



Technology Executive Committee

03 September 2024

Twenty-ninth meeting

17–20 September 2024 (20 September TEC-CTCN Advisory Board Joint session)

Draft analysis of success stories of implemented Technology Action Plans

Cover note

I. Background

1. As per activity B.1.1 of its rolling workplan (2023-2027), the TEC is to publish a knowledge product in 2024 on the analysis of success stories of implemented Technology Action Plans (TAPs), and identification of key elements of success.
2. At TEC 28, the TEC discussed a draft outline¹ of an analysis paper and requested the activity group, in collaboration with the UNEP Copenhagen Climate Centre, to prepare a draft analysis of success stories of implemented TAPs, taking into account the guidance provided at the meeting.
3. At TEC 29, a co-lead of the activity group will present the draft paper, as contained in the annex.

II. Scope of the note

4. The annex to this note contains a draft analysis paper on success stories from implemented TAPs, referred to in paragraph 2 above.

III. Expected action by the Technology Executive Committee

5. The TEC will be invited to consider the draft analysis paper and provide guidance to the activity group for further work on this matter.

¹ See TEC document TEC/2024/28/7.

Annex

Analysis of success stories of implemented Technology Action Plans

Draft paper

Table of contents

I.	Introduction	3
A.	Background	3
B.	Objective	4
C.	Scope and approach	4
II.	Analyses of success stories of implemented TAPs	5
A.	Antigua and Barbuda - Bolstering an ecosystems of support for cross-cutting technology action in SIDS	6
B.	Armenia – Promoting cross-sectoral and multi-level climate technology actions	9
C.	Ghana –Integrated technology solutions for advancing climate adaptation in the water and agriculture sectors	11
D.	Grenada – Utilizing regional platforms and readiness support to advance technology implementation	14
E.	Liberia – Technology and innovation in support of enhanced resilience in coastal areas	16
F.	Pakistan - Innovation and technology for integrated risk management and climate adaptation	18
III.	Key elements of success for TAP implementation	21
A.	Technology action plans enabling implementation at scale	21
B.	Challenges, gaps and learnings from unimplemented TAPs by different stakeholders	24
IV.	Linking TAP implementation with relevant national and inter-governmental processes on climate change	25
V.	Key findings and recommendations	26
	Annex	29

I. Introduction

A. Background

Technology action plans under the UNFCCC and Paris Agreement: from priorities to implementation

1. The technology needs assessment (TNA) methodology is a long-standing and evolving process under the UNFCCC, which follows a participatory and country-driven approach and assists countries in identifying and analyzing priority technology needs for climate change mitigation and adaptation, and articulating appropriate actions for addressing them in line with the national circumstances. The concept of the TNA was formalized under the UNFCCC process in 2001 with the establishment of the technology transfer framework.¹ Thereafter, Parties recurrently highlighted² that the TNA process should be country-driven and integrated in broader national processes on climate change to ensure coherence and synergy and avoid fragmentation and duplication of efforts.
2. The GEF has been the primary provider of support for undertaking TNAs, particularly under the Global TNA Project (2009 - present) implemented by the UNEP Copenhagen Climate Centre (UNEP-CCC, formerly UNEP-DTU Partnership). Moreover, the TNA methodology has been utilized by other actors including national authorities as well as the CTCN and GCF for identifying prioritized technologies for climate change mitigation and adaptation in developing countries and articulating associated technology action plans (TAPs) for their implementation.
3. Over time and through an iterative process, collective learnings and practical insights from the global- and country-level work on TNAs have informed and enriched the TNA methodology, including through growing guidance³ available to countries and implementation actors. Today, the TNA process has evolved into a step-by-step process that goes beyond technology needs and is geared towards enabling technology implementation and demonstrating technology viability, including by closing the gap between needs of developing countries and global support options.
4. In this process, TAPs have been increasingly recognized as means to form a portfolio of nationally-endorsed projects and programmes which can facilitate both action and support for the implementation of prioritized climate technologies. The enhanced quality and level of details in the elaboration of TAPs (e.g. on timelines of actions, costs, and identified funding options) in latter phases of the Global TNA Project compared to the Phase I is an indication of this growing attention to the TAPs as instruments to accelerate technology implementation and uptake.
5. This shift of focus to the implementation, and the foundational role of TAPs therein, can also be traced through the intergovernmental work on technology development and transfer under the UNFCCC. With the establishment of the technology framework under the Paris Agreement⁴, and particularly under the theme of ‘implementation’, Parties have underscored the implementation of the TNA/TAP outcomes as a vehicle towards achieving the global climate and sustainable development goals. The outcomes of the first Global Stocktake under the Paris Agreement⁵ also emphasized the importance of ensuring the availability and access to enhanced financial and capacity-building support for developing countries, in particular the least developed countries (LDCs) and small island developing states (SIDS), for implementing and scaling up prioritized technology measures, including those identified in TNAs, TAPs, and low-greenhouse gas emission development strategies.

Technology Executive Committee and guidance on TAPs

6. To date, more than 100 developing countries have undertaken a TNA⁶ and produced hundreds of TAPs and project ideas⁷. While there is a recognition of the role of TAPs in informing and fostering post-TNA implementation, evidence gathered by the TEC⁸ suggests that: countries are at different starting points in the formulation of their TAPs as regards technical depth and details of envisaged

¹ Decision 4/CP.7, Annex.

² Including through Decision 1/CP.16; Decision 13/CP.18, Decision 15/CP.22.

³ For more information on TNA methodology and guidance see: <https://tech-action.unepccc.org/tna-methodology/> or <https://unfccc.int/tclear/tna/guidance.html>.

⁴ Decision 15/CMA.1, Annex.

⁵ Decision 1/CMA.5, para 106.

⁶ Available at: <https://unfccc.int/tclear/tna/outcomes.html>

⁷ Available at: <https://unfccc.int/tclear/projects>

⁸ For example in documents TEC/2015/11/6; TEC/2019/19/5; and TEC/2024/29/16.

actions; many of the TAPs remain unimplemented; and the information on post-TNA/TAP implementation efforts in developing countries continues to be fragmented at both national and global levels.

7. Addressing underlying issues that have led to such gaps and challenges is a complex, resource- and time-demanding task that requires concerted efforts of different actors at various levels across the value chain of technology implementation. As the policy arm of the Technology Mechanism, the TEC has continually monitored lessons learned and good practices from undertaking TNAs and implementation of their results, with a view to enhancing the guidance and support available to developing countries on how the results of the TNAs, in particular TAPs, can be developed into projects that can be ultimately implemented. For example, the TEC:
 - In 2015, conducted a study on improving the implementation of the results of the TNA process⁹, that was mainly built upon outcomes of the Phase I of the Global TNA Project;
 - In 2016, at the request of COP 20 and in collaboration with UNEP-DTU Partnership (now UNEP-CCC), released a guidance for preparing a TAP, and published an enhanced version of the guidance in 2017,¹⁰
 - In 2019, conducted a study¹¹ on experiences, lessons learned and good practices in conducting TNAs and implementing their results to examine how the guidance on TAP was applied in the latest phase of the Global TNA Project (mainly Phase II of the Global TNA Project), and also reviewed success stories from implemented TAPs to date (mainly from participating countries in Phase I of the Global TNA Project).
8. In its rolling workplan for 2023-2027,¹² the TEC has agreed to work on the analysis of success stories of implemented TAPs and identification of key elements of success (current report), with a view to facilitate the undertaking and updating of TNAs, as well as enhancing the implementation of their results, and promote the links between the TNA and other relevant national processes on climate change.

B. Objective

9. The objective of this paper is, through the analysis of success stories from implemented TAPs in different national contexts, to gain insights into common elements that may have contributed to successful implementation of prioritized technologies in developing countries, linked to the TNAs/TAPs.
10. This report builds on the findings of previous work of the TEC on the topic and examines which elements of success from implemented TNAs/TAPs identified to date (see table 1) are present in the development and implementation of realized TAPs in recent years, and what other contributing elements and enabling conditions have led to the implementation of prioritized technologies in various national contexts, linked to the TNAs/TAPs. The report also aims to highlight the challenges and potential underlying factors that may have led to many of the TAPs remaining unimplemented.
11. Findings of this report could inform the future development of TAPs in developing countries, for example through the provision of additional guidance on conducting TAPs under the Global TNA Project, TEC policy recommendations, and its systematic feedback to and collaboration with the CTCN.

C. Scope and approach

What is defined as a success story

12. The focus of the analysis is on country experiences in which the TNA process has led to implementation of prioritized technologies, including through delivery of large-scale project proposals funded by the GEF, GCF and other financing institutions, domestic or international investors and the private sector, as well as strong integration of TAP outcomes in national climate programming and investments.

⁹ TEC document TEC/2015/11/6.

¹⁰ Available at : <https://unfccc.int/ttclear/tna/guidance.html>.

¹¹ TEC document TEC/2019/19/5.

¹² Available at: <https://unfccc.int/ttclear/tec/workplan>.

What are the parameters of analysis

13. This analysis tracks country-led efforts in six developing countries across three regions to better understand elements of success and effective approaches that have led to the implementation of prioritized climate technologies identified or communicated through TNAs/TAPs, particularly regarding how TAPs are positioned within the broader national climate planning processes (TNA process within the broader institutional arrangement), formulated (Structuring, formulation and content of TAP), utilized to trigger action and uptake (engagement of TAP implementation partners), and followed up into scaled-up implementation (post-TNA/TAP project development, financing, and implementation tracking).
14. The success stories are by no means attributed solely to the TNA process or TAPs, since actions can be traced back to multiple activities in the country. Moreover, acknowledging that success factors may be country-specific with regard to both location and country size, the analysis refrains from any generalization.

Sources of information and selection of country stories

15. Acknowledging that there is no comprehensive set of data on tracking the implementation of TAPs after their conclusion, the current report has acquired information on implemented TAPs through the following sources:
 - A 2023 survey conducted by the UNEP-CCC, inviting for inputs on TNA/TAP implementation status from all participating countries in phases I, II, and III of the Global TNA Project,¹³
 - The series of TNA success stories produced by the UNEP-CCC and UNFCCC, ‘From needs to implementation’,¹⁴ building on the available evidence of initiatives and actions taken by participating countries in the Global TNA Project after the conclusion of TNA/TAP;
 - Data gathered from the websites and reports of the CTCN, GCF, and GEF on TNA/TAP-based projects supported by them, and exchanges with their secretariats;¹⁵ and
 - Information shared by TNA coordinators and experts at TNA-related workshops, events and dialogues convened by the TEC and UNFCCC, including at the margins of UN Climate Change Conferences.
16. The criteria applied in the selection of country cases include ensuring diversity in examples from different geographic regions and sectors, including adaptation and mitigation technologies, as well as in implementation model, and the length of time elapsed since the completion of TAPs in selected countries.
17. On this basis, six country cases with successful examples of implemented TAPs were selected, for in-depth analysis (see Annex for an overview of reviewed country cases). Information on post-TNA implementations in these countries are acquired through both desk research and exchanges with relevant national focal points, where possible.

