to additionally reduce flooding. Another common intervention is the use of permeable pavings throughout city walkways to reduce flooding and improve water infiltration. Examples include the use of grass, permeable concrete and gravel. An example of implementing Nature-based Solutions or EbA for urban systems is provided below:

- **Building climate resilience of urban systems through ecosystem-based adaptation in Latin America and the Caribbean (GEF)**

The *Building climate resilience of urban systems through ecosystem-based adaptation in Latin America and the Caribbean* project includes several EbA interventions designed to reduce flooding and erosion in urban areas. The project was implemented by UNEP between 2013–2015 in urban areas across El Salvador, Jamaica and Mexico. Specific EbA interventions are as follows.

*San Salvador:* The main interventions were designed to restore the Arenal-Monserrat watershed through climate-resilient reforestation and conservation agriculture.

Approaches included the: i) establishment of agroforestry gardens (Figure 31); ii) demonstration of no-tillage techniques to local communities; iii) use of green manure to improve agricultural yields; and iv) development of vegetated ditches such as contour slopes along the San Salvador volcano to improve water infiltration and reduce erosion (Figure 32 and Figure 33 below). Flooding was additionally mitigated through the implementation of rainwater harvesting systems in schools and houses, and the restoration of vegetation along riparian corridors to improve the flood resilience of river networks. Finally, ecological sanitation systems were also developed at schools to ‘close’ the water cycle. These systems included grey water management systems, which were designed to improve water use efficiency and reduce water pollution (Figure 34).

---

<sup>237</sup> <https://ilssi.tamu.edu/publications/reports/>

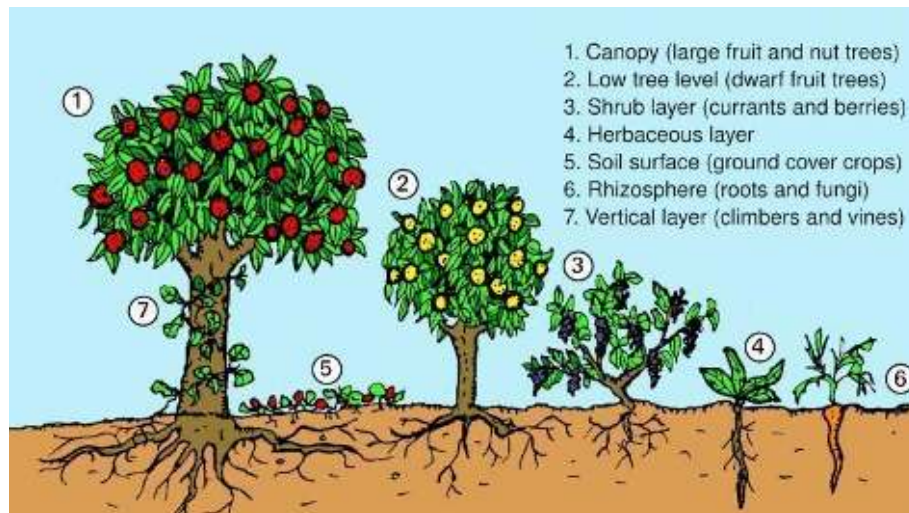


Figure 31. Example of an agroforestry garden<sup>238</sup>.

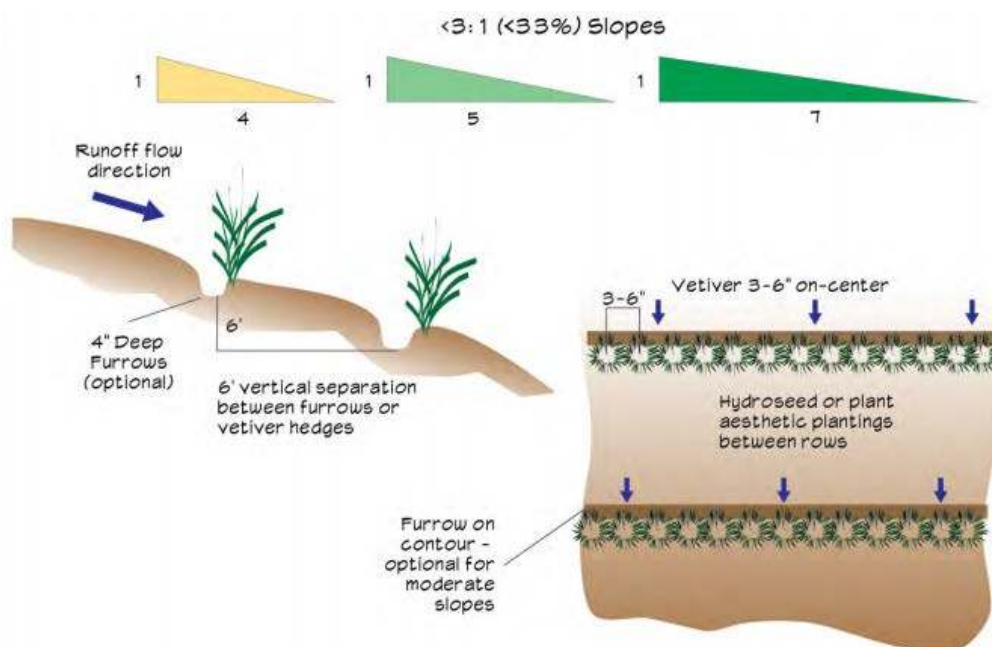


Figure 32. Contour hedge installation on a moderate slope<sup>239</sup>.

<sup>238</sup> 52 Climate Actions. N.d. Plant an Edible Forest Garden. [online] Available: <https://www.52climateactions.com/plant-edible-forest-garden/full>

<sup>239</sup> Richardson, S. 2017. Vegetation for Erosion Control — A Manual for Residents. [online] Available: [http://www.bviark.org/uploads/4/3/0/9/43091807/cbcc\\_landscape\\_manual\\_-\\_final\\_7\\_17\\_reduced.pdf](http://www.bviark.org/uploads/4/3/0/9/43091807/cbcc_landscape_manual_-_final_7_17_reduced.pdf)

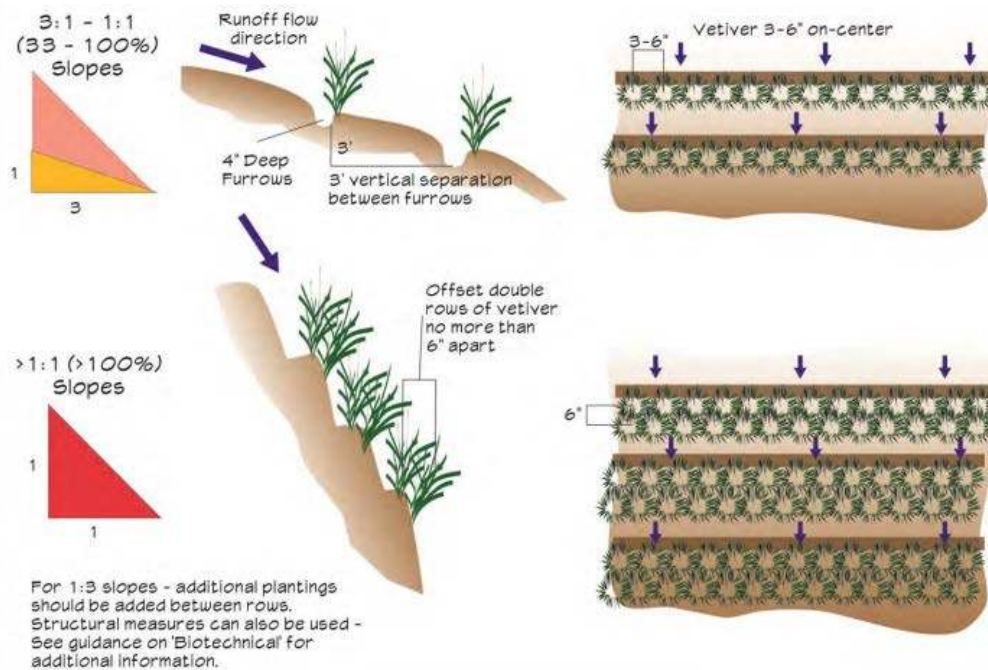


Figure 33. Contour hedge installation on a steep slope<sup>240</sup>.

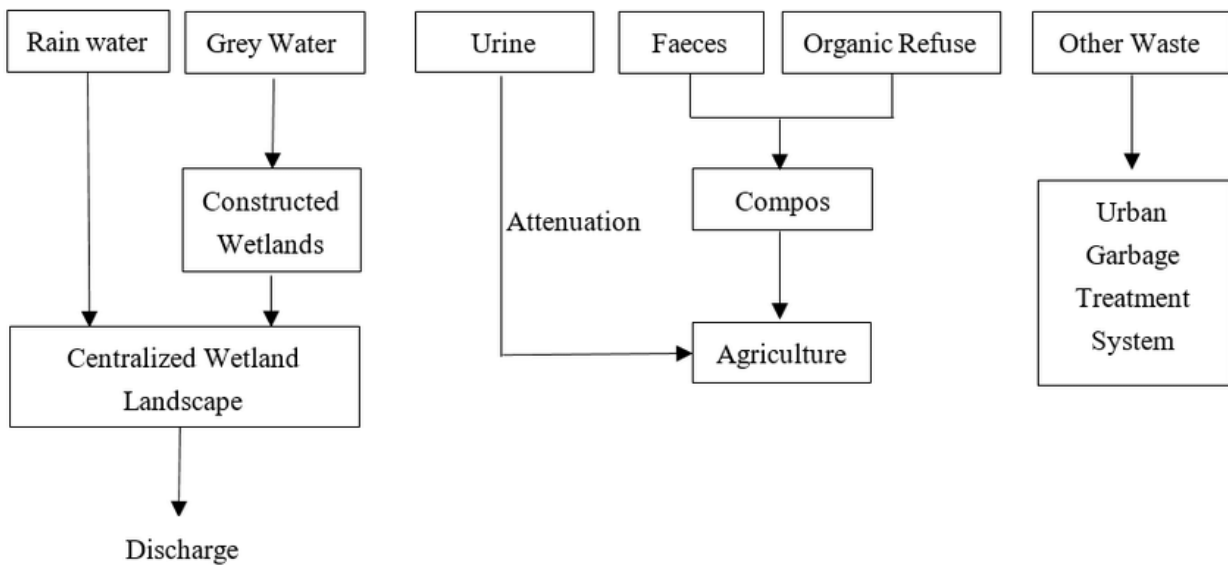


Figure 34. Flow Chart of an Ecological Sanitation System<sup>241</sup>.

