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Framing and tracking 21st century climate adaptation

Monitoring, evaluation and learning for Paris, the SDGs and beyond

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Current trends suggests global warming is likely to exceed 2°C by mid-century. The Paris Agreement and the 2030 deadline for meeting the SDGs provide a framework for adaptation action in the short term, but beyond that, incremental approaches will need to be complemented by transformational adaptation involving the radical restructuring, replacement or abandonment of systems, processes and practices that are no longer viable under new climatic conditions. There is an urgent need for frameworks to help countries meet their adaptation obligations under the Paris Agreement while preparing for warming that breaches the Paris temperature thresholds. Countries will need to track their adaptation activities to determine what does and does not work, identify good practice, and capture lessons that can inform adaptation planning, design and implementation. They will also need to report on these activities at the global level. We have created a framework for developing climate adaptation monitoring, evaluation and learning systems, or CAMELS, that can support countries in all of these tasks.

Contents

Summary

Climate adaptation monitoring, evaluation and learning systems, or CAMELS, can help to frame and inform countries' adaptation planning, design, implementation, monitoring, evaluation and learning, and support reporting at the global level. We have created a framework for developing CAMELS based on the adaptation principles embodied in Article 7 of the Paris Agreement, viewed through the lens of relevance, quality, effectiveness and adequacy. The approach used ensures that adaptation addresses the potential magnitude of warming, and that adaptation actions are linked to specific risks, impacts and needs. It also ensures that adaptation is inclusive and transparent, is based on sound data and methods, and actively supports development needs, priorities and goals.

The Paris Agreement explicitly frames adaptation in terms of a set of actions required to address the impacts of a 1.5–2°C global warming relative to the pre-industrial period.

Warming of 1.5°C is likely before 2040, possibly as early as 2030. A 2°C warming is likely by the 2040s or 2050s in the absence of strong emissions reductions in the very near term — something not currently on the horizon.

In the near to medium term, countries will need to adapt to a warming of 1.5–2°C while simultaneously delivering and securing the Sustainable Development Goals (SDGs) and implementing their immediate successors. Supporting the delivery of the SDGs and wider development goals should be a key aim of adaptation.

In the medium to longer term, countries should be planning for a warming of 3°C. This is likely to occur by the 2060s or 2070s based on current policy trajectories and the lack of adequate action to mitigate emissions.

A warming of 4°C or more as a result of direct unmitigated anthropogenic emissions would require a high reliance on coal after 2050, which may be unrealistic. However, a warming in excess of 4°C before 2100 is a distinct possibility under weak-to-moderate mitigation regimes, as a result of feedback mechanisms associated with tipping points in the climate system.

We recommend a phased approach to adaptation that addresses the Paris mitigation and adaptation goals while planning for warming significantly in excess of 2°C. 'Paris-compliant' adaptation actions to address a warming of 1.5–2°C must be compatible with the actions needed to address a subsequent warming of 3°C or more and must avoid locking in 'maladaptation' that creates obstacles to further adaptation and exacerbates risks beyond 2°C of warming. Countries need to move beyond generalised vulnerability reduction and resilience building (although these are important activities) and pursue adaptation in relation to the impacts of specific levels of warming over specific timescales.

Current incremental approaches to adaptation seek to preserve existing systems and practices at their current locations. Over time, these are increasingly likely to give way to transformational approaches. This will involve fundamentally altering or replacing systems and practices that are no longer viable in the face of larger climatic and environmental changes.

Article 7 of the Paris Agreement provides us with six principles for designing and implementing adaptation actions and processes. These can be made more robust when they are mapped to the criteria of relevance, quality, effectiveness and adequacy, and viewed in light of likely rates and levels of global warming and their potential impacts.

Countries will need to track their adaptation activities to determine what does and does not work, identify good practice, and capture lessons that can inform subsequent adaptation planning, design and implementation. They will also need to report on their adaptation activities at the global level through the mechanisms emerging from the Paris Agreement and the Katowice climate package for implementing the Agreement. Guidance for reporting on adaptation under the Paris Agreement's Enhanced Transparency Framework (ETF) for climate action identifies eight information areas on which countries should report.

Integrating the Article 7 adaptation principles, the criteria of relevance, quality, effectiveness and adequacy, and the ETF information areas provides us with a framework for planning, designing, implementing and tracking adaptation.