II. Analyses of success stories of implemented TAPs

18. A combination of context-dependent factors, conditions, processes and activities come together to facilitate the uptake and scale-up of climate technologies in developing countries. As such, this report does not by any means attribute the successful implementation of prioritized technologies solely to TNAs/TAPs, rather aims to highlight which elements in the development of TAPs and national efforts associated with them may have positively contributed to bolstering the ecosystem of climate action and support in each country.
19. Table 1 provides an overview of common success factors identified by the TEC in its past work on the topic, as referred to in para 7. When reviewing the experience of countries in the implementation of TNA results in this paper, the analysis highlights which of these elements are present, and also

¹³ As at 05 May 2024, responses were received from Belize, Mali, Moldova, Seychelles, Fiji, Tunisia, Uruguay, Ghana, Mozambique, and Guyana.

¹⁴ Available at: https://tech-action.unepccc.org/resources/?fwf_content_type=tna-story or https://unfccc.int/tclear/tna/suc_stories.html

¹⁵ A snapshot of this information, as at 29 January 2024, is captured in a [submission by the UNEP](#) to the UNFCCC regarding linkages between the Technology Mechanism and Financial Mechanism, available on the UNFCCC submission portal: <https://collaborate.unfccc.int/submissions/Pages/Home.aspx> (in the search bar type ‘linkages’)

sheds light on other aspects and approaches that may have contributed to the successful implementation of TAPs and prioritized technologies therein.

Table 1: Summary of success factors in the implementation of TNAs and TAPs (non-exhaustive)	
TAP development process	<ul style="list-style-type: none"> - Engagement of key stakeholders including line ministries as well as academia, R&D, practitioners, businesses, and NGOs in the TAP development to ensure TAPs are country- and demand-driven - Aligning the in-country TNA institutional arrangements with existing ones on climate change - Cross-integration of TNA results in a country's overarching policy framework and processes on climate change and development (e.g. NAP and NDC)
Structuring and formulation of TAPs	<ul style="list-style-type: none"> - Detailed and concrete information about foreseen outputs, timeline, scale of actions, associated costs and benefits, roles and responsibilities of different actors, and potential funding sources - Coupling identified technology needs with information on the financial and capacity-building needs for their implementation - Including socio-economic co-benefits of adaptation technologies and coupling mitigation actions with adaptation co-benefits to enhance the feasibility of their implementation
Engagement of TAP implementation partners	<ul style="list-style-type: none"> - Management planning combined with capacity-building (i.e. among government officials) and strong in-country coordination (i.e. with focal points of GEF, GCF, AF) to ensure the commitment and ownership of relevant stakeholder for promoting and applying TNA/TAP results in their sectoral and thematic areas of work - Engaging potential funders at an early stage and throughout the process, for example through 'donor conference' as a final step of the TNA process - Utilizing the reach and efforts of equipped and trained national technology 'champions' who have a task or a clear incentive or motivation to advance a technology to implementation beyond TNA/TAP
Post-TNA/TAP implementation	<ul style="list-style-type: none"> - Development of pilots to demonstrate the viability of a technology option, thereby increasing the likelihood for financial support and investments - Consideration of TNA prioritised technology options in proposals submitted to the GCF, GEF and Adaptation Fund - Tracking the implementation results including to enhance transparency and enable monitoring, evaluation, and learning

20. Acknowledging that it often takes several years for a TAP to go through a process of further elaboration and approval to become an investment-ready proposal or implemented project, these country stories are identified mostly from participating countries of Phases II and III of the Global TNA Project.
21. Highlighted examples of post-TNA/TAP implementation are selected if the project documentations makes direct references to the TNA/TAP or another policy document in which the TNA/TAP results are systematically embedded. Moreover, if the focus of technology actions formulated in such projects is closely resembling the technologies identified in the TAP of the country, such relations and potential linkages are highlighted in the review of country stories.
22. The country stories from Antigua and Barbuda, Armenia, Ghana, Grenada, Liberia and Pakistan (Section II) are supplemented with experience from a broader range of countries from Phase IV of the Global TNA Project as well as those that have conducted TNAs outside of the Global TNA Project to enrich the issues discussed and inform the analysis in the following sections (Section III and IV).

A. Antigua and Barbuda - Bolstering an ecosystems of support for cross-cutting technology action in SIDS

TAP development process

23. Antigua and Barbuda concluded its first TNA in 2002, which resulted in identifying four priority areas for technology transfer: strengthening early warning systems, integrating climate change into development planning, coastal area protection, and developing wind energy. From 2019 to 2022,

Antigua and Barbuda conducted its second TNA, which resulted in cross-cutting TAPs, covering sectors of water, buildings and transport.

24. The Department of the Environment (DoE), under the Ministry of Health, Wellness and the Environment spearheaded the TNA process, **engaging with a range of stakeholders**, public and private sector representatives. DoE is also the responsible entity for the development of other planning and reporting documents under the UNFCCC and the Paris Agreement (e.g. BUR, Adaptation Communications and NDC), and acts as the NDE of Antigua and Barbuda.
25. The **centralized institutional mandate of the DoE** may have been a contributing factor to its success in ensuring **coherent messaging** in the articulation of climate technology needs and identification of prioritized sectors and actions across various climate planning and reporting tools. The integration of TNA results into NDC is rather limited, which in part may be due to the parallel processes happening roughly around the same time, but the outcomes of TNA and relevant follow-on supports are discussed at length in the country's BUR.

Structuring and formulation of TAPs

26. The TAP takes a cross-cutting approach to identifying and prioritizing climate technologies in the water, buildings, and transport sectors, often **combining adaptation action with mitigation and socio-economic co-benefits**. Moreover, the actions outlined in **TAPs are often multi-sectoral and formulated through integrated approaches**. For example, 'rainwater harvesting' in the water sector is closely linked with climate actions for enhancing food security, as set out in the NDC, as well as 'climate-proofing assets' and enhancing climate resilience in the buildings and infrastructure sectors.
27. The content of the TAP contains **clear information** on the costs, timeline, envisaged outputs, responsible authorities and potential sources of funding for prioritized technologies in each sector. The TAP outcomes resulted **in a series of policy briefs** in which further information related to each prioritized technology measure is provided (e.g. on the technology readiness level, costs, and relevant policy interventions).
28. Across the board, the TAP contains **strong elements of capacity-building, research and education, technical training, and awareness raising**. Such measures are highlighted as key to support and enable implementation including at both technical and institutional levels, targeted not only at government institutions but also other national and local actors, particularly **NGOs and local communities**.
29. Another key aspect of the TAPs is the **focus on establishing and strengthening innovative financing mechanisms to support implementation** of prioritized technologies. The focus is also reflected in the project proposals submitted to the climate funds, as seen in the following sections.

Engagement of TAP implementation partners

30. The DoE is the national designated authority of the GCF, the designated authority for the Adaptation Fund, and the operational focal point of the GEF in the country. It has been successful in **leveraging its institutional role and coordination capacities for mobilizing international support** for the implementation of prioritized climate actions, including through strategic **readiness support and project preparation facilities**. The project documents and proposals submitted by Antigua and Barbuda to climate funds often refer to the NDC as the source of information for explaining the rationale.
31. One of the ways through which Antigua and Barbuda has raised the profile of its technology needs and priorities and strengthened the engagement with implementation partners is through **sustained participation in global/regional initiatives and partnerships**, for example through the **needs-based climate finance project in the Eastern Caribbean**. Antigua and Barbuda has also utilized its engagement with the **NDC Partnership** and the Commonwealth secretariat to benefit from **economic and financial advisors** in the preparation of project proposals for NDC implementation.
32. A strong element of the engagement of Antigua and Barbuda with implementation partners is the prominent role of the country's **Ambassador for climate change**, including through high-level participation in multilateral processes on support for climate and development action and engagement with climate and development funds.
33. Another noteworthy mention is that **national ministries and institutions have shown the capacity and leadership to execute internationally-funded climate projects**, for example through the use

of the Adaptation Fund's [direct access grants](#) to advance [innovative technologies for improved water availability to increase food security](#). The DoE also supports the 'start-up' phase **of a national fund** 'the Sustainable Island Resource Framework Fund', which enables Antigua and Barbuda to earmark income from a range of sources (national and international) to achieve its environmental and climate change goals in a coordinated, systematic and cost-effective manner.

Post-TNA/TAP implementation and scale-up

34. Given that a relatively short time has elapsed since the conclusion of Antigua and Barbuda's TNA, the success story is not necessarily focused on implemented projects on the ground as a result of TAPs. The focus is rather on the process and approach and the steps undertaken by Antigua and Barbuda to bring the outcomes of the TNA, including TAPs, closer to implementation, including through utilizing existing structures and platforms, and bolstering the ecosystem of climate action and support. The experience of Antigua and Barbuda, for example in the transport and buildings sectors as explained in the next paragraphs, also shows how ongoing efforts in the country and **prioritized sectors for climate action identified prior to the TNA/TAPs, have shaped its outcomes.**
35. In the transport sector:
 - **In 2019**, a GEF project on [sustainable low-emission Island mobility](#) was conceptualized, and started implementation by UNEP in 2021, with a value of close to USD 10 mil.
 - **In 2021**, Antigua and Barbuda utilized the [multi-year GCF readiness support to advance its NDC implementation](#). The project included in-depth assessment of technology and capacity needs and barriers for scaling up the electric vehicle (EV) transition in the transport sector, including through regulatory frameworks and market analysis. This could be characterized as an advancement of TAPs in the transport sector, that happened in parallel to the TNA process and used a very similar methodology as the TNA.
 - **In the same year**, Antigua and Barbuda utilized the technical assistance by IRENA to develop a [renewable energy roadmap](#), including for the transport sector.
 - **In 2024**, building on the findings of the GCF-funded multi-year readiness programme regarding EV transition, and findings of the GEF project on sustainable low-emission Island mobility, Antigua and Barbuda submitted a concept note to the GCF for an [electric mobility transition project](#) at a value of USD 43 mil.
36. In the buildings and infrastructure sector:
 - **Between 2017 and 2019**, Antigua and Barbuda benefitted from a [technical assistance by the CTCN](#) to improve resilience to climate variability in the buildings sector.
 - **In 2020**, building on the outcomes of the CTCN technical assistance, Antigua and Barbuda accessed GCF grants for a project on [resilience to hurricanes in the building sector in Antigua and Barbuda](#), implemented by the country itself and valued over USD 46 Mil.
 - **In 2023**: Antigua and Barbuda joined a [multi-country project preparation facility \(PPF\)](#), funded by the GCF and implemented by UNDP, to prepare a full-scale proposal which accelerates the delivery of the priority actions required to meet the targets of Early Warnings for All (EW4All). This is a continuation of the country's efforts in increasing its climate resilience and advancing early warning systems that are key priorities identified in the TNA and TAPs. A key function of the PPF is conducting in-depth assessment of technical and capacity needs in each participating country, which could **advance and update the findings of TAPs in relevant areas.**
37. Besides sectoral projects, Antigua and Barbuda has pursued a systemic approach to **strengthening planning and financing mechanisms** that support climate policy and action with sustainable development outcomes aligned with the country's climate and development goals. For example:
 - **Since 2018**, Antigua and Barbuda is spearheading the implementation of a GCF-funded multi-country project for [integrated physical adaptation and community resilience through an enhanced direct access pilot in the public, private, and civil society sectors](#) of three Eastern Caribbean SIDS.
 - **Since 2023**, Antigua and Barbuda is part of a GEF-funded global project implemented by UNIDO, focused on [introducing systemic climate resilience methodologies in infrastructure investment planning](#).