*Kingston*: EbA interventions were designed to reduce the exposure to, and impact of, flooding on urban communities. The main interventions included the restoration of the adjacent Hope watershed to reduce surface runoff and erosion, enhance infiltration and offset the risk of landslides. This was achieved through the: i) development of natural drains to channel surface runoff during high-intensity rainfall events (Figure 35); ii) construction of detention ponds to reduce surface runoff during high-intensity rainfall events as well as increase water availability during periods of drought (Figure 36 and Figure 37); iii) rehabilitation of mangroves in urban wetlands to reduce flood risk and improve water

<sup>240</sup> Richardson, S. 2017. *Vegetation for Erosion Control — A Manual for Residents*.

<sup>241</sup> Duan, C., and Chen, H. 2018. Investigation and Control Mode of Domestic Pollution in Rural Areas of Guangxi Province. *IOP Conference Series Earth and Environmental Science*, 108(4).

availability; and iv) the creation of permeable pavements to improve water infiltration and reduce flooding (Figure 38).

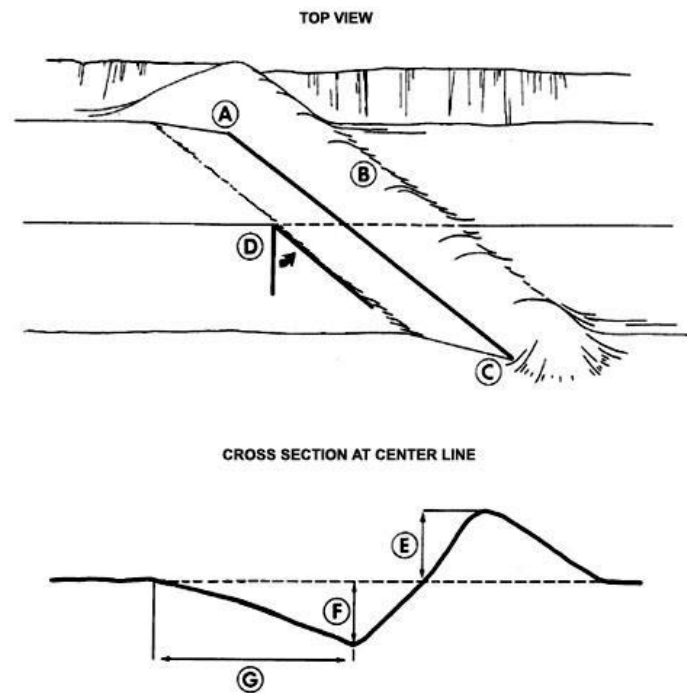


Figure 35. A cross ditch for redirecting surface runoff<sup>242</sup>.

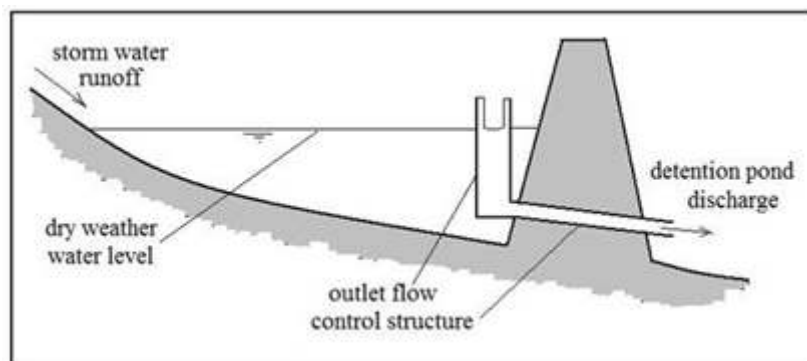
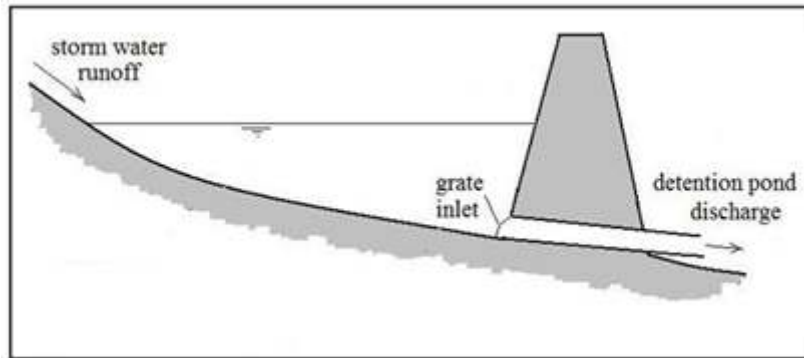


Figure 36. Storm water retention pond and control structure<sup>243</sup>.

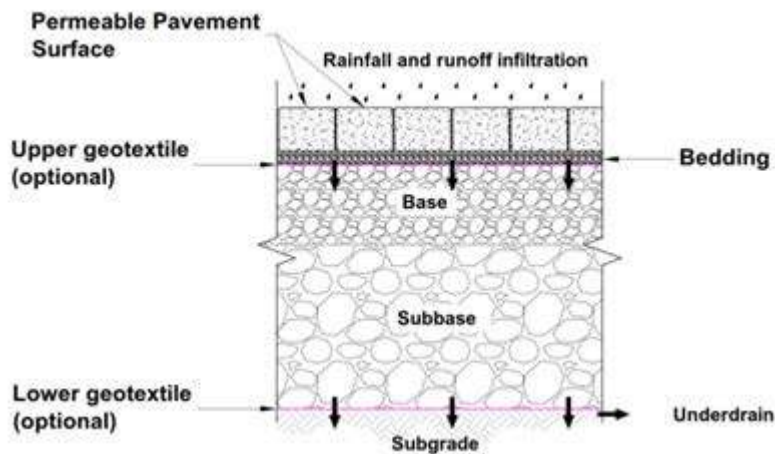
<sup>242</sup> Food and Agriculture Organization (FAO). 1998. *Watershed management field manual*. FAO, Rome

<sup>243</sup> Bengtson, H. 2010. Excel Spreadsheet Templates for Storm Water Detention Pond Outlet Structure Design. [online] Available: <https://www.brighthubengineering.com/hydraulics-civil-engineering/95513-design-of-detention-pond-outlet-structures/>



**Figure 37.** Storm water detention pond with pipe outlet control<sup>244</sup>.

*Xalapa:* EbA interventions in Xalapa were also geared towards the reduction of flood risk and enhancement of water availability. The main interventions include the: i) restoration of riparian areas along the El Palenquillo stream; and ii) restoration of the Cerro del Estropajo hill and simultaneous development of retention ponds to reduce erosion and flood risk, and improve water availability. Within urban areas, interventions included the construction of permeable pavements to improve water infiltration and reduce flooding (Figure 38), and the development of an artificial wetland to reduce flood risk and improve water availability (Figure 39).

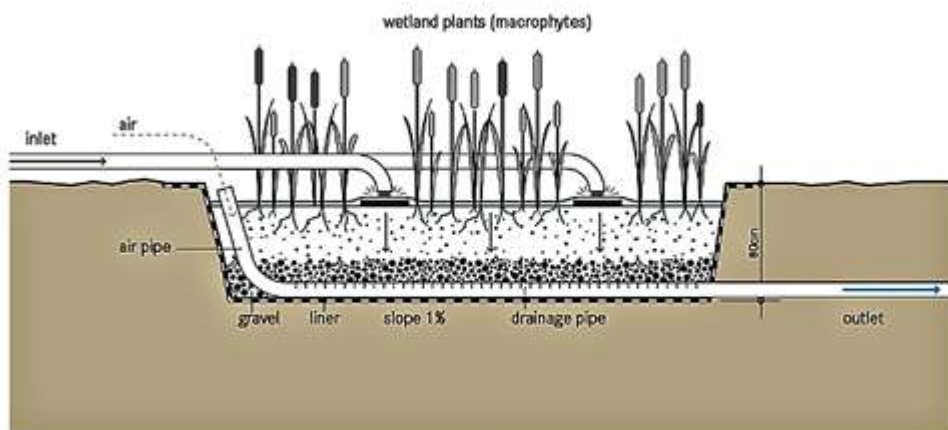


**Figure 38.** A permeable paving design<sup>245</sup>

<sup>244</sup> Bengtson, H. 2010. Excel Spreadsheet Templates for Storm Water Detention Pond Outlet Structure Design. [online] Available: <https://www.brighthubengineering.com/hydraulics-civil-engineering/95513-design-of-detention-pond-outlet-structures/>

<sup>245</sup> Tota-Maharaj, K., Hills, C. D., and Monrose, J. 2017. Novel permeable pavement systems utilising carbon-negative aggregate. Conference: NexGen Technologies for Mining and Fuel Industries. New Delhi, India





**Figure 39.** Vertical flow artificial wetland<sup>246</sup>

- **Building the resilience of urban populations in Laos with ecosystem-based adaptation**

The *Building the resilience of urban populations in Laos with ecosystem-based adaptation* project implemented by UNEP between 2017–2019 also targeted flood mitigation in four major cities in Laos — Vientiane, Paksan, Savannakhet and Pakse. There are several similarities in the EbA interventions used in this project and the *Building climate resilience of urban systems through ecosystem-based adaptation in Latin America and the Caribbean* project detailed above. EbA interventions are as follows.

Component 2 involves the rehabilitation and protection of the Nong Peung Wetland in Paksang. A wetland management plan will be developed and supported by restoration activities including: i) removing invasive alien plants; ii) removing man-made barriers which constrain natural flow and undermine the effective functioning of wetlands; and iii) restoration of indigenous vegetation. A second part of this component will target the restoration of natural urban stream in Savannakhet and Pakse. This will involve: i) removing solid waste around the streams to improve drainage capacity of the channels; ii) removing invasive plants; and iii) planting indigenous, climate-resilient vegetation along degraded stream banks to stabilise the banks and improve water quality. The third activity will also be supported by the small-scale installation of geotextile sandbags to reduce erosion. These interventions will then be supported by the development of management plans. Finally, permeable pavements will be installed in public areas to improve to flood reduction (Figure 19).

- **Ecosystem-based Adaptation to increase climate resilience in the Central American Dry Corridor and Arid Zones of the Dominican Republic**

The *Ecosystem-based Adaptation to increase climate resilience in the Central American Dry Corridor and Arid Zones of the Dominican Republic* project, implemented by UNEP between 2018 – 2020 was targeted at enhancing the resilience of vulnerable communities to the impact of increasing temperatures, drought and extreme rainfall events. EbA interventions are detailed in Table 13 below.

<sup>246</sup> Tota-Maharaj, K., Hills, C. D., and Monrose, J. 2017. Novel permeable pavement systems utilising carbon-negative aggregate. *Conference: NexGen Technologies for Mining and Fuel Industries*. New Delhi, India.



**Table 17.** EbA/NBS Interventions<sup>247</sup>.

Measure	Description and considerations	Adaptation and other co-benefits
Large-scale Ecosystem Based Adaptation		
Ecological restoration of forest and wetland remnants	<p>Ecological restoration can be defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. In the context of this proposal, this measure includes activities in <b>forest</b> and <b>wetland</b> remnants.</p> <ul style="list-style-type: none"> <li>● <b>Passive restoration</b> (to cease the damaging activity). Includes activities such as installing fences for livestock in riparian areas, to allow the secondary succession process to recover riparian forests, or the recovery of the hydrological flow of estuaries through the removal of sediments, to induce the natural regeneration of mangroves.</li> <li>● <b>Active restoration</b>: (mechanisms to facilitate the ecological succession or tree cover establishment), e.g. seeding and planting trees (including fruit trees), and fire management for natural forests.</li> </ul> <p>Other adaptation measures presented in this table are also related to ecological restoration and sustainable forest management (see measures 2, 3 and 4), provide inputs for restoration initiatives (n°5, mixed nurseries) or relates to specific restoration practices (n° 6, firebreaks).</p>	<p>Benefits include:</p> <ul style="list-style-type: none"> <li>● Reduced soil erosion because of binding action of roots as well as increased canopy cover.</li> <li>● Increased infiltration of rainwater into soils, relative to degraded soil, thereby increasing water security under conditions of climate change.</li> <li>● Carbon sequestration and storage through increased tree cover and soil conservation.</li> <li>● Reduced vulnerability to climate-related hazards, particularly landslides.</li> <li>● Enhanced biodiversity and improved landscape aesthetics, thereby supporting the development of ecotourism businesses.</li> <li>● Increased generation of useful or commercially valuable products such as timber and multiple non-timber forest products, thereby improving household income and food security.</li> <li>● The economic benefits of ecosystem and biodiversity services generated by 1 ha of tropical forest have been valued at more than US\$ 16,000, with an average of US\$ 6,120 in 2007 (TEEB 2009).</li> </ul>
Sustainable production of wood and firewood	<ul style="list-style-type: none"> <li>● This measure refers to the sustainable production of firewood in natural forests based on the management of native species with re-sprouting capacity<sup>55</sup> and plantations of species that provide firewood and other goods.</li> <li>● This measure should be coupled with the promotion of efficient biomass stoves.</li> </ul>	Benefits on ecosystem services and biodiversity on provision, regulation and support (Same as above).
Mixed plantations with native species	<p>This measure refers to reforestation with native species in <b>natural forests</b> and <b>plantations</b>, using:</p> <ul style="list-style-type: none"> <li>● Fast growing species of commercial value.</li> <li>● Slow growing species for precious hardwood production.</li> </ul>	Benefits on ecosystem services and biodiversity on provision, regulation and support (Same as above).
Recovery or establishment of agroforestry systems	<ul style="list-style-type: none"> <li>● Agroforestry systems can be defined as an integrated approach to the production of trees and of non-tree crops or animals on the same piece of land.</li> <li>● In the context of this proposal, agroforestry systems to protect water recharge zones refer mainly to <b>shade-grown coffee</b>. In some countries (e.g. El Salvador) these agroforestry systems are the only/main type of tree cover in water recharges zones.</li> <li>● This measure refers to both the <b>recovery</b> of existing agroforestry systems and the <b>establishment</b> of new ones, through <b>improved agroforestry practices</b> such as the renewal of coffee plantations with coffee varieties resistant to new climate conditions, pests and diseases,</li> </ul>	<p>Agroforestry can improve the resilience of agricultural production to current climate variability as well as long-term climate change through the use of trees for intensification, diversification and buffering of farming systems.</p> <p>In particular, benefits include:</p> <ul style="list-style-type: none"> <li>● Improved binding of soils by roots, thereby preventing erosion and maintaining topsoil during erratic, heavy rainfall.</li> <li>● Increased provision of food – even under conditions such as drought – thereby increasing food security.</li> </ul>

<sup>247</sup> Green Climate Fund. 2019. Concept Note: Ecosystem-based Adaptation to increase climate resilience in the Central American Dry Corridor and Arid Zones of the Dominican Republic. [online] Available: <https://www.greenclimate.fund/sites/default/files/document/21480-ecosystem-based-adaptation-increase-climate-resilience-central-american-dry-corridor-and-arid.pdf>

	<p>the inclusion of fruit trees for income diversification, or the inclusion of shade trees species with commercial value<sup>59</sup> for the transition from full-sun coffee cultivation to shade-grown coffee.</p> <ul style="list-style-type: none"> <li>● Dispersed trees in pastures is a common <b>silvo-pastoral</b> system in the region. It can be considered part of the adaptation actions, but not in critical areas for regulation of the water flow, as they provide less soil protection.</li> </ul>	<ul style="list-style-type: none"> <li>● Increased soil fertility as a result of nutrient-rich leaf litter and nitrogen fixation.</li> <li>● Increased availability of fodder for increased resilience of animal husbandry.</li> <li>● Increased incomes through product diversification (e.g. firewood, wood and fodder), certification, and payments / compensation for ecosystem services.</li> </ul>
Firebreaks	<ul style="list-style-type: none"> <li>● Firebreaks are a common practice in the context of ecosystem restoration and conservation and sustainable forest management to prevent forest fires from spreading before they damage ecosystems, croplands or infrastructure.</li> <li>● In Guatemala and Honduras, firebreaks are also part of the practices to manage the Pine beetle outbreak.</li> </ul>	<ul style="list-style-type: none"> <li>● Firebreaks protect material, agricultural and ecosystem services; hence their benefit is related to their effectiveness at providing protection. E.g., a 400 m firebreak would protect 1 ha of forest.</li> <li>● Firebreaks construction could represent an opportunity for generate temporal incomes and dissemination of the benefits of ecosystem services and other adaptation measures</li> </ul>
Mixed nursery	<ul style="list-style-type: none"> <li>● Mixed-plant nurseries are agronomic facilities where plants are germinated and cultivated under controlled conditions of light and moisture.</li> <li>● Their main purpose is to reproduce resilient native species for reforestation or restoration (see Measures 1, 2, 3 and 4) and can contribute to diversify income through the sale of high-quality timber or fruit trees (such as avocado).</li> </ul>	<ul style="list-style-type: none"> <li>● Rehabilitating the forest ecosystem where the nursery is established decreases the pressure on timber resources, contributes to recover soil fertility and to retain moisture.</li> <li>● Mixed nurseries are an opportunity for green business in combination with restoration, sustainable forest management and agroforestry systems: E.g. 13,500 timber trees, 6,750 fruit trees, and other purposes species (such as ornamental plants), after a period of three years, could generate an approximate income of US\$ 31,000.</li> </ul>
<b>Water-energy efficient technologies</b>		
Efficient biomass stoves	<ul style="list-style-type: none"> <li>● The different models of efficient biomass stoves are made with local supplies. They use less biomass (firewood) than traditional stoves to obtain energy and eliminate smoke from the kitchens.</li> <li>● While there is a long history of improved cookstove programs in Central America, many of these initiatives have not been adopted in a sustained way, due to the poor performance of cookstoves in the field, the absence of quality standards, and the lack of attention to the needs of the end users. Hence, evaluation of previous programs will be important for the design of the measure.</li> </ul>	<ul style="list-style-type: none"> <li>● Maintenance of soil fertility (The charcoal obtained serves to restore the soil, which increases its productivity)</li> <li>● Reduced greenhouse gas emissions (The efficient combustion of the gasifier reduces the emissions of CO<sub>2</sub> in 3 tons per family unit per year)</li> <li>● For people who cook indoors with wood in an unventilated or partially ventilated space, the introduction of efficient biomass stoves is a significant health benefit.</li> </ul>
Firewood drying and charcoal production	<ul style="list-style-type: none"> <li>● This measure consists of using solar and half orange ovens to obtain dry firewood and charcoal, respectively, with better quality standards. The half orange ovens, built with bricks, guarantee a process of carbonization more efficient and economic than the artisanal production, based on pits dug in the ground.</li> <li>● The experience in Nicaragua shows that dry firewood and quality charcoal could be part of profitable value chains.</li> </ul>	<ul style="list-style-type: none"> <li>● Half-orange ovens increase the production yield by 10% and produce higher quality charcoal.</li> <li>● The reduction of smoke and risk of burns improve the working conditions of the producers.</li> <li>● Dry firewood produces less smoke and has fewer biological attacks and consequently can be sold at a higher price. It also reduces transport costs.</li> <li>● The collection of wood for drying and the production of coal allows controlling its legal origin if it comes from forests with authorized management plans.</li> </ul>