B. Armenia – Promoting cross-sectoral and multi-level climate technology actions

38. Armenia concluded its first TNA in 2003, which resulted in the assessment of technology needs of the country for advancing climate change mitigation and adaptation action, as well as improving climate observations and monitoring. During 2015-2017, Armenia conducted its second TNA, which resulted in TAPs for adaptation (covering water and agriculture sectors) and TAPs for mitigation (covering energy, land-use, industry and waste management sectors).
39. The TNA process was coordinated by the Ministry of Environment (MoE), under the guidance of an inter-agency council tasked with coordination of requirements and provisions of the UNFCCC, which is comprised of representatives from key ministries and public administration agencies. Sectoral **experts were also engaged** in the preparation of related TAPs. A **similar institutional arrangement** has been utilized to develop other planning and reporting documents under the UNFCCC and Paris Agreement in Armenia, for example the NDC and LT-LEDs. The NDE role in the country is performed by the Technology Transfer Association Union of Juridical Persons.
40. The **centralized institutional mandate of the council** has been effective in **ensuring coherence and coordination** of short-term, midterm and long-term actions and measures related to climate change in Armenia, particularly through development of **nationally endorsed climate strategies and programmes in prioritized sectors**. While references to the TNAs/TAPs is limited across other climate planning and reporting instruments in the country (e.g. NDC, NAP, NC, BUR), the content of such documents (e.g. in the energy and agriculture sectors) with regard to prioritized technologies and sectors are aligned, reflecting national climate and development agendas.

Structuring and formulation of TAPs

41. The adaptation and mitigation TAPs were developed with different approaches; while the mitigation TAP covered a broad range of technologies in multiple sectors, the adaptation TAP focused on water and agriculture sectors and the interlinkages between the two, following an **ecosystem-based approach**. Both mitigation and adaptation TAPs contain a number of project ideas that are focused on **inter- and cross-sector solutions and cooperations** in technology development and transfer. There are **adaptation and mitigation co-benefits** associated with actions and technologies in the mitigation and adaptation TAPs.
42. The content of TAPs contain **clear information** on the costs, timeline, envisaged outputs, responsible authorities and potential sources of funding for prioritized technologies in each sector, as well as **financial and capacity-building needs** associated with each technology measure.
43. Across the board, TAPs put a strong focus on **software and orgware measures (e.g. standards, data and regulatory frameworks, supportive financing mechanism, enabling environments and awareness-raising and trainings)** as prioritized actions for technology implementation. The focus on **establishing and strengthening innovative financing mechanisms to support implementation** of prioritized technologies is also reflected in the project proposals submitted to the climate funds, as seen in the following sections.
44. The prioritized technologies in TAPs reflect **needs and priorities identified in the existing and ongoing projects** in Armenia, and **focus on ready-for-implementation technologies** that address priorities and needs of the country and support its climate and development agenda in different sectors.

Engagement of TAP implementation partners

45. After the conclusion of the TAPs, the inter-agency council mandated the UNFCCC National Focal Point to establish a **climate technology platform** based on the TNA (particularly the mitigation TAPs) and linked to the CTCN, entitled national CTCN or Arm CTCN. The idea of the Arm CTCN, introduced in the INDC of Armenia published in 2015 and further elaborated in the TNA process, is to establish a national inventory of climate technologies and enhance coordination and collaboration for technology development and transfer among various actors in Armenia, including for the preparation of project proposals as well as their implementation and monitoring. The CTCN provided **technical assistance to Armenia** for the conceptualization of such a platform in 2018. It is not clear how and if any progress was achieved in setting up this platform.

46. Armenia has utilized its participation in **flagship global initiatives and programmes**, including at the **sub-national and local levels**, to further articulate its technology priorities and engage with implementation partners. For example, a study on an [assessment of investment needs for climate action in Armenia up to 2030](#) conducted in 2019 and co-financed by the European Union and the Government of Germany builds on the findings of mitigation TAPs and further elaborate required resources and actions for technology implementation.
47. Like many other countries, Armenia has also utilized **continued engagement with implementation agencies** to advance its sectoral goals across different climate and development projects and programmes. For example, the support of the World Bank Group in conducting a vulnerability assessment in 2014 in Armenia seems to be a key source that informed the prioritization of technologies in the adaptation TAPs and also led to implementation of relevant sectoral actions such as efforts related to [irrigation system enhancement](#) in Armenia in the period of 2013-2020, supported by the Bank.
48. The project documents and proposals submitted by Armenia to climate funds often refer to the NDC as the source of information for explaining the rationale, and not the TNA/TAPs. However, due to **alignment of the TAP content with the NDC** of the country, the results on the ground to a large extent respond to the needs and priorities identified in Armenia's TAPs, for example the formulation of actions in the energy sector for achieving climate mitigation targets and following an ecosystem-based approach for climate change adaptation.

Post-TNA/TAP implementation and scale-up

49. There is no dedicated mechanism in place to systematically track the results of TAP and their implementation, and the BUR of Armenia does not provide detailed information on technology projects implemented in the country. A review of Armenia profile across various climate funds shows implementation efforts with direct links to the TAP or prioritized technologies therein. Without being exhaustive, some of the related projects include:
50. In the intersection of buildings and energy sector:
- **2016-2026:** The GCF-funded project for '[de-risking and scaling-up investment in energy efficient building retrofits in Armenia](#)' implemented by the UNDP, has over USD 116 million in value (USD 20 million in the form of grants and over USD 86 million as loan), and is closely aligned with the mitigation TAPs. The UNDP had previously supported Armenia in the energy efficiency sector, including through GEF-funded projects that led to the development of energy building codes and secondary legislation for EE in buildings and mobilized significant private sector investment in the sector.
 - **2016-2033:** In parallel with the abovementioned project, Armenia joined the [EBRD and GCF Green Economy Financing Facility](#) that aims to create self-sustaining markets in the areas of energy efficiency, renewable energy, and climate resilience. The focus on fostering financing infrastructure is a strategy that Armenia has pursued consistently across its climate planning tools, including its TAPs.
 - **2024-2027:** The project Advancing Armenia's climate-resilient and resource-efficient development co-financed by the Government of Germany (EUR 1.25 million) and the European Union (EUR 6.2 million) and implemented by the GIZ, [supports sustainable energies for climate resilient municipal development](#) in Armenia, and is closely aligned with TAPs related to advancing energy efficiency and renewable energies in the built environment sector.
51. In the agriculture and land-use sector:
- **2018-2029:** the GCF-funded project on '[forest resilience of Armenia, enhancing adaptation and rural green growth via mitigation](#)' is an example of a cross-cutting approach to climate change adaptation and mitigation in the formulation of climate and technology actions in Armenia. The project is implemented with support from FAO and has a value of over USD 10 million in grants.
 - **2019-2024:** a project funded through bilateral support of the Government of Austria, implemented by the International Center for Agribusiness Research and Education, at a value of close to EUR 700 k, has focused on the [fruit production sector development project in Armenia](#). This is closely linked to priorities for 'agriculture diversification', as articulated

in the adaptation TAPs. The project involves strong elements of capacity-building and education, and focuses on technical and vocational education and training (TVET) institutions.

- **2024-2026:** the Asian Development Bank is financing a [climate-adaptive food security enhancement project](#) at a value of USD 3 million in grants. The project is closely linked with adaptation TAPs in Armenia.
52. A notable aspect in technology implementation is the **role of sub-national and level actors** in advancing implementation efforts for sectoral and multi-sectoral priority technologies. In many cases, domestic resources are combined with grants to advance development and climate goals. For example:
- **2009-present:** many of the climate change focused projects implemented through the support of the [GEF Small Grants Programme](#), administered by the UNDP, are closely aligned with the TNA outcomes in Armenia and have led to the engagement of local communities and actors in the technology implementation, including in the agriculture, waste, and energy sectors.
 - **2016-2019:** With the use of over USD 500 k from the European Union and resources from the Government of Armenia, a project on [plastic waste recycling](#) was implemented by the Urban Foundation, which collected plastic waste in 10 selected cities of Armenia and turn it into sand-polymeric pavement or tile blocks. The project is closely aligned with Armenia's TAPs in the waste sector.
 - **2018-2020:** The participation of Yerevan in **city networks and initiatives**, such as the Covenant of Mayors, has led to the mobilization of USD 1 million grants from the European Union for the implementation of demonstration project for the installation of 90 rooftop [PV systems in multi apartment buildings](#). The project is in line with Armenia's the TAP related to advancing energy efficiency and renewable energies in the built environment.

C. Ghana –Integrated technology solutions for advancing climate adaptation in the water and agriculture sectors¹⁶

TAP development process

53. Ghana conducted its first TNA in 2003 with a focus on mitigation technologies in the energy and waste sector. In 2011-2013, Ghana conducted its second TNA focused on climate change adaptation, and produced TAPs and a number of project ideas on prioritized technologies in the agriculture and water resources sector with interlinkages between the two.
54. The Environmental Protection Agency of Ghana (EPA), which is responsible for the technical coordination of the implementation of climate programmes and climate reporting under the Convention and the Paris Agreement under the Ministry of Environment, Science, Technology and Innovation (MESTI), spearheaded the TNA process in both rounds.¹⁷ EPA has also been the responsible entity for the development of other planning and reporting documents under the UNFCCC and the Paris Agreement (e.g. biennial update reports (BUR), NDC, Adaptation Communications), and is the national designated entity for matters related to technology development and transfer under the UNFCCC (NDE). The **centralized institutional mandate of the EPA** may have been a contributing factor to its success in ensuring **coherent messaging** in the articulation of technology needs and priorities in the selected sectors across various climate policy documents. For example, results of the TNA process later on informed the INDC of Ghana, published in 2015.
55. Members of the TNA steering committee were drawn from the institutional representations of the National Climate Change Committee. Mobilizing similar **institutional arrangements** may have been a contributing factor to **strengthening and retention of national capacities** and ensuring **cross-integration** of technology needs and priorities across various climate planning and reporting tools of Ghana in the water and agriculture sectors. With regard to engagement of stakeholders in the TNA process, representatives of line ministries and lead agencies (e.g. Ministry of Food and

¹⁶ Information presented in this paper related to the experience of Ghana in conducting TNA and implementation of its results has benefitted from valuable insights by Joseph Amankwa Baffoe of the EPA, who also serves as the NDE of Ghana.

¹⁷ The third TNA of Ghana is set to be conducted under phase V of the Global TNA project, coordinated by the EPA.

Agriculture, the Irrigation Development Authority, and the Water Resources Commission), research institutions and universities (e.g. Science and Technology Policy Research Institute, Council for Scientific and Industrial Research (CSIR-STEPRI)), NGOs and a number of financial actors (e.g. Agriculture Development Bank) were engaged in various stages of consultation and development of TAPs. The **early engagement of relevant actors** has proven to be effective in bolstering follow-on actions in the implementation of TNA results, including through sectoral actions.

Structuring and formulation of TAPs

56. The content of the TAP is informed by the national climate change strategy and national policy documents in the water and agriculture sectors in Ghana. It also contains **clear information** on the costs, timeline, envisaged outputs, responsible authorities and potential sources of funding for prioritized technologies in the water and agriculture sectors. In addition, a number of project ideas were developed to flesh out further details, scope and outputs and potential funding entities as well as the **socio-economic co-benefits** of prioritized technologies and **capacity-building and financial requirements** for their implementation. Capacity-building support is mainly envisaged to target agricultural extension officers, farmers and local communities.
57. Integrated climate monitoring and early warning system was considered a priority for both sectors. Other prioritized technologies in TAP – such as integrated water resources management and integrated nutrient management – also reflect the importance given to **integrated and multi-sectoral solutions**, **community-based approaches**, and **management-related** technologies in advancing climate adaptation in the country.