Rainwater collection - small reservoirs	<ul style="list-style-type: none"> <li>• This practice consists of collecting rainfall from ground surfaces using micro-catchments to divert or slow runoff so that it can be stored before it can evaporate.</li> <li>• The second option consists of collecting flows from a river, storm or other natural watercourse which can be stored and used to improve soil moisture.</li> </ul>	<ul style="list-style-type: none"> <li>• Reservoirs support the restoration of natural ecosystems and agriculture due to increased relative humidity and access to water.</li> <li>• Carbon capture through increased tree cover and soil conservation.</li> <li>• A 500 m3 reservoir can meet the water needs for 80 animals or up to 2500 m2 of vegetable crops during a period of low water levels. Placement in the marketplace of the 60,000 vegetable plants produced would be equivalent to an annual income of US\$ 3,000 to 5,000.</li> </ul>
Rainwater harvest systems from rooftops	This basic technology involves the collection of rainwater from rooftop catchments and diversion to a storage reservoir (tank) for later use.	The availability of water within the household implies an average saving of 30% of women's time (INCAP, 2016), which can represent between four and five hours a day depending on the place
Solar photovoltaic water pumping systems	<ol style="list-style-type: none"> <li>1. This technology convert sunlight into electricity to pump water for community water supply and irrigation.</li> <li>2. They are relatively simple, reliable, cost competitive, and low maintenance.</li> <li>3. There is a good match between seasonal solar resource and seasonal water needs (dry season).</li> </ol>	<ol style="list-style-type: none"> <li>4. Reduction of expenses: There have been dramatic price reductions in PV modules over the past decade, by over 80%, while prices for competing gasoline or diesel fuel have risen by over 250%.</li> <li>5. Reduced greenhouse gas emissions (minimizes the dependence on diesel, gas or coal-based electricity).</li> </ol>
Drip irrigation	This technology involves dripping water onto the soil at very low rates. Drip irrigation reduces water consumption and loss of soil and nutrients. Simplified systems that use local supplies can have very low investment costs.	Benefits include: <ul style="list-style-type: none"> <li>• Erosion prevention and maintenance of soil fertility</li> <li>• Increased resilience to drought due to efficient use of scarce water resources (decrease in water consumption by up to 70%).</li> <li>• Increased quality and quantity of products due to efficient use of fertilizers and controlled supply of nutrients with irrigation water.</li> <li>• Increase in income of up to 35% due to improvements in productivity.</li> </ul>
Ceramic filters to purify water	This is a technology to eliminate microbiological components of water. An experience developed in Nicaragua shows the importance of quality controls and training for local manufacturers.	Given the reduction in availability of drinking water in the proposal area, and its degree of contamination, it is considered a complementary measure of adaptation. <ul style="list-style-type: none"> <li>• Increase in local labour sources and incomes</li> <li>• Reduction of diarrheal diseases</li> </ul>
Ecotourism	<ul style="list-style-type: none"> <li>• Economic development tool based on conserving and sustainably using existing ecosystem services and making them available to visitors.</li> <li>• In the context of this proposal, low-scale local tourism in natural ecosystems or in agricultural areas (agrotourism) that allows visitors to appreciate nature, and the values and cultural traditions associated with it, and purchase sustainable products, could be promoted.</li> </ul>	<ul style="list-style-type: none"> <li>• Ecotourism projects promote the conservation of natural areas and agroforestry systems while safeguarding their biological and cultural diversity.</li> <li>• Local population is benefited with around 30% of jobs generated by ecotourism projects.</li> <li>• This type of tourism is based on local resources, is low impact and offers socio-economic benefits to the populations responsible for conserving the goods or services promoted.</li> </ul>

## Annex 5: Recommendations for ENE adaptation project development – theories of change

### 5.1. EAE/ENE climate change adaptation portfolio review

The Adaptation Strategy development included an internal review of existing and proposed projects conducted between January and April 2021. The current proposals to either the Adaptation Fund, GCF or equivalent were reviewed for their integration of adaptation principles. The following shows the recommendations and example Theories of Changes on how to integrate the best adaptation practices/ideas for each division.

#### 5.1.1. CTI

The classic successful proposal by CTI is to support SMEs to provide adaptation innovation along the value chain. This has worked well, as in the case of the DRC and Sierra Leone with the GEF. For future project proposals, the overarching recommendation is to simplify the project concepts. In the case of the Adaptation Fund proposal to Madagascar, the proposal is trying to support Early Warning System (EWS) development, disaster relief, adaptation innovation SMEs while establishing PPPs to finance climate proofed infrastructure and EWS. It would be best to focus on only a couple of these themes as demonstrated in the Theory of Change attached.

The TOC streamlined the topics to focus on i) improving planning for climate resilience and early warning, ii) supporting development of entrepreneurship for climate change adaptation and iii) climate-proofing interventions. Pertinent activities were chosen due to the following reasons:

- Disaster relief is often rejected by adaptation funding donors because humanitarian aid is not fully aligned with building resilience to climate impacts; Aid is provided after disasters happen and does not prepare the most vulnerable to handle the impacts.
- Early Warning Systems are complex and often require entire projects (see GEF EWS regional project for Africa). Financing only the building elements of EWS such as data collection and presentation is more realistic during the project lifetime.
- Setting up PPPs to finance climate-proofing of infrastructure is realistic since equity investments are typically provided for financing infrastructure (See InfraCoAfrica and UNCDF LoCAL). In contrast, EWS services are usually the role of the government (e.g., the Meteorological Service). There can be an element of selling forecast data to the private sector (such as the building sector) but generally developing countries do not have the capacity to prepare sophisticated forecasting scenarios. It is thus recommended to use PPPs related to infrastructure, particularly mini-grids and not to emphasize PPPs for EWS purposes.
- The Background speaks about agriculture. It would be recommended to add more detail on what kind of adaptation innovation SMEs would be supported for the agriculture sector such as, for example, water efficiency for agriculture, solar powered pumping etc.
- Due to the resilience aspect and the need for emergency services in the case of climate extremes, it is recommended for proposals to focus on climate proofing of essential infrastructure with decentralized energy access.

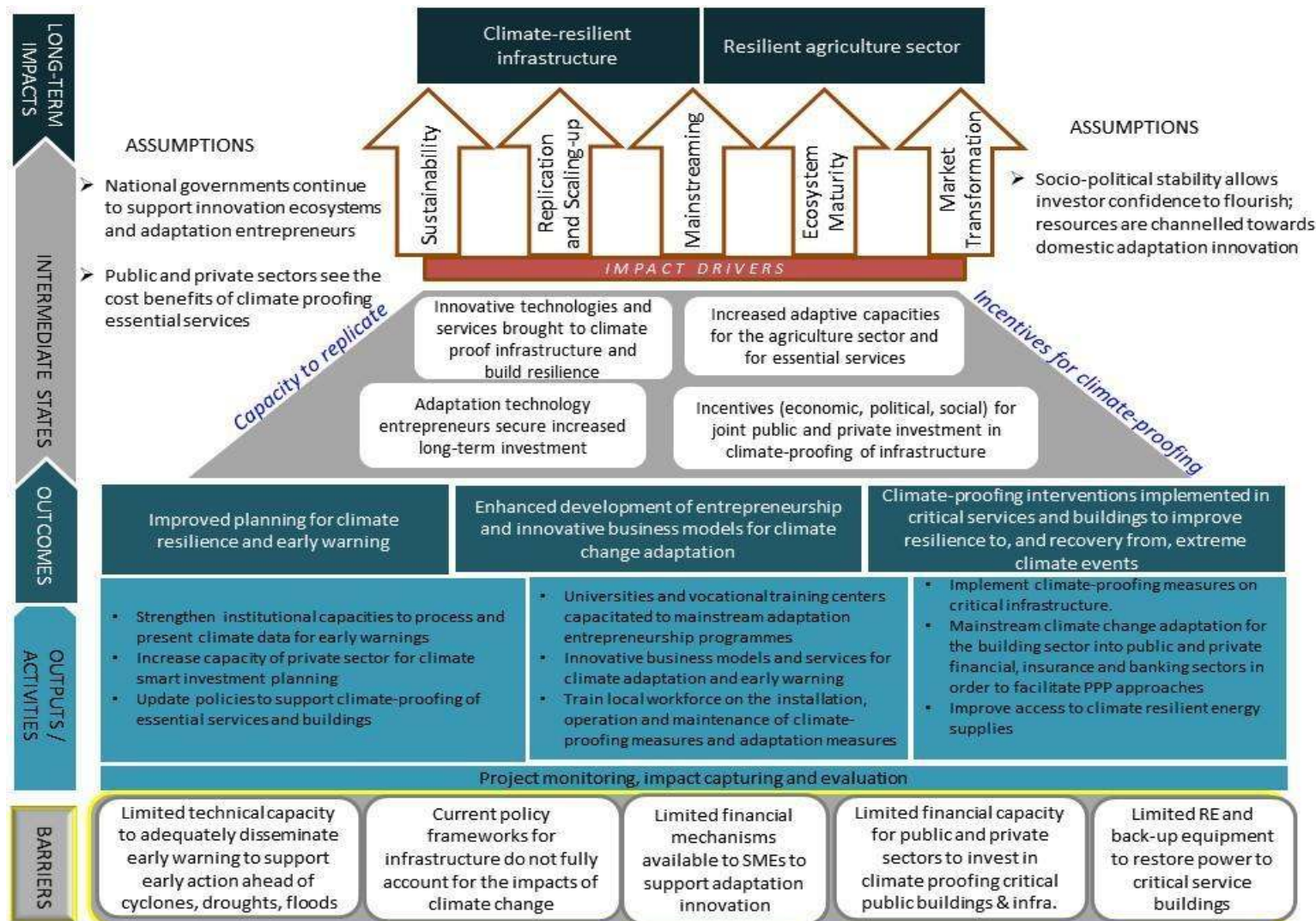


Figure 40. Recommended Madagascar Theory of Change for submission from CTI to the Adaptation Fund.



### 5.1.2. ESI

Three proposed ESI projects were reviewed to validate adaptation integration, which include: i) Fostering Resilient and Green Ports in the Pacific (Pacific Islands); ii) Building the capacity of selected cities in the Philippines to adopt climate-smart capital investment plans – GCF Readiness (Philippines); and iii) Improving the disaster preparedness and supporting growth of local enterprises for basic services provisioning in vulnerable regions of the Philippines (Philippines).

For the ESI Pacific port project, the project concept document was commented throughout and the following recommendations were provided:

- More discussion on the problems and the main barriers as well as on the climate vulnerabilities is required
- Not enough emphasis on building climate resilient infrastructure and energy self-sufficiency to indicate more cross-cutting
- More focus on how decentralized mini-grids and renewable water treatment solutions enable resiliency is required
- Need to focus on updating or developing policies on building climate resiliency in ports (not just policies related to mitigation), particularly updating or developing a Master Plan that integrates both adaptation and mitigation aspects
- E-mobility is expensive but setting the groundwork such as focusing on policy development to create an enabling environment to encourage the private sector to increase their investment in EVs could be supported by some adaptation funding agencies. The issue will be how to build the capacities of the organizations maintaining the e-mobility infrastructure.
- Must emphasize Nature based Solutions (NBS) such as natural berms or breakwaters placed before the ports to absorb any storm surges, strong wave action
- Environmental management and pollution prevention are not a focus for adaptation funds such as the GCF. Waste management and pollution issues should be financed by co-financing. Pollution, waste and waste-water are not eligible for GCF funding unless one can demonstrate direct mitigation or adaptation benefits.
- More discussion on engagement with the stakeholders for proposal development and a Stakeholder Engagement Plan is required
- Information on the gender or social benefits is required in the proposal

The UNIDO ESI Pacific port proposal was commended for highlighting the Green Pacific Ports initiative that has been introduced and trialled in three ports since 2016<sup>248</sup>. More information on the Green Pacific Ports initiative should be provided (e.g., What were the outcomes?). The UNIDO ESI project is also supporting the Pacific Ports 2030-2050 vision. Relevant elements of this vision for cross-cutting projects include:

- Resilient Ports – to adapt port development and strengthen preparedness, response and recovery to climate change and disasters, implement processes to support economic development, and achieve port operational efficiency and compliance to international standards and best practices;
- Green Ports – to contribute to a low-carbon development pathway by reducing the carbon footprint of Pacific ports, increase their energy efficiency and incentivize green shipping;

A proposed theory of change for the UNIDO ESI Pacific port is provided in Figure 13. The project would be transformational in that it will lead to reduced GHG emissions and increased resilience of the islands to climate change by providing reliable energy infrastructure independent from imported fossil fuel and increasing the provision of essential services. The fishing sector could also be enhanced with improved ports in the Pacific Islands.

<sup>248</sup> Fiji Ports Corporation Limited (FPCL), Solomon Islands Ports Authority (SIPA) and Port Authority Tonga (PAT)

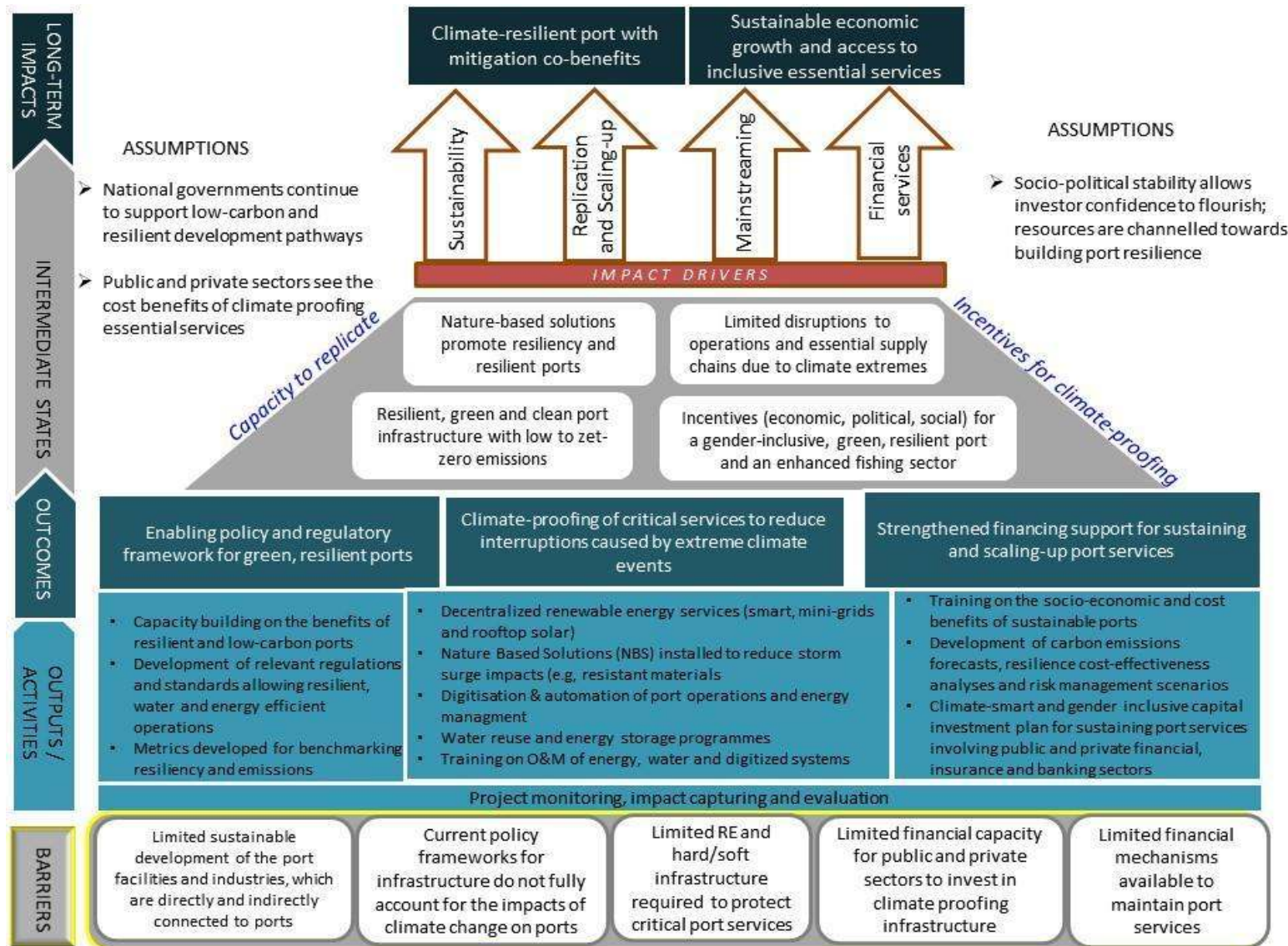


Figure 41. Recommended Theory of Change for the Pacific Islands - Port project for ESI.