Engagement of TAP implementation partners

58. Beyond the TNA process, both in parallel and after the development of TAPs, Ghana has continually used the TNA/TAPs to articulate and communicate its technology needs and priorities in the agriculture and water sectors, particularly in relation to potential donors. The EPA has played a significant role in **early engagement with implementation partners and potential funders** during and after the TNA process. For example, one of the consultation workshops for the TNA project was held at the premises of the CSIR-STEPRI in Accra, which is a national research institution with international reach, and became one of the first partners to advance the implementation of TNA results. While the role of R&D institutions are mentioned as important, in the linkage with extension systems, the TAP does not emphasize such institutions as key players in the implementation.
59. The EPA is the designated authority of the Adaptation Fund and the operational focal point of the GEF in the country, and has been successful in **leveraging its institutional role and coordination capacities for mobilizing international support** for the implementation of TAPs through support providers under the UNFCCC, namely from the GEF, Adaptation Fund, GCF and CTCN. Some examples from such efforts are provided in the following section.
60. Ghana has shown agility in utilizing existing and emerging opportunities to integrate its technology priorities across various policies, programmes and projects at both national and global levels. This may be attributed to **clear and coherent messaging in the articulation of climate priorities**, the **cumulative capability and know-how of the EPA and other executing agencies** in development of project proposals, and effective **inter-ministerial mandates and coordination for advancing sectoral climate and development goals** (i.e. under national sectoral strategies and roadmaps).
61. Another contributing factor to a successful engagement with providers of support through various funding cycles may be the **continued engagement with an implementing agency** (e.g. World Bank and UNEP) for work on a geographic region or thematic issue where the said agency has implemented previous projects or possesses an in-depth and unique expertise.
62. Moreover, Ghana has managed to enhance its capacity and engagement with implementation partners through **utilizing regional and umbrella projects and programmes**, as relevant to its prioritized technologies and climate goals.
63. Another means through which Ghana has raised the profile of its technology needs and priorities and strengthened the engagement with implementation partners is through **sustained participation in global initiatives and partnerships**. For example, since 2011 around the same time that the TNA project was kicked-off, Ghana has elevated its engagement in the Global Water Partnership, both at the national and regional levels. In 2019, with support from the Partnership, Ghana formulated an integrated water resources management implementation action plan, aimed at catalyzing national

action for accelerated implementation of country's water-related sustainable development goals by 2030, including through **elaboration of management plans and roles and responsibilities** of various entities. This has helped Ghana to ensure technology priorities previously identified through TAPs in the water sector **are up-to-date**.

Post-TNA/TAP implementation and scale-up

64. While there is no dedicated mechanism in place to systematically track the results of TAP and their implementation, **the NCs and BURs of Ghana provide a glance at the country's prioritized technology needs through TNAs, as well as efforts in mobilizing support for technology implementation**. Moreover, the project documents and proposals submitted to the funds and prepared through the CTCN technical assistance in the country contain valuable information that links implementation efforts of Ghana to the results of TAPs. Ghana's focal point was among few countries responding to a survey by the Global TNA Project (conducted in 2023) and communicated some of the actions taken to follow-up on the implementation of the TAPs.
65. Without being exhaustive, some of the highlighted projects emerging from these efforts in the water and agriculture sectors with direct link to the TAP or its results are listed below, showcasing success of Ghana in implementing the results of its TNA/TAPs:
 - **2013-2015:** The collaboration with the CSIR-STEPRI led to a project on 'rain water harvesting (RWH)' in collaboration with a leading research institution in Norway and financed by the [Nordic Development Fund \(2013-2015\)](#), at a value of over EUR 400k. The aims of the project include assessment and development of appropriate and innovative model of RWH systems, installation of the model systems in 20 households and 2 schools, training of artisans in building RWH systems as a business and promoting the model RWH systems in Ghana.
 - **2010-2021:** In parallel with overseeing the TNA process, EPA ensured that the outcomes of the TAP were fed into the formulation and evolution of a [GEF project focused on 'sustainable land and water management \(SLWM\)'](#) implemented by the World Bank Group (2010-2021), with the GEF grants totaling USD 29.67 million over three funding tranches. From 2017-2021, the project was implemented as a [national project](#) under the umbrella of the 'Resilient Food Systems' pilot programme spearheaded by the GEF and IFAD with a focus on promoting integrated approaches to food security. A range of SLWM technologies and practices were demonstrated under the original project and later scaled up, among other outcomes.
 - **2016-2020:** EPA mobilized the support of the [Adaptation Fund to advance the management of water resources](#) through implementation of prioritized technologies in the TAP, with implementation support from the UNDP. The project value is over USD 8 million in grants and has led to the construction and rehabilitation of a number of small dams and boreholes in key areas across Northern Ghana, as well as implementation of irrigation schemes, thereby improving water access and management, and enabling local farmers to cultivate the land and grow their crop throughout the year, even during the dry season.
 - **2017-2018:** the EPA mobilized the support of the CTCN for a [technical assistance on 'early warnings for droughts'](#), through the readiness support of the GCF at a total value of just over USD 300k and with technical and in-kind support from the UNEP-DHI. The UNEP-DHI continued its support to Ghana by putting in place [a web-based portal](#) in 2018 to implement the drought early warning system in Ghana, and training key national stakeholders in using the system.
 - **2017-2019:** Building on previous efforts, two project concept notes were developed and submitted to the GCF, both with the support of UNEP as the implementing agency; one submitted by the EPA and Ministry of Food and Agriculture in 2017, at a value of over USD 26 million, aimed at improving food security [and climate-resilient landscapes for sustainable livelihoods in northern Ghana](#); and the other submitted by the Water Resources Commission in 2019, with the objective of [building climate resilience of the agriculture sector through improved early warning systems](#) in Ghana at a value of over USD 11 million. According to the Ghana's fourth BUR published in March 2024, both of these proposals are currently under review by the GCF secretariat.

- **2022:** the Government of Ghana received a grant of EUR 44.7 million from the European Union and the Government of France to for an [agricultural water management project](#), that is directly linked with the TAPs and will be implemented by the Ministry of Food and Agriculture and the Ghana Irrigation Development Authority.
66. Though not exhaustive, the review of implemented climate projects in Ghana sheds light on a number of factor that may have contributed to its successful technology outcomes on the ground, for instance, [utilizing various windows of support for technology implementation in a strategic manner and with complementarities in mind](#) have resulted in the mobilization of funds from different sources for supporting different stages of technology development and transfer (e.g. capacity-building, technical assistance, investment planning, implementation).

D. Grenada – Utilizing regional platforms and readiness support to advance technology implementation

TAP development process

67. Grenada conducted its TNA process in 2015-2018, with support from the CTCN and UNEP-DTU Partnership (now UNEP-CCC), which resulted in TAPs for adaptation (addressing technology priorities in the agriculture, water, and tourism sectors) and TAPs for mitigation (addressing technology priorities in the energy sector, including transport and a number of sub-sectors).
68. The Ministry of Agriculture, Lands, Forestry and Fisheries and the Environment (now Ministry of Economic Development, Planning, Tourism, Creative Economy, Culture, Agriculture and Lands, Forestry, Marine Resources and Cooperatives, in short MoEDA) spearheaded the TNA process by establishing a national TNA committee, comprising representatives from key ministries, operating under the broader umbrella of the National Climate Change Committee (NCCC) in Grenada. The NCCC has overseen the development of other climate-related documents such as the INDC, NDC and NAP of Grenada, which were coordinated by the Ministry of Climate Resilience, The Environment and Renewable Energy (MoCRE). The latter is also the NDE of Grenada.
69. The TNA and NAP processes were conducted around the same time and the NAP builds on the findings of the TNA process. The INDC of Grenada (2016) refers to both these processes. The second NC of Grenada (published in 2019) includes outcomes of the TNA and the NDC of Grenada (submitted in 2020) contains priority sectors aligned with the sectors of focus in the mitigation TNA and makes general reference to the NAP as the guiding document for adaptation action. The **centralized institutional mandate** of the NCCC plays an important role in ensuring **interlinkages and strategic alignments** between different climate policy documents in Grenada at the national level and in the context of international frameworks.

Structuring and formulation of TAPs

70. The adaptation and mitigation TAPs are different in the level of details for prioritized actions as well as the formulation of the project ideas. The content of the mitigation TAP **contains clear information** on the costs, timeline and envisaged outputs, as well as information on responsible authorities and potential sources of funding, for prioritized technologies in each sector. The adaptation TAP took a similar approach in the formulation of actions, but contains less details for example on the estimated costs. The mitigation TAP concluded with one project idea that focused on EVs. The adaptation TAP contains a long list of ideas in each sector which are not elaborated in detail.
71. Across the board, TAPs articulate **sustainable development co-benefits** of prioritized technologies and put a strong focus on [capacity-building and training](#) as enablers for advancing implementation. Another common approach in Grenada's TAPs is the focus on [technology piloting to advance implementation](#).

Engagement of TAP implementation partners

72. The MoCRE is in most cases the focal point for engaging with the UNFCCC processes and funds. Although the ministry was not the responsible entity for conducting the TNA process, the project documents and proposals submitted to climate funds are closely linked to the outcomes of the TNA. This may be explained by close alignment of the TAP content with the NDC, NAP and NC of the country.

73. A **continued engagement with the GIZ as an implementing partner** seems to have contributed to advancing TAPs in the energy and water sectors. Through support of the GIZ, Grenada joined the multi-country project [Cool Contributions fighting Climate Change II](#) (2021-2025) which is directly linked to the TNA priorities for high energy efficiency air conditioners.
74. A notable approach in engaging with implementation partners and fostering technology implementation in Grenada is the focus on **strengthening institutional frameworks including the establishment of innovative financing mechanisms** to support implementation of prioritized technologies in TAPs, for example through **the use of readiness support** from the GCF and **participation in regional and multi-country initiatives** and projects with this objective.
75. The country has also benefitted from the presence of the UNFCCC **regional collaboration center** (RCC) for the Caribbean region,¹⁸ including through improved access to innovative solutions, including financing instruments, emerging technologies, and capacity building towards achieving its climate goals.

Post-TNA/TAP implementation and scale-up

76. Grenada's [Climate Finance Portal](#), co-funded by the GCF and Government of Germany and implemented by the GIZ, enable the country to communicate its climate priorities (i.e. in the energy and water sectors) and keep track of support received for the implementation of various climate projects. While the TNA is not among the featured policy documents on the portal, its outcomes are closely reflected, owing to the **close alignment of the TAP content with the NDC, NAP and NC** of the Grenada. Without being exhaustive, some of such projects include:
- **2019-2025:** A GCF-funded project on [Climate Resilient Water Sector in Grenada](#), implemented by the GIZ, addresses **cross-sectoral** goals of Grenada by incorporating technology measures for water and energy efficiency, and devising water solutions in the agriculture and tourism sectors, in line with priorities articulated in TAPs. The project is valued at over USD 46 million.
 - **2022-2025:** Grenada mobilized over USD 1 million in GEF grants and over USD 4 million in co-financing (loan and in-kind support) to [accelerate the introduction of low-emission and climate-resilient electric mobility](#) under a larger parent project by the GEF, which is fully aligned with TAP priorities for the energy sector. The project supports the development of a solar PV and battery hybrid project and finances a facility that will support geothermal energies and renewable energy frameworks in the Eastern Caribbean, and is implemented by UNEP. The project includes technology measures that had **proven effective through piloting** in previous activities and project in the country.
 - **2023:** Grenada submitted a project proposal with a value of USD 10 million to the Adaptation Fund, with IFAD as the implementing agency, to [increase climate resilience and adaptive capacity among farming and fishing communities](#) in Grenada. The project has a strong focus on technology implementation in the agriculture sector, and refers to the NAP as a key source of strategic direction.
77. As mentioned previously, Grenada has effectively embedded its technology priorities in a number of GCF readiness projects, with a view to address associated capacity-building and technical needs. Examples include:
- **2019-2021:** a readiness proposal at a value of close to USD 400k, implemented by the Caribbean Community Climate Change Centre (CCCCC), focused on strengthening institutional and implementation capacity for delivery of climate change investment projects in Grenada
 - **2021-2023:** a readiness proposal at a value of over USD 1 million, implemented by FAO, aims to support national adaptation planning for [improved food security](#) in Grenada, while advancing regional data on agriculture and food security. The project has strong components of technology, including hardware, software and org-ware measures and includes **technology piloting** as a key component for future larger-scale implementation.
 - **2021-2024:** a readiness proposal at a value of over USD 600 k, implemented by the Grenada Development Bank, which has a focus on [getting Grenada private sector ready for climate](#)

¹⁸ The RCC Caribbean is hosted by the Windward Islands Research and Education Foundation at St. George's University on the island of Grenada.

[finance](#) aims to address the gaps to accessing finance for technology diffusion in Grenada and includes direct references to the TNA results.

- **2023-2025:** a readiness proposal at a value of nearly USD 1 million, implemented by the CCCCC, supports building Grenada's [strategic framework to enhance the country's capacity to transition to low emission development](#). The project encompasses many of the sectoral goal in the energy sector, as articulated in the TNA, and makes direct references to such outcomes.

E. Liberia – Technology and innovation in support of enhanced resilience in coastal areas¹⁹

TAP development process

78. Liberia conducted its TNA process in 2018-2021, which resulted in TAPs for three sectors; for adaptation technologies in the coastal zones and the agriculture sector, and for mitigation technologies in the energy sector. The Environmental Protection Agency of Liberia (EPA) spearheaded the TNA process, in **consultation with a diverse range of stakeholders** including representatives of line ministries and agencies, research institutions and universities, NGOs, farmers, youth and businesses. EPA has also been the responsible entity for the development of other planning and reporting documents under the UNFCCC and the Paris Agreement (e.g. BUR, NDC, NAP), and is the NDE of Liberia.
79. The **centralized institutional mandate of the EPA** may have been a contributing factor to its success in ensuring **coherent messaging** in the articulation of technology needs and priorities in the selected sectors across various climate planning and reporting tools at the national level (i.e. Liberia's national climate change strategy) and under international frameworks (i.e. Liberia's NDC and NAP). For example, the adaptation technologies in the agriculture sector and coastal zones identified in the TAP informed the NAP of Liberia that was developed around the same time, and led by the same team.

Structuring and formulation of TAPs

80. The content of the TAP contains **clear information** on the costs, timeline, envisaged outputs, responsible authorities and potential sources of funding for prioritized technologies in each sector. The TAP outcomes resulted **in a series of policy briefs** in which further information related to each prioritized technology measure is provided (e.g. on the technology readiness level, costs, and relevant policy interventions). The policy briefs were targeted at policy makers and were used as outreach materials by the national team to disseminate the results of the TNA process.
81. Besides stakeholders that participated in TNA workshops and sectoral working groups (capped at 10 stakeholders per sector, based on available resources), the national TNA team also **mobilized their professional networks and contacts** to inform the prioritization of technologies, for example in the assessment of costs and socio-economic impacts of various technology measures, through exchanges with technology practitioners and senior experts in sectoral ministries and academic institutions.
82. Across the board, TAPs contains estimated **financial needs as well as strong elements of capacity-building that would support and enable implementation** including at both technical and institutional levels, targeted not only at government institutions but also other national and local actors, particularly **research and training institutions in different sectors**.
83. Prioritized technology solutions in the agriculture sector included value addition, improved storage and integrated soil fertility management, all with anticipated **sustainable development co-benefits** including related to farmers' income level and biodiversity conservation. In the coastal areas, integrated coastal zone management (ICZM), flood early warning systems and revetments were prioritized, many of which have been implemented. The prioritized solutions in the energy sector were focused on the use of renewable energy, in particular the implementation and scale up of solar photovoltaic (PV) technology and small hydropower plants.

¹⁹ Information presented in this paper related to the experience of Liberia in conducting TNA and implementation of its results has benefitted from valuable insights by Christopher B. Kabah of the Environmental Protection Agency, NDE of Liberia who also served as the TNA coordinator.

84. A noticeable difference between the work of the sectoral teams, that may have impacted the implementation outcomes, is different approaches to the type of technologies included into the prioritization process of the TAP. For example, while the coastal **TAP focuses on ready-for-implementation technologies that address immediate needs** and the increasingly at-risk infrastructure and populations in Liberia, the agriculture TAP prioritizes technologies that are rather new to the country and have a high up-front cost. This may explain why projects that have attracted investments in the coastal areas are more closely aligned with the TAP priorities, in comparison with the agriculture sector projects. For example a project on [building climate resilience in Liberia's cocoa and Rice sectors](#), funded by the Adaptation Fund (values at about USD 9 million, implementation period 2022-2027), include technology components with higher level of maturity in Liberia that were discussed during the TNA process but were not necessarily prioritized in the TAP.
85. Liberia followed the **latest TNA guidance to strengthen the content of its TNA/TAP**, including the 'Guidance for a gender-responsive TNA', and have consistently **integrated gender consideration** across all TAPs. This approach has been consistently applied across various climate planning tools in Liberia, including in the NDC and NAP.

Engagement of TAP implementation partners

86. The EPA is the national designated authority of the GCF, designated authority for the Adaptation Fund, and the operational focal point of the GEF in the country, and has been successful in **leveraging its institutional role and coordination capacities for mobilizing international support** for the implementation of its prioritized technologies (as articulated in its NDC and TNA) through support providers under the UNFCCC, namely from the GEF, GCF and CTCN.
87. The project documents and proposals submitted by Liberia to climate funds often refer to the NDC as the source of information for explaining the rationale, and not necessarily the TNA/TAPs. However, due to **close alignment of the TAP content with the NDC and NAP** of the country, the results on the ground are closely responding to the needs identified in Liberia's TAPs, particularly in the coastal area.
88. The national team has also played a pro-active role to utilize their **professional networks and contacts** to disseminate and enhance the reach of the TAP outcomes to relevant actors in different sectors (e.g. including heads of public and private institutions).
89. The UNDP, as an **implementing agency with continued engagement** in adaptation efforts of Liberia (e.g. supporting the preparation of the NAP), plays a key role in advancing implementation of climate action in the coastal areas and the agriculture sector, as evidenced by examples in the following sections.
90. Another means through which Liberia has raised the profile of its technology needs and priorities and strengthened the engagement with implementation partners is through **participation in global initiatives**. Liberia is the first West African nation to launch the [early warnings for all initiative](#) in the country in July 2024, which is closely linked with advancing priorities in coastal TAPs.

Post-TNA/TAP implementation and scale-up

91. There is no dedicated mechanism in place to systematically track the results of TAPs and their implementation, and the BUR of Liberia does not provide detailed information on technology projects implemented in the country. A review of Liberia profile across various climate funds shows implementation efforts with direct links to the TAP or its results, especially in the coastal areas. Without being exhaustive, some of the highlighted projects include:
- **2021-2027:** The GCF-funded '[Monrovia Metropolitan Climate Resilience Project](#)', with a value of over USD 17 million, has a dedicated component on the implementation of ICZM, which is one of the prioritized technologies in coastal TAPs of Liberia. UNDP is the implementing agency supporting the project. Despite the direct link, the TNA/TAP is not mentioned in the project rationale or background.
 - **2022-2027:** The GCF-funded project '[Enhancing Climate Information Systems for Resilient Development in Liberia](#)' valued at over USD 11 million and implemented by the African Development Bank is also directly linked to the prioritized technologies in coastal TAPs. However, the project documents make no reference to the TNA, despite direct request of

the fund to indicate such linkages. The project document, however, makes links to Liberia's NDC that is aligned with the findings of the coastal TNA.

- **2022-2028:** The GEF-funded project at a value of over USD 11 million, implemented by the UNDP, '[Enhancing the resilience of vulnerable coastal communities in Sinoe County of Liberia](#)', is another project with a strong ICZM component that was conceptualized around the same time as the abovementioned project. UNDP as the implementing agency for both projects have indicated and utilized synergies and complementarities in the implementation of relevant activities under these projects.
92. While the implementation of TAP outcomes is more advanced in coastal areas, other noteworthy development include a technical assistance by the UNEP/CTCN, that has mobilized the readiness and preparatory support of the GCF at a value of over USD 600 k (2022-2025) to '[Develop a renewable energy investment framework to increase the share of renewable energy-based electricity generation to achieve Liberia's NDC commitments](#)', aligned with and informed by prioritized technologies in the energy sector.
 93. A recent development in advancing prioritized technologies in agriculture TAPs, particularly related to 'value addition technology', is the approval of a full-scale GEF-funded project '[Strengthening agricultural resilience through transformational livelihood adaptation in Liberia \(SARTLA\)](#)', with a value of over USD 103 mil in co-financing, and the UNDP as implementing agency.
 94. Liberia has also utilized **international cooperation to advance its sectoral goals** in the agriculture sector. For example, in 2024, Liberia and China have agreed to [enhance their agricultural cooperation](#) including through introduction of advance agricultural technology in farming, irrigation, and field management, and the implementation of infrastructure projects.

F. Pakistan - Innovation and technology for integrated risk management and climate adaptation²⁰

TAP development process

95. Pakistan conducted its TNA process in 2015-2017, with support from the CTCN and UDP (now UNEP-CCC), which resulted in TAPs for adaptation (addressing technology priorities in the agriculture and water sectors) and TAPs for mitigation (addressing technology priorities in the energy, agriculture and LULUCF, and transport sectors).
96. The Ministry of Climate Change and Environmental Coordination (MoCC&EC, formerly MoCC) spearheaded the TNA process, and **extensively engaged actors at the national, sub-national, and local levels** throughout the TNA process. MoCC&EC has also been the responsible entity for the development of other planning and reporting documents under the UNFCCC and the Paris Agreement (e.g. BUR and NAP), in close coordination with line ministries. It is also the NDE of Pakistan.
97. The **centralized institutional mandate of the MoCC&EC** may have been a contributing factor to its success for advancing the implementation of prioritized technologies identified in the TAPs, and ensuring **cross-integration** and **coherent messaging** in the articulation of technology needs and priorities in these sectors across various climate planning and reporting tools at the national level (i.e Pakistan's national climate change strategy) and under international frameworks (i.e. Pakistan's NDC).