Comments on the other two proposals included the following:

UNIDO ESI Proposal 1: Local climate-smart capital investment plans GCF Readiness Proposal

Comments:

- Not enough emphasis on investment plans integrating resilience such as: Climate-proofing infrastructure
- Theory of Change is not in suggested GCF format
- Table of projects & readiness support with synergies is missing

UNIDO ESI Proposal 2: Improving the disaster preparedness and supporting growth of local enterprises for basic services provisioning in vulnerable regions of the Philippines -KOICA

Comments:

- Problem needs to be more clearly articulated
- Relationship between activities and outputs needs strengthening
- Too many problems to tackle: DRRM, energy access, SMEs
- Why DRRM on national level and climate smart investment plans on local, what is linkage?
- Barriers are unclear

A Theory of Change was developed for the Philippines climate-smart capital investment project which integrates Nature Based Solutions as a means to build the resilience of urban and peri-urban communities. See Figure 42.

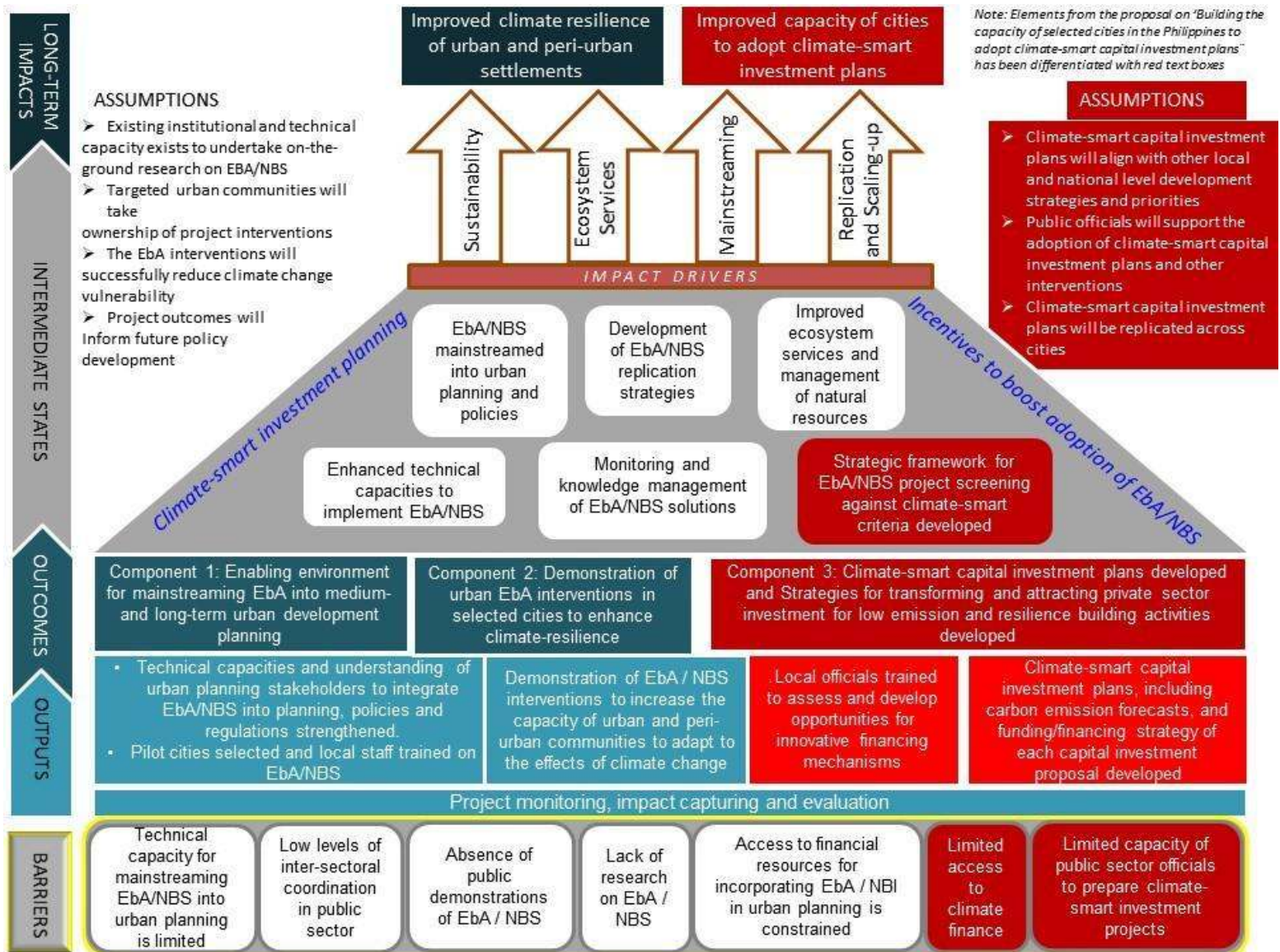


Figure 42. Theory of Change on Integrating Nature Based Solutions for Climate-Smart Urban Planning for ESI.

### 5.1.3. ETI

During discussions with ETI during Strategy development, the division stated their interest in developing Water Energy Food Nexus project due to their technical experiences with energy production and efficiency, particularly with small hydropower (SHP). Efficient energy and water use within small scale irrigation projects in particular require sustainable technical designs and integrated water catchment planning. Pumping for food production requires choosing appropriate energy sources such as solar power pumping to supplement SHP operations as well as energy storage. Irrigation projects should be based on an assessment of improved water-use efficiency and agricultural water management. An example Theory of Change for ETI is provided below.

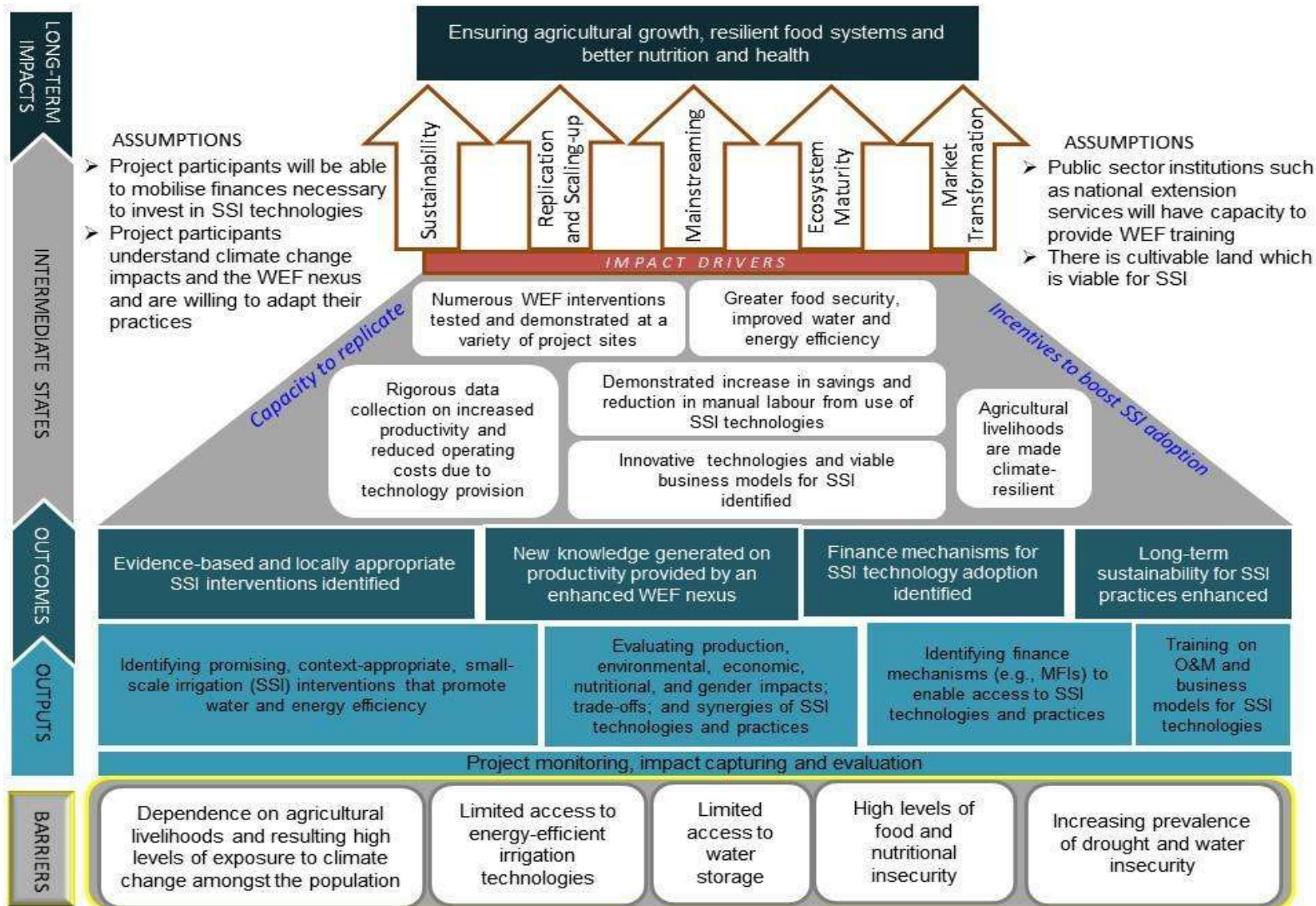


Figure 43. Theory of Change on the WEF Nexus for Small Scale Irrigation for ETI.