Structuring and formulation of TAPs

98. The TAPs cover a broad range of technologies in multiple sectors. The content of the TAPs contains **clear information** on the costs, timeline, envisaged outputs, responsible authorities and potential sources of funding for prioritized technologies in each sector. The TNA/TAP also resulted in a number of project ideas that have been pursued and embedded in various project proposals submitted by Pakistan to the GEF, GCF and Adaptation Fund, as outlines in the following sections.
99. Across the board, TAPs contain estimated **financial needs as well as strong elements of capacity-building that would support and enable implementation** including at both technical and

²⁰ Information presented in this paper related to the experience of Pakistan in conducting TNA and implementation of its results has benefitted from valuable insights by Irfan Tariq, former director general in the MoCC&EC who also served as a UNFCCC national focal point in Pakistan.

institutional levels, targeted not only at government institutions but also other national and local actors, particularly **R&D institutions in different sectors**.

100. The prioritized technologies, for example those in the water and agriculture sectors, reflect the importance given to **integrated and multi-sectoral solutions**.

Engagement of TAP implementation partners

101. The MoCC&EC has been effective in **utilizing relevant outreach and engagement platforms** to raise visibility and awareness of TAPs, for example by: publishing the TAP documents on the ministry website; making clear references to TNA/TAPs in the BUR; and dedicating a section of Pakistan's NDC to results of TNA/TAPs.
102. An important platform for guiding and fostering climate action implementation is the Pakistan Climate Change Council, which was established in 2017 by the Pakistan Climate Change Act and headed by the Prime Minister. The Council, which has a **high visibility and the authority in setting the climate agenda in the country**, sets the priorities for climate action and governs the engagement with implementation partners. Through such platforms, and by **engaging high-level influential decision makers in different sectors**, Pakistan has managed to raise awareness of the NDC targets, including technology elements extracted from the TNA/TAPs.
103. Another aspect of Pakistan efforts in highlighting the result of TAPs is how **such outcomes are weaved into relevant projects and processes, and further developed using available resources**. For example, in the context of [Climate Innovation Challenge \(CIC\) consultative process](#), supported by the Asian Disaster Preparedness Center, the outcomes of adaptation TAPs were taken up and further discussed and elaborated, resulting in greater **visibility of TAPs among relevant stakeholders and continued application and update of results over time**.
104. The MoCC&EC is the national designated authority of the GCF, the designated entity for the Adaptation Fund, and the operational focal point of the GEF in the country. When formulating project proposals submitted to the GCF and GEF, prioritized technologies in the TAPs are often well integrated. However, many of the project proposals do not make direct references to the TNA/TAPs, and rather refer to the **NDC which includes TNA results**. The use of support windows (e.g. provided by the CTCN or GCF) for technical assistance, project preparation and readiness seems to be rather limited in Pakistan. In most cases, project preparation is conducted through the support of implementing agencies active in the country.
105. Utilizing **international cooperations and bilateral support** is another avenue through which Pakistan has advanced technology implementation aligned with its sectoral goals, for example with the Republic of Korea's International Cooperation Agency (KOICA) in the establishment of [a solar PV testing facility](#), and with the Government of Japan for the installation of weather surveillance radar as discussed in more details in the next section.

Post-TNA/TAP implementation and scale-up

106. While there is no dedicated mechanism in place to systematically track the results of TAP and their implementation, **the BURs of Pakistan provide a glance at country's prioritized technology needs through the TNA, as well as efforts in mobilizing support for technology implementation**. Without being exhaustive, some of the highlighted projects emerging from these efforts with direct link to the TAP or the prioritized technologies therein are listed below, showcasing success of Pakistan in implementing the results of its TNA in the water and agriculture sectors, and more broadly its climate adaptation priorities:

- **2017-2025:** The GCF-funded project on [scaling-up of glacial lake outburst flood \(GLOF\) risk reduction in Northern Pakistan](#), with a value of over USD 37 million, utilizes a cross-sectoral approach in addressing adaptation goals in the agriculture and water sectors. The UNDP, the implementing agency of the project, has drawn upon a previously implemented project funded by the Adaptation Fund in the country to inform the formulation of activities and expected outcomes under this project.
- **2018-2022:** with support from FAO as one of the implementing agencies of the restoration initiative, [Pakistan joined this multi-country project](#) financed by the GEF (USD 4.3 million GEF grants and 24 Million in co-funding) that helped advancing the implementation of prioritized technology actions in the forestry sector.

- **2019-2026:** Another example of a cross-sectoral approach in the formulation of climate projects and the use of technologies is the GCF-funded project on [transforming the Indus Basin with Climate Resilient Agriculture and Water Management](#), implemented by the FAO, with a value of over USD 47 million. While the project does not mention the TNA/TAP, several links are made to the Pakistan's NDC and the prioritized technologies outlined therein, which are the results of the TNA.
 - **2020-2024:** a project financed by the Adaptation Fund and implemented by the UN-Habitat to [enhance community, local and national-level urban climate change resilience to water scarcity, caused by floods and droughts in Rawalpindi and Nowshera](#) is another example of a cross-sectoral approach to adaptation, combining TAP related to 'water harvesting' with climate resilient goals in the built environment. The project has a value of over USD 6 million grants.
 - **2021-2026:** The government of Pakistan received bilateral from the Government of Japan in the form of grants through JICA for the [Installation of Weather Surveillance Radars](#) in Multan city (at a value of approximately USD 20 million) and in Sukkur city (at a value of approximately USD 18 million). This is directly linked with the TAP priorities in the water sector, but has a cross-sectoral nature and supports the overall efforts of countries related to climate information and risk management.
 - **2024-2031:** [Recharge Pakistan](#) is a GCF-financed project implemented by the WWF that aims to build Pakistan's resilience to climate change through Ecosystem-based Adaptation (EbA) and green infrastructure for integrated flood risk management. The project builds upon the findings of previous work in the sector, particularly those supported by the GCF. It is valued at around USD 78 million and is another example of integrated solutions for climate adaptation that have combined a number of prioritized technologies in the TAPs for the water and agriculture sectors sector.
 - **2024:** In a recent development, a project for [integrated climate risk management for strengthened resilience to climate change in Buner and Shangla Districts of Khyber Pakhtunkhwa Province](#) was approved for implementation, with a value of USD 9 million and the WFP as the implementing agency.
107. While the overview above shed lights on projects that mobilized grant-based finance for the implementation of prioritized technologies in TAPs mostly on the adaptation side, it is noteworthy that Pakistan has effectively engaged with **financing institutions**, to scale up the level of resources mobilized for mitigation technologies through climate funds. For example, project [Green bus rapid transit \(BRT\) Karachi](#) financed through GCF (2018-2024) with support from the Asian Development Bank (close to USD 12 million in the form of grants and USD 440 million in loan) has a direct link with Pakistan's TAP in the transport sector. [Pakistan Distributed Solar Project \(2022-2033\)](#), financed by the GCF (USD 1 million in grants and USD 9 million in guarantee) with support from JS Bank Limited (44 million in loan), which is a national and private sector entity headquartered in Pakistan, is a continuation of advancing the implementation of prioritized technologies in the energy sector.
108. The review of implemented climate projects in Pakistan, though not exhaustive, sheds light on a number of factors that may have contributed to successful technology outcomes on the ground. For instance, Pakistan has capitalized its **bilateral international cooperation** to advance technology implementation in various sectors. Moreover, the diversity of UN Agencies supporting project implementation in Pakistan shows the capacity of the government in **mobilizing and maintaining sectoral support from specialized UN agencies and international organizations** with unique and in-depth expertise in said areas, for example FAO in the agriculture sector, UN-Habitat in the built environment, and WWF and IUCN in EbA projects.
109. Another noteworthy mention in the experience of Pakistan is how ongoing efforts in the country and prioritized sectors for climate action identified prior to the TNA, have shaped its outcomes. In fact, the TNA is both **a reflection of ongoing climate-related work in the country and a contributing element to enrich and inform such efforts**, and bring them closer to implementation.

III. Key elements of success for TAP implementation

A. Technology action plans enabling implementation at scale

110. Attribution of TNAs to project proposals and implementation is not always obvious since any actions can be associated with multiple activities in the country. The engagement of key stakeholders, including decision-makers, during the TNA and TAP preparation and post-TNA/TAP stages, is instrumental in securing that TNA-prioritized technologies are included in new and ongoing governmental programmes, strategies, and plans, so that sector-level goals can be achieved with the help of concrete actions from TNAs and TAPs. This also helps substantiate requests for funding from domestic and international funding instruments. Taking into account findings from the review of country stories, this section highlights:

- Which elements of success from implemented TNAs and TAPs identified to date (see table 1) are present and offers insights into how such factors have been put in use in practice; and
- What other contributing elements and enabling conditions related to conducting and formulating TNAs and TAPs or promoting their outcomes and translating them into implementation-ready projects may have led to the realization of prioritized technologies in various national contexts.

TAP development process

111. The success factor related to the development process of TNAs and TAPs (see Table 1), identified by the TEC in its previous work, as referred to in paragraph 7, are confirmed in the review of the country cases in this analysis. For example:

- All reviewed cases have put emphasis on the **engagement of stakeholders across governmental bodies and with non-state actors**. The engagement of **sectoral actors, including high-level decision makers**, has proven to be an effective means for ensuring follow-on technology actions in said sectors. Extensive stakeholder engagement aligned with the institutional work on climate change in the country has also enabled **strengthening and retention of domestic capacities** and **cross-fertilization in relevant planning and reporting processes**.
- In all cases, **TNAs are reflecting broader national climate policy frameworks** and in many cases, TNAs make references to other planning and reporting under the UNFCCC, including national communications, NDCs, and NAPs. In some of the reviewed cases, the TNA has been **integrated in national climate strategies and agendas**. **Overlapping processes, inefficient in-institution and/or inter-ministerial information flow on issues related to climate technologies in the country, or timing of different planning processes** in some cases have led to TNAs not being utilized adequately in informing climate policy and reporting documents.
- When it comes to institutional arrangement, in the majority of cases the governmental body in charge of conducting the TNA is the same as the one with a **centralized mandate on climate change in the country**. However, in some of the reviewed cases, TNAs are conducted as a **technical exercise and do not benefit from political visibility** and reach that support the NDC. Moreover, in many cases the institutional work on TNAs **ceases to exist after the completion of the project**, making the follow-up actions and updates a challenging task. The role of NDEs seems to be critical in continuation of technology prioritization and implementation.

112. Other potential success factors related to the TAP development process that have emerged from the review of country stories in this paper include the importance of a **coherent messaging in the formulation of climate strategies and priorities**, often reflected in a national climate change strategy. In the presence of such an overarching framework, TNAs are better aligned with climate priorities of the country and contribute to them. Capitalizing on the **existing domestic capacity and expertise** - including through **formal and informal networks, stakeholder platforms and communities of practice** - is another factor that can enrich the development process of the TAPs and ensure synergies with the broader climate policy landscape in the country.

Structuring and formulation of TAPs

113. When it comes to the content of TAPs, the success factor identified by the TEC in its previous work (see Table 1), are also confirmed in the review of the country cases in this analysis. Overall, there seems to be a consistent approach across different country cases in relation to the use of the TNA methodology for the preparation of TAPs. However, not all TNA guidance is consistently applied. For example, some of the TAPs conducted after 2018 (when the guidance for a gender-responsive TNA was made available) lack elements related to gender mainstreaming. Some of the recurring approaches used in reviewed country cases for the formulation of TAPs include:

- In all reviewed cases, TAPs include **clear and detailed information** about foreseen outputs, timeline, scale of actions, associated costs and benefits, roles and responsibilities of different actors.
- In all cases, TAPs **couple technology needs with information on capacity-building and financial needs** for their implementation. This includes a focus on **R&D and TVET institutions** as enabling actors for the implementation of TNA results and TAPs.
- In some cases, TAPs include **socio-economic co-benefits (for example information on SDG co-benefits and trade-offs)**. In most cases, there are dedicated TAPs for adaptation actions. Such measures are sometimes included in **cross-cutting TAPs** and/or as **co-benefits in mitigation TAPs**.

114. Other factors related to the content of TAPs that may have contributed to their successful implementation, identified from the review of country cases, include:

- Focusing on **integrated and cross sectoral technology solutions** – while countries like Ghana and Antigua and Barbuda have applied this approach in the formulation of TAPs, others such as Pakistan utilized this approach at the project level.
- Focusing on **few interlinked sectors instead of broad-ranging TAPs** may have been another factor in ensuring effective articulation of needs and priorities and the mobilization of resources for implementation of technology actions contained in TAPs.
- Factoring in different ecological contexts and sub-national development needs within a country may have been another factor in ensuring priority actions identified in the TAPs are **context-specific and relevant to implementation actors on the ground**.
- Consideration of gender issues and impacts of technology measures on marginalized and vulnerable groups in the formulation of TAPs would contribute to better alignment with socio-economic safeguards of climate funds and implementation partners.

Engagement of TAP implementation partners

115. The success factor related to the engagement with TAP implementation partners, identified by the TEC in its previous work (see Table 1), are confirmed in the review of the country cases in this analysis to varying degrees. Overall, there is not a consistent pattern or approach in engagement with partners, as each country has utilized different means in engagement with partners, donors and investors. For example:

- With regard to **management planning and in-country coordination**, Pakistan has utilized a **high-level national political platform with the authority on climate change** to articulate its climate priorities and manage the engagement with international donors and implementation agencies in line with its national agenda.
- With regard to **early engagement with potential funders**, **Ghana engaged potential donors in the process of conducting its TNA and TAPs**, **Liberia worked with implementing agencies active in the country** to formulate relevant project proposals in parallel. Some countries, for example Pakistan and Liberia, have developed project ideas and policy briefs for **promoting TNA and TAP results and utilized them to engage with sectoral actors, including influential figures and decision makers in specific sectors**.
- The presence and role of national **technology champions** in promoting TNA and TAP results in the reviewed country cases is not clear. This may be in part due to the fact that the sources of information for this analysis are primarily official reports and such functions may be performed informally in the country. Findings from the review of country cases shows that some countries have utilized the reach of **high-level political and influential figures** (e.g. Ambassador for climate change in Antigua and Barbuda) **and platforms** (e.g. Council

of Climate Change in Pakistan) to raise the visibility of the technology needs and priorities nationally and internationally.

116. Other potential contributing factors in support of the engagement with TNA implementation partners include:

- Some of the country experiences reviewed in this paper show how countries have utilized **their participation in international initiatives** to promote their technology priorities in specific sectors (e.g. participation of Liberia in the Early Warnings for All initiative).
- Utilizing **regional or global partnerships** (e.g. NDC Partnership in the case of Antigua and Barbuda and Global Water Partnership in the case of Ghana) is another means through which countries have raised the profile of their technology needs and improved their engagement capacity with implementation partners.
- **Multi-country and regional readiness projects** (e.g. participated by Antigua and Barbuda and Grenada in the Caribbean) and **project preparation facilities** (e.g. in support of the Early Warnings for all) are another effective strategy used by countries for strengthening engagement with technology implementation partners, including though conducting in-depth technical assessments of needs and improving institutional and domestic implementation capacity.
- Some of the country cases shows the importance of **agility in utilizing existing and emerging opportunities to integrate its technology priorities** across various policies, programmes and projects at both national and global levels. For example, Ghana embedded its prioritized technologies in TAPs in latter funding tranches of a project that was under implementation before the TNA process. Liberia embedded its technology priorities in the agriculture sector when renewing a memorandum of understanding with the Government of China on agricultural cooperation. Grenada integrated outcomes of the TNA in its NAP that was under development around the same time.

Post-TNA/TAP implementation and scale-up

117. Some of the success factors related to post-TNA/TAP efforts (see Table 1) are present in the review of country cases in this paper, to varying degrees. For example:

- Some of the reviewed country cases indicate examples of how the outcomes of TNAs and TAPs are used in or has emerged from **pilot projects or small-scale technology implementation** to increase the likelihood for financial support and investment at scale. In some cases, countries have utilized resources from **bilateral international cooperations** (e.g. Pakistan using KOICA support for establishing PV testing facility) or **international initiatives and partnership** to demonstrate the viability of a technology.
- While in many cases the **project proposals submitted to climate funds have technology elements in line with outcomes of TNAs and TAPs**, the mention of TNA reports as source of information for strengthening the rationale of climate project proposals is rather limited. Most often, countries refer to their NDCs to provide such a rationale, which shed light on the importance of policy coherence and integration between the TNAs and NDCs.
- There is no evidence for a dedicated **tracking or reporting mechanism** to monitor the results of the TNA or TAPs in any of the reviewed country cases, however, some countries have **utilized the BUR to articulate technology support needed** using the TNA and TAP outcomes and/or indicate the list of relevant projects that have received support for implementation.

118. Other factors that may have contributed to successful implementation of TNA results, particularly TAPs, identified from the review of country cases include:

- All reviewed country cases have utilized **CTCN technical assistance** in some capacity. Many have utilized **readiness support and project preparation facilities to advance the technology implementation**.
- All reviewed country cases have examples of **continued and/or recurring work with implementing agencies**, utilizing their **cumulative knowledge of the national/local context and know-how** in a specific sector or region.

- Many reviewed cases show how countries have **utilized bilateral support and resources available through ongoing projects or activities to integrate, disseminate, follow-up and elaborate** on their TNA results.
- Many countries have utilized **regional, multi-country and umbrella projects and programmes to advance their sectoral goals** including in-depth articulation of their technology needs and priorities.
- Some reviewed cases show how the use of **direct-access funding windows, small-grant programmes, and demonstration projects**, especially when managed by the country, enhances the ownership of domestic actors in technology implementation, support the uptake of technology, and the sustainability of results over time.
- Some reviewed experiences showcase how countries **utilize domestic resources (including from the private and financial sector and at the sub-national and local levels) and capacities (e.g. research and R&D institutions)** to advance the implementation of prioritized technologies.
- Some country cases highlight effective approaches in **strengthening the ecosystem of support, for example through the engagement with MDBs and strengthening investment infrastructure** for climate action in the country.

B. Challenges, gaps and learnings from unimplemented TAPs by different stakeholders

119. Each country will experience different circumstances and challenges in implementing its prioritized technologies. Findings from survey responses by national TNA coordinators, and previous activities of the TEC including previous reports and multi-stakeholder events (as referred to in para 15 of this report) point to a number of contributing factors that may hinder the implementation of TNA results. Some of the recurring challenges in implementing TAPs, reported by national teams and implementation partners alike are as follows.
120. Regarding the TAP development process: limited resources and lack of ownership (e.g. due to high staff turn-over or inadequate capacity in the government) may impact the engagement of stakeholders in the TNA process and the capacity of the government to pursue the implementation of its results beyond the lifetime of the TNA. Also, fragmented institutional mandates could lead to silos in the integration of TNA/TAPs into broader climate planning and programming in a country. For example, different consultation processes in Pakistan have led to different level of policy integration when it comes to TNA/TAP outcomes. Pakistan's NAP, prepared in a fast-tracked process and published in 2023 makes little to no references to the TNA/TAPs, while the country's NDC, undergone an extensive stakeholder engagement and published in 2021, features the outcomes of the TNA prominently.
121. Regarding structuring and formulation of TAP: inadequate understanding of the national market and economic situation for technology diffusion and uptake, unclear management planning, as well as outdated and obsolete information due to irregular or non-existent updates of TNA/TAPs information may lead to limited uptake of their outcomes. Another issue is inconsistencies between prioritized actions in the TAPs and other climate policies and plans, sometimes due to misaligned timelines and processes in which such documents are developed. For example, the Antigua and Barbuda's NDC, last updated in 2021, brings in a strong focus on gender, just transition and other cross-cutting issues compared to the country's INDC released in 2015. While the TAP was developed around the same time and published in 2022, and the TNA report indicated consideration of gender issues as a cross-cutting priority, the TAPs makes little to no references to gender considerations in the prioritization of technologies.
122. Another issue that, for instance in Liberia, may have led to a sectoral TAP remaining unimplemented (e.g. in the agriculture sector) and others advancing at a faster pace (e.g. in the coastal zones), is the high up-front cost of introducing new technologies to the country context with long-term climate and development gains compared to those that have been already in use and require scaling up and/or those that respond to immediate needs of the country.
123. Regarding engagement with TAP implementation partners: The inadequate visibility and awareness of TNA/TAPs in major climate policy documents and national platforms, as well as sectoral and

sub-national processes when the actions are to take place, is an important factor that may lead to TAPs remaining unimplemented. Related to this, another reported issue is the lack of resources and/or a coherent strategy for post-TNA outreach at an institutional level. For example, in Pakistan, the TNA/TAPs were supported by a technical unit in the ministry, with limited and interrupted interaction with the NDE of country (due to high staff turnover in the latter) that has the institutional mandate and reach for engaging with focal points of financial institutions. Resources are needed to ensure TNA outcomes are continually disseminated to relevant stakeholders, their implementation is monitored and evaluated, and their content are updated on a regular basis.

124. Related to post TNA/TAP project development, the mismatch between TNA outcomes and requirements of funding entities and international donors, inadequate domestic capacity and operational continuity to turn TAPs into project proposal after the lifetime of the TNA, and inadequate mechanisms to track the implementation are among challenges faced and reported by stakeholders.
125. Beyond elements related to the process of conducting TNAs, the content of TAPs, and capabilities for engagement with implementation partners and formulation of fund-able project proposals, context-specific factors including broader socio-economic context in a country, the enabling environments (or lack thereof) for innovation and technology development and transfer, the policy framework and processes on climate change, play a critical role in fostering or hampering the implementation of technology priorities. For instance, Lebanon has reported how a large-scale, multiyear project in the transport sector informed by country's TNA that was approved for financing by the World Bank Group was cancelled due to financial instability and crisis.
126. Lack of policy integration between the climate and development agendas in a country could also lead to inadequate integration of climate technology priorities in projects that are addressing development issues within the same sectors. For example, the [Liberia Urban Resilience Project with](#) worth of USD 40 million, financed by the World Bank Group (2022-2028), which aims to increase flood resilience and access to urban infrastructure in vulnerable informal neighborhoods of Greater Monrovia and three secondary cities of Liberia, establish low to no linkage with the TNA/TAPs and other climate change strategies in the country.

IV. Linking TAP implementation with relevant national and inter-governmental processes on climate change

127. The TNA process is inherently connected with or related to other major climate change initiatives and processes, as well as other key nationally driven analyses, projects and plans. Parties to the UNFCCC have frequently and explicitly highlighted, particularly through COP decisions, that the TNA process should be integrated with other related processes under the Convention. The same understanding has been re-iterated under the Paris Agreement.
128. The 2021 synthesis report of submitted TNAs indicated that most of the Parties consider the TNA process not to be a standalone process, but complementary to their national processes on climate change, including various planning and reporting instruments under the Convention and the Paris Agreement. Parties are increasingly drawing on linkages between the TNA and other relevant processes to ensure synergies and cross-fertilization and avoid duplication of efforts and inefficiencies in the use of limited resources for national climate programming and prioritization.
129. Linking TAP implementation with relevant national and inter-governmental processes is also a common aspect in all reviewed cases. Moreover, examples of such efforts are reported through the survey responses received from TNA focal points, as referred to in para 15 of this report.