#### 5.1.4. Adaptation Themes and UNIDO Indicators

Proposed adaptation elements were extracted from the UNIDO EAE/ENE pipeline review from the projects analysed. The project concepts, namely the outcomes and activities, were updated to include state-of-the-art adaptation concepts taken from the global pipeline review (such as from the *Antigua and Barbuda project* and the *Building climate resilience of urban systems through EbA in Latin America and the Caribbean project*). Recommended examples of Theories of Changes aforementioned were then evaluated to see how they would contribute to UNIDO core indicators. The table below demonstrates how the updated theoretical projects address most of the core UNIDO indicators.

**Table 18.** CTI IRPF Indicators and Links to Adaptation Themes.

Indicators		Theme 1: Adaptation Innovation and Technology Transfer	Theme 2: Resilience to hurricanes in the building sector in Antigua and Barbuda	Theme 3 & 4 (WEF Nexus): Feed the Future: Innovation Lab for Small Scale Irrigation (ILSSI)	NBS Projects: Building climate resilience of urban systems through ecosystem- based adaptation in Latin America and the Caribbean
<b>Bennet Level 2 – Activities and Outputs</b>					
TCO.1	Number of capacity building activities provided		X	X	X
TCO.2	Value of assets provided (USD)		X	X	X (unclear whether ES valuation happened)
TCO.3	Number of toolkits and guidelines produced		X	X	X
TCO.4	Number of business plans developed			TBD	
PAO.1	Number of industrial strategies and industrial policy documents drafted / prepared		X	TBD	
PAO.2	Number of analytical and statistical publications produced			X	X
NOO.1	Number of standard setting processes with UNIDO participation		X	TBD	
CPO.1	Number of global fora, workshops/EGM/side events organized			X	
CPO.2	Number of UN interagency				

	mechanisms with UNIDO participation				
CPO.3	Number of international networks and platforms for which UNIDO is providing secretariat functions				
<b>Bennet level 3 – Engagement, involvement</b>					
REA.1	Number of people reached		X	X	X
REA.1	Number of firms reached		X	X	
REA.1	Number of intermediary institutions reached		X	TBD	
REA.1	Number of government bodies reached		X	X	X
REA.1	Number of global actors reached		Difficult to measure	TBD	
REA.1	Number of actors reached		Ambiguous	Ambiguous	Ambiguous
REA.2	Number of people engaged		X	X	X
REA.2	Number of firms engaged		Ambig & repetitive	Ambig & repetitive	Ambig & repetitive
REA.2	Number of intermediary institutions engaged		Ambig & repetitive	Ambig & repetitive	Ambig & repetitive
REA.2	Number of government bodies engaged		Ambig & repetitive	Ambig & repetitive	Ambig & repetitive
REA.2	Number of global actors reached		Ambig & repetitive	Ambig & repetitive	Ambig & repetitive
REA.2	Number of actors engaged		Ambig & repetitive	Ambig & repetitive	Ambig & repetitive
<b>Bennet Level 4 - Reactions</b>					
REACT.1	Percentage of people satisfied with UNIDO interventions		X	X	
REACT.1	Percentage of firms satisfied with UNIDO interventions		Unclear if this will be measured in TE	Unclear if this will be measured in TE	
REACT.1	Percentage of intermediary institutions satisfied with UNIDO interventions		As above	As above	
REACT.1	Percentage of government bodies satisfied with UNIDO		As above	As above	

	interventions				
REACT.1	Percentage of global actors satisfied with UNIDO interventions		As above	As above	
REACT.1	Percentage of actors satisfied with UNIDO interventions		As above	As above	
<b>Bennet Level 5 – Knowledge, attitude, skills and aspirations</b>					
KASA.1	Number of people gaining awareness/knowledge on:		X	X	X
KASA.1	Number of firms gaining awareness/knowledge on:		X	X	
KASA.1	Number of intermediary institutions gaining awareness/knowledge on:				
KASA.1	Number of government bodies gaining awareness/knowledge on:		X	X	
KASA.1	Number of global actors gaining awareness/knowledge on:		X (awareness raising)		
KASA.2	Number of people gaining skills on:		X	X	X
KASA.2	Number of firms gaining skills on:		Unsure		
KASA.2	Number of intermediary institutions gaining skills on:		Unsure		
KASA.2	Number of government bodies gaining skills on:		X		X
KASA.2	Number of global actors gaining skills on:		Unsure		
<b>Bennet Level 6 – Practice and behaviour change (number of)</b>					
BUS.1	firms with improved management practices		Unclear		
BUS.2	actors developing new products		X (possibly)	X	X
BUS.3	Start-ups established		X		
BUS.4	new technologies developed or adapted		X	X	X
BUS.5	new technologies adopted		X	X	X



BUS.6	new or revised policies adopted		X		
BUS.7	new standards adopted or implemented		X		
BUS.8	guidelines adopted by relevant actors		X	X	X
BUS.9	investment-ready proposals elaborated				
BUS.10	projects or businesses financed		X	X	
BUS.11	new investments leveraged (USD)		X		
BUS.12	institutions established or strengthened		X		
BUS.13	actors participating in enhanced collaboration settings				X
<b>Bennet level 7 – ISID Impact</b>					
<b>Advancing economic competitiveness</b>					
ECO.1	Number of firms with economic gains (sales, savings)		Unclear	X	
ECO.1b	Value of economic gains (USD) realized by firms		Unclear	X	
ECO.2	Number of firms with improved labour productivity		Unclear	X	
ECO.3	Number of firms with an increase in exports		Unclear	Unclear	
ECO.3b	Value of additional exports (USD) realized by firms		Unclear	Unclear	
<b>Creating shared prosperity</b>					
SOC.1	Number of additional jobs created or retained		X	X	
SOC.2	Number of SMEs with increased inclusion in value chains			X	X
SOC.3	Number of people living under poverty line who gain access to quality-assured products			X	X
<b>Safeguarding the environment</b>					
ENV.1	CO <sub>2</sub> eq emissions reduced (tons)				
ENV.2	Pollutants reduced or phased out (tons)				X
ENV.3	Improved energy		X	X	

	efficiency (MWh)				
ENV.4	Improved material efficiency			X	X
ENV.5	Number of new or improved green products made available or used		X	X	X

## Annex 6: Vulnerability assessment and adaptation planning tools and source data

**Table 19.** Tools for developing adaptation projects.

Name	Description
World Bank Climate and Disaster Risk Screening Tools <sup>249</sup>	Tools designed to be used by development practitioners, who are designing or working on: i) national strategies and diagnostics; ii) sector-wide strategies and development policy reforms; and iii) project investments in key sectors. The tools provide a structured and systematic way to undertake due diligence and flag potential risk at the national or project levels, notably seven key project areas (agriculture, coastal flood protection, energy, health, roads, water and general).
Community-based Risk Screening Tool: Adaptation and Livelihoods (CRISTAL) <sup>250</sup>	CRISTAL is a project-planning tool to help users identify and prioritise climate risks and identify livelihood resources most important to climate adaptation, and uses these as a basis for designing adaptation strategies.
Integrated Valuation of Environmental Services and Trade-offs (InVEST) <sup>251</sup>	InVEST is a set of spatially explicit models that can be used to quantify, map and value the benefits provided by terrestrial, freshwater and marine ecosystems in either biophysical or economic terms. It can be used to map the relative importance of different areas for ecosystem services.
Adaptative risk and vulnerability management at conservation sites (MARISCO) <sup>252</sup>	The MARISCO methodology is used to facilitate the integration of the risk and vulnerability perspective into the management of conservation projects and sites. It is designed to ensure that the impact of climate change is considered in the strategic management of protected areas, but is not limited to climate change.
Climate witness: community toolkit <sup>253</sup>	The toolkit presents 14 methodologies that are an adaptation of participatory techniques WWF-South Pacific has used over the years in community resource conservation and development projects. It should give facilitators a clear sense of process when trying to illicit information specific to impacts of climate change and developing appropriate community response measures to them.
Water Evaluation and Planning (WEAP) system <sup>254</sup>	WEAP is a user-friendly software tool that takes an integrated approach to water resources planning. It comprises a water balance database, a scenario generation tool and a policy analysis tool.
Pacific Climate Futures 2.0 <sup>255</sup>	Pacific Climate Futures Version 2.0 is a free web-based climate impacts decision-support tool that provides national and some sub-national climate projections for East Timor and 14 Pacific countries. Pacific Climate Futures has three levels of detail: i) the basic interface provides a summary of the projected changes in annual temperature and rainfall and is accessible for everyone; ii) the intermediate level provides access to a guided interface to generate climate projections tailored to an impact assessment; and iii) the advanced level provides more flexibility to the user along with additional options for exporting data for use in risk assessments.
PROVIA / MEDIATION Adaptation Pathfinder <sup>256</sup>	The PROVIA / MEDIATION Adaptation Pathfinder is a web-based decision support guide for monitoring and evaluating adaptation. The guidance provides a framework for considering the full range of approaches to vulnerability, impacts and adaptation. The structure is based on a five-stage iterative adaptation learning cycle: i) identifying adaptation needs; ii) identifying adaptation options; iii) appraising adaptation options; iv) planning and implementing adaptation options; and v) monitoring and evaluation of adaptation
SimCLIM <sup>257</sup>	A software package that links data and models in order to simulate the impacts of climatic variations and change, including extreme climatic events on, <i>inter alia</i> , agriculture, health and water resources. It contains tools for importing and analysing both spatial (monthly, seasonal) and time-series (hourly, daily or monthly) data.
Assessment and Design for Adaptation to climate change: A Prototype Tool	ADAPT is a software-based multi-sectoral tool for screening development projects for potential sensitive areas to climate change. The tool brings together climate databases and expert assessments on the threats and opportunities arising from climate variability and change, and focuses primarily on agriculture, biodiversity, rural

<sup>249</sup> <https://climatescreeningtools.worldbank.org>

<sup>250</sup> <http://www.iisd.org/cristaltool/>

<sup>251</sup> <http://www.naturalcapitalproject.org/invest/>

<sup>252</sup> <http://www.marisco.training/>

<sup>253</sup> McFadzien D, Areki F, Biuvakadua T, Fiu M. 2005. WWF South Pacific, Fiji.

<sup>254</sup> <http://www.weap21.org/>

<sup>255</sup> <http://www.pacificclimatefutures.net/en/>

<sup>256</sup> [http://www.mediation-project.eu/platform/apf\\_entry/entry\\_point.html](http://www.mediation-project.eu/platform/apf_entry/entry_point.html)

<sup>257</sup> [www.climsystems.com](http://www.climsystems.com)

(ADAPT) <sup>258</sup>	infrastructure and coastal zones.
Costing Nature (Co\$ting Nature) <sup>259</sup>	Costing Nature is a web-based tool for the analysis of ecosystem services provided by natural environments, identification of service beneficiaries and assessment of the impacts of human interventions
Ecosystem Valuation <sup>260</sup>	A web-based tool designed for non-economists to address questions about the benefits of ecosystem conservation, preservation or restoration. It provides a clear, non-technical explanation of ecosystem valuation concepts, methods and applications.
EX-Ante Carbon balance Tool (EX-ACT) <sup>261</sup>	EX-ACT is an appraisal system which provides estimates of the impact of agriculture and forestry development projects. The tool is used for quantifying mitigation co-benefit for projects which need more in-depth assessment of carbon.

**Table 20.** Datasets for vulnerability and climate information.

Dataset type	Name	Description
General	WorldPop <sup>262</sup>	High-resolution distribution of the world's population with age and gender demographics that can be used for dependency ratios and various other sensitivity indicators.
	DIVA GIS <sup>263</sup>	General administrative GIS data.
	ESA CCI Land Cover <sup>264</sup>	High-resolution landcover, giving <i>in situ</i> context.
	MODIS <sup>265</sup>	Various data products but predominately used for fire analysis.
	SRTM <sup>266</sup>	High-resolution elevation data.
	OECD Statistics <sup>267</sup>	Various datasets including agriculture, development, economy, education, energy, environment, health, society and others.
	Weiss Accessibility <sup>268</sup>	Global travel time to the nearest city as a proxy for rurality.
	EM-DAT International Disaster Database <sup>269</sup>	Provides information on human and economic impacts of disasters, as well as international aid contributions. Can be used to inform vulnerability assessments and DRR planning.
Climate	UN Statistics Division <sup>270</sup>	Compilation of global statistical information, standards and norms for statistical activities to support countries' efforts in strengthening their national statistical systems.
	CHIRPS <sup>271</sup>	Provides high-resolution daily global rainfall that can be used to validate climate models and is particularly useful for extreme event analysis.
	Climate Data Store (C3S) <sup>272</sup>	Modelled historical high-resolution global temperature and precipitation that can be used to fill data gaps and allows for sub-daily analysis such as the timings of convective thunderstorms. Also provides other environmental datasets.
	NOAA — tropical cyclone tracks <sup>273</sup>	Various meteorological datasets and can be used for tropical cyclone tracks and categories.
	TERRACLIMATE <sup>274</sup>	A dataset of monthly climate and climatic water balance for global terrestrial surfaces from 1958–2015.
	Cordex climate data <sup>275</sup>	The RCP climate analysis dataset of CMIP5 IPCC AR5 projected experiments at 0.5° x 0.5° spatial resolution and daily temporal resolution from 1951–2005 and 2006–2100 is used for the projection of climate data with high temporal resolution, providing the basis for long-term trends, as well as allowing for short-term

<sup>258</sup> <https://climatescreeningtools.worldbank.org/>

<sup>259</sup> <http://www.policysupport.org/costingnature>

<sup>260</sup> <http://www.ecosystemvaluation.org/>

<sup>261</sup> <http://www.fao.org/tc/exact/ex-act-home/en/>

<sup>262</sup> <https://www.worldpop.org/>

<sup>263</sup> <https://www.diva-gis.org/>

<sup>264</sup> <http://www.esa-landcover-cci.org/>

<sup>265</sup> <https://modis.gsfc.nasa.gov/data/>

<sup>266</sup> <https://www2.jpl.nasa.gov/srtm/>

<sup>267</sup> <https://data.oecd.org/>

<sup>268</sup> Weiss, D. J. et al. A global map of travel time to cities to assess inequalities in accessibility in 2015. *Nature* 553, 333–336 (2018)

<sup>269</sup> <https://emdat.be/>

<sup>270</sup> <https://unstats.un.org/home/>

<sup>271</sup> <https://www.chc.ucsb.edu/data/chirps>

<sup>272</sup> <https://cds.climate.copernicus.eu/>

<sup>273</sup> <https://oceanservice.noaa.gov/news/historical-hurricanes/>

<sup>274</sup> <http://www.climatologylab.org/terraclimate.html>

<sup>275</sup> <https://cordex.org/>

		extreme event analysis.
	WorldClim <sup>276</sup>	Set of bias corrected high-resolution (1 km x 1 km) downscaled climate models that can be used for detailed spatial analysis of an area's climate changes.
	WRI Aqueduct Water Risk Atlas <sup>277</sup>	The data assesses the impacts of climate change on a catchment level, focusing on water-related issues, such as seasonal precipitation variability, water supply and demand change, and water stress. Also provides historical data on, <i>inter alia</i> , sensitivities to flood and drought.
	Climate Information <sup>278</sup>	Climate historical and projection data, which provides: i) instant summary reports of climate change around the globe; ii) pre-calculated climate indicators; and iii) guidance on linking global changes to local observations.
	PREP Data <sup>279</sup>	Various datasets for access and visualisation on climate, exposure, vulnerability and physical features across the world.
	Princeton Climate Analytics <sup>280</sup>	Provides climate science products and data for global high-resolution risk and vulnerability analysis. The platform includes historical, real-time and projected climate data.
	Climate Change Knowledge Portal <sup>281</sup>	Provides global data on historical and future climate, vulnerabilities and impacts. Data can be explored by country, region and watershed. Portal also contains comprehensive Country Profiles for selected countries.
	IPCC Data Distribution Centre <sup>282</sup>	Climate, socio-economic and environmental data used to inform IPCC reports.
Human indicators	IPUMS <sup>283</sup>	Source of census data that can be used for analyses of adaptive capacity and sensitivity.
	NASA SEDAC <sup>284</sup>	Various data products but predominately used for indicators of sensitivity, such as infant mortality or human footprint data.
	World Bank Open Data <sup>285</sup>	Data and statistics on a variety of indicators to support effective public and private actions, goal- and target-setting, progress monitoring and impact evaluations.
Environment	ISRIC database <sup>286</sup>	Various spatial datasets related to land terrain and soil chemistry, texture, lithology, depth and similar parameters.
	Global Forest Change <sup>287</sup>	Results from time-series analysis of Landsat images, characterising forest extent and change from 2000–2018.
	Landscape Portal <sup>288</sup>	ICRAF's interactive online spatial data storage and visualisation platform.
Agriculture	FAOSTAT <sup>289</sup>	Various datasets that include Climatic Stress Index on humans, agriculture and natural systems.
	EarthStat <sup>290</sup>	Modelled agricultural data per major crops, showing yields and suitability.
	IWMI Data Portal <sup>291</sup>	High-resolution agricultural data that disaggregates area by crop cycles
Water	Hydro Sheds <sup>292</sup>	High-resolution hydrological data, including catchments and river systems.
	WHYMap —	Ground water datasets, including infiltration and sensitivities.

<sup>276</sup> <https://worldclim.com/>

<sup>277</sup> <https://www.wri.org/resources/maps/aqueduct-water-risk-atlas>

<sup>278</sup> <https://climateinformation.org/>

<sup>279</sup> <https://www.prepdata.org/>

<sup>280</sup> <https://www.princetonclimate.com/>

<sup>281</sup> <https://climateknowledgeportal.worldbank.org/>

<sup>282</sup> <http://www.ipcc-data.org/>

<sup>283</sup> <https://ipums.org/>

<sup>284</sup> <https://earthdata.nasa.gov/eosdis/daacs/sedac>

<sup>285</sup> <https://data.worldbank.org/>

<sup>286</sup> <https://www.isric.org/>

<sup>287</sup> <http://earthenginepartners.appspot.com/science-2013-global-forest>

<sup>288</sup> <http://landscapeportal.org/>

<sup>289</sup> <http://www.fao.org/faostat/en>

<sup>290</sup> <http://www.earthstat.org/>

<sup>291</sup> <https://waterdata.iwmi.org/>

<sup>292</sup> <https://hydrosheds.org/>

	groundwater <sup>293</sup>	
	FAO WaPOR <sup>294</sup>	Portal to monitor water productivity through open access of remotely sensed derived data.

---

<sup>293</sup> <https://www.whymap.org/>

<sup>294</sup> [https://wapor.apps.fao.org/home/WAPOR\\_2/1](https://wapor.apps.fao.org/home/WAPOR_2/1)