Linkages between TNA and planning tools under the UNFCCC and Paris Agreement

130. With regard to **policies and plans** for mitigating GHG emissions and adapting to climate change, several Parties refer to previously conducted TNAs as a starting point and/or source of information for their national climate change strategies, NAPs and NDCs, and vice versa. The TEC has conducted analytical work on linkages between the TNA and nationally appropriate mitigation

actions and NAP processes in 2013²¹ and with the NDC process in 2022²² with relevant country examples, good practices, and policy recommendations. **Pakistan** is an example of effective integration of TNA/TAPs in its NDC. **Grenada** is an example of integrating TNA/TAP outcomes in its NAP. The review of country cases shows several examples of how the TNA methodology is embedded or replicated in other climate planning processes. For example, **Liberia** utilized a very similar process as in the TNA methodology to formulate its NAP.

Linkages between TNA and reporting tools under the UNFCCC and Paris Agreement

131. With regard to climate **reporting, many Parties have integrated TNAs into their** national communications (NC), BURs, and biennial transparency reports (BTRs) under the enhanced transparency framework, for the articulation of both support needed (prioritized technologies) and tracking of support received (implemented TAPs). **South Africa** conducted its TNA, using domestic resources, in the context of preparing its second NC to the UNFCCC. **Ghana and Antigua and Barbuda** embedded findings of the TNA in the articulation of the support needed in their BURs.

Linkages between TNA and long-term climate and development strategies and roadmaps

132. With regard to **long-term low greenhouse gas emission development strategies and technology roadmaps**, TNAs/TAPs are being used to inform the development of LT-LEDS, as well as sectoral decarbonization roadmaps. **Guyana** has embedded the findings of the TNA in its Low Carbon Development Strategy 2030. Projects under Guyana's Low Carbon Development Strategy 2030 are financed from the sale of carbon credits and from earnings under the Guyana Norway Bilateral Cooperation, as well as being financed from the EU, IDB and FAO. **Antigua and Barbuda** has embedded the TNA methodology into its strategic planning to advance its NDC implementation towards a transformation to climate resilient and low-emission development pathway by 2030. The TNA may also be utilized to complement the LT-LEDS technologies by focusing on adaptation technologies that were not considered in the LT-LEDS process.

Linkages between TNA and national climate and development agendas and processes

133. Beyond planning and reporting instruments under the Convention and the Paris Agreement, countries have utilized the TNA/TAPs in informing or advancing their national policy and implementation processes for various purposes, for example to: strengthen business cases for implementing technology actions; remove some of the identified capacity, policy and regulatory barriers; and assess the feasibility of technology choices and investments. The content of TAPs in many reviewed cases is closely aligned with and informed by national climate change strategies. For example, the selection of prioritized sectors for TNA is often based on the priority sectors of the country, as outlined in their national climate and development strategies.

V. Key findings and recommendations

134. Countries that have conducted TNAs and developed TAPs have benefitted from the process in the years that had follows, for example through integrating TNA outcomes in other climate policy documents, applying the TNA methodology in similar contexts, establishing a baseline for technology needs and priorities in sectors, improving awareness of and engagement with climate and technology stakeholders, and enhancing in-country coordination capacities as results of conducting the TNA process. However, the extent to which the TNAs and TAPs have yielded lasting benefits and sparked technology actions in a country can vary depending on the context, timing, resources, and importantly, country's commitment and leadership.
135. The review of country cases in this analysis confirms findings of the past work of the TEC on possible elements of success and challenges faced by developing countries in translating TNAs and TAPs into technology action on the ground. Key elements of success identified by the TEC in its past work (Table 1) remain present in the review of country experiences. In what follows, additional details or new findings from the review of country cases in this analysis are presented, with a view

²¹ See

https://unfccc.int/tclear/misc/_StaticFiles/gnwoerk_static/TEC_column_L/4f85c880f1b54a6bb1ed32a3b7e1bc94/7262a425eab84ac8a0ab4a5980d7e58d.pdf.

²² See <https://unfccc.int/tclear/tec/tnandclinkages.html>.

- to inspire future efforts of developing countries and TNA and TAP implementation partners in advancing the implementation and scale up of prioritized technologies.
136. The in-country institutional arrangements and coordination capacity remains as important as any other element, if not the most critical element for successful technology implementation in line with the TNA and TAPs. Establishing relevant institutional mandates, allocation of sufficient resources to pursue post-TNA and TAP outreach, and tracking the results of implementation are efforts that require the high-level buy-in of and operational capacity within the government. Examples of efforts for mobilizing resources to improve technical and institutional capacities for advancing TNA and TAP implementation in reviewed country stories show some countries have:
- Allocated resources, including from domestic resources and international support, to strengthen enabling environments for obtaining and managing funds, for example by establishing a national fund for climate action;
 - Used multi-country and regional platforms to reduce administrative burden and combine their technical capacity in a cost-efficient manner for conducting in-depth technology needs assessment and formulation of project proposals.
137. Related to the point before, is the importance of policy integration for medium- and long-term uptake of TNA outcomes and the implementation of TAPs. When the TNA outcomes, including TAPs, are systematically informed by and integrated into nationally endorsed high-visibility climate policies (i.e. the national climate change strategies and NDC and NAP of a country), they have a higher likelihood for implementation, including due to the fact that formulation of any climate project in the country uses such documents as a source of information and strategic guidance.
138. In the formulation of technology-focused climate projects and programmes in reviewed country stories, there often is a focus on multi-institutional, multi-sector and multi-scale solutions. Integrated approaches are also common among success stories from implemented TAPs.
139. While TNAs and TAPs could be suitable instruments in informing climate projects and funding proposals, there is often a need for intermediary steps to translate TNA outcomes and TAPs into fund-able project proposals. Countries have utilized different means to bridge the existing gaps and facilitate technology implementation, for example by:
- Using available support for technical assistance (e.g. provided by the CTCN), readiness, and project preparation (e.g. provided by the GEF and GCF);
 - Using small-scale grants or domestic budgets to pilot, test, or demonstrate a prioritized technology;
 - Using advisory services through global and regional initiatives and networks to better inform feasibility and market studies in the process of technology prioritization and formulation of TAPs.
140. The role of national systems of innovation is also highlighted in different ways and to different extents in reviewed country cases. Many countries highlight the role of academia, R&D and TVET institutions in creating enabling environments for turning TAPs into larger scale implementation. Such references are often made in the context of capacity-building needs for technology implementation.
141. Countries have also focused on strengthening the ecosystem of financing and investment for technology including through piloting and implementing innovative financing mechanisms for technology implementation, enhancing the engagement of the private sector, and strengthening conducive regulatory frameworks.
142. Besides the role of national actors, the analysis of country cases highlights the important role of actors at other levels of governance in bringing TAPs closer to implementation. For example:
- Some countries engage with regional implementation partners, particularly MDBs and regional organizations, to advance their technology priorities;
 - Some countries integrate specific needs of large cities or selected ecological zones in their TNAs and TAPs, which has led to the implementation of technologies at sub-national levels involving local actors.
143. The analysis underscores that the role of implementing agencies for advancing implementation of TNAs and TAPs is manifold. Countries have benefitted from continued engagement with implementing agencies for, inter alia:

-
- Accessing various windows of funding, given their institutional role as implementing agencies of various climate funds, and the know-how in project formulation, administration and implementation;
 - Ensuring synergies and complementarities between different consecutive or concurrent projects in a sector or geographical location in the country;
 - Elaborating and updating sectoral TAPs with support of specialized agencies and international organizations with unique and in-depth sectoral expertise (e.g. FAO, UNIDO);
 - Enhancing the overall data landscape of country on climate technologies and assessment of needs, and promoting evidence-based technology prioritization and target setting.
144. While the review of country cases in this analysis sheds light on useful approaches and good practices that have assisted countries to realize some of their prioritized technologies, the analysis is in no way exhaustive and refrains from any generalization of the findings.
145. Further work on this analysis may benefit from insights from country expert as well as experts from climate funds and implementing agencies that have been involved in the formulation of TNAs and TAPs, and design and implementation of reviewed projects in this analysis or other similar projects and programmes.
146. Identification, dissemination and exchange of information on lessons learned and good practices from post-TNA and TAP efforts in developing countries, for example through case studies such as those presented in this paper, peer-exchanges, networks and knowledge hubs at the national, subregional and regional levels is a useful practice to enhance the collective knowledge of various stakeholders and implementation actors in advancing climate technology action.

Annex

Overview of country stories reviewed in this paper and information on implemented TAPs

Country/Region (Participation in the Global TNA Project)	Prioritized technology sectors in TAP		Lead national entity for TNA	Key national focal points for technology implementation (non-exhaustive)	Timeline of TNA/TAP development	TAP implementation partners (non-exhaustive)	Type of TAP-informed implemented projects (non- exhaustive)
	Mitigation	Adaptation					
Antigua & Barbuda - LAC (Phase III)	Transport	Buildings, Water	DoE	GEF: DoE GCF: DoE AF: DoE NDE: DoE	2019-2022	GCF, GEF, Adaptation Fund, CTCN, IRENA, UNDP, UNIDO, UNEP	Technical assistance, GCF multi-year readiness, multi-country project preparation facility, GCF project
Armenia - Asia (Phase II)	Energy, Land-use, Waste management	Agriculture, Water resources	MoE	GEF: MoE GCF: MoE AF: MoE NDE: Technology Transfer Association Union of Juridical Persons	2015-2017	GCF, GEF, UNDP, ADB, EBRD, CTCN, FAO, EU, GIZ, Austrian Development Agency	Small-grant programme of the GEF, GEF and GCF projects and bilateral support
Ghana - Africa (Phase I & V)		Agriculture, Water resources	EPA	GEF: EPA GCF: Ministry of Finance AF: EPA NDE: EPA	2011-2013	GEF, GCF, Adaptation Fund, CTCN, UNEP-DHI, IFAD, World Bank, UNDP, EU, Nordic Development Fund, AFD	GCF readiness support and CTCN technical assistance, GEF and Adaptation Fund projects, and bilateral support
Grenada - LAC (Phase II)	Energy	Agriculture, Water resources	MoEDA	GEF: Ministry of Mobilisation, Implementation & Transformation GCF: MoCRE AF: MoEDA NDE: MoCRE	2015-2018	GEF, GCF, Adaptation Fund, UNEP, GIZ, IFAD, FAO, Grenada Development Bank, CCCCC	GEF, GCF and Adaptation Fund projects, GCF readiness support
Liberia - Africa (Phase III)	Energy	Agriculture, Coastal zones	EPA	GEF: EPA GCF: EPA AF: EPA NDE: EPA	2018-2021	GEF, GCF, Adaptation Fund, CTCN, UNDP, African Development Bank	GCF readiness support and CTCN technical assistance, and GEF and GCF projects
Pakistan - Asia (Phase II)	Energy, Agriculture-LULUCF, Transport	Agriculture, Water	MoCC&EC	GEF: MoCC&EC GCF: MoCC&EC AF: MoCC&EC NDE: MoCC&EC	2015-2017	GEF, GCF, Adaptation Fund, ADB, FAO, WWF, UNDP, UN-Habitat, WFP, KOICA, JICA	GEF, GCF and Adaptation Fund projects and bilateral support