Based on this framework, we propose a model for developing **climate adaptation monitoring, evaluation and learning systems, or CAMELS**, which can support countries in (i) designing and implementing appropriate adaptation responses, (ii) tracking their effectiveness and delivering valuable learning, and (iii) reporting on their adaptation activities through global mechanisms, principally the ETF.

CAMELS should perform seven key functions:

1. Validate the climate-risk and adaptation needs assessments on which adaptation actions are based, ensuring that these address actual and likely vulnerabilities, risks and impacts associated with projected levels of warming
2. Assure the quality of adaptation actions to confirm they are relevant to and adequate for risks and needs, support the most vulnerable, are gender sensitive, are grounded in relevant science and knowledge, and are sufficiently inclusive, participatory and transparent
3. Track adaptation implementation to ensure that outputs are being delivered as intended, that quality is maintained throughout implementation and that lessons from implementation are captured
4. Monitor and evaluate adaptation actions to track their effectiveness in reducing vulnerability and building resilience at the outcome level and deliver development benefits in the face of climate change at the impact level
5. Assess the impacts of adaptation on development performance by explicitly examining the effectiveness of adaptation in supporting delivery of the SDGs and other development goals
6. Capture lessons and identify good practice, including what works and what does not, how to ensure that adaptation benefits women, the most vulnerable and the marginalised, and the most effective ways of supporting/delivering adaptation, and
7. Disseminate information and learning horizontally and vertically within a country to inform policy, planning and programming and via international mechanisms, such as the ETF.

Based on these seven functions, and taking into account the Article 7 principles, the ETF information areas, the four criteria (relevance, quality, effectiveness, adequacy) and the scientific context of likely future warming under different scenarios, we present a template for the development and assessment of CAMELS. It addresses each of the Article 7 principles through a few questions on each of the seven key functions.

A review of existing and emerging national adaptation monitoring, evaluation and learning (MEL) systems reveals a diversity of starting points and pathways for developing CAMELS. The framework and template presented here are intended to be sufficiently flexible to accommodate this diversity, while ensuring national-level consistency that will facilitate coherent reporting at the global level. The framework and template are intended to support countries in developing nationally appropriate MEL systems that help them address emerging and projected climate-change risks and impacts associated with warming beyond the Paris temperature thresholds.

1 Introduction

The Paris Agreement identifies countries' responsibilities in terms of the mitigation of climate change through reductions in greenhouse gas emissions and adaptation to the impacts of unavoidable climate change (United Nations, 2015). The Katowice climate package, agreed at the 24th Conference of the Parties to the United Nations Framework Convention on Climate Change (COP24), "sets out the essential procedures and mechanisms that will make the Paris Agreement operational"[1] and includes guidance on Adaptation Communications and reporting under the ETF.

The Paris Agreement exists alongside other international agreements and frameworks, most notably (from a development perspective) the 2030 Agenda on Sustainable Development. Countries must square their commitments under these frameworks, both with each other and with the need to address actual future global warming and its impacts. This means aligning adaptation in the context of the Paris Agreement with their commitments to deliver the SDGs, while recognising the very real potential for warming to exceed the thresholds stipulated in the Paris Agreement.

Within this context, there is an urgent need for coherent frameworks within which countries can (i) plan, design and implement adaptation actions that are fit for purpose in the face of warming that may temporarily or permanently exceed the Paris temperature thresholds and (ii) monitor, evaluate and report on adaptation progress and results while capturing learning to inform and improve adaptation practice (Berrang-Ford et al., 2019).

In this paper, we seek to triangulate the Paris Agreement goals, the science of climate change and support for the SDGs and wider development goals. We do this by framing the Paris goals and SDGs in the context of likely timescales for different levels of global warming, drawing on the temperature projections (generated using the MAGICC energy balance model, which projects future global mean temperatures and the rise in sea levels) used by Arnell et al. (2019) for nine scenarios based on different assumptions about future socioeconomic trajectories and atmospheric greenhouse gas concentration pathways (see Annex 1 for details of the methodology). We aim to provide a pragmatic framework for effective adaptation decision-making, meaningful adaptation tracking at the national and sub-national levels and efficient adaptation reporting to global mechanisms. We, therefore, map the key adaptation criteria of relevance, quality, effectiveness and adequacy against the adaptation principles embodied in Article 7 of the Paris Agreement and against reporting requirements under the ETF. We then present a simple framework for the development of national climate adaptation monitoring, evaluation and learning systems, or CAMELS, built around seven key functions.

This framework is complemented by a template that can be used as a starting point for the development of CAMELS (by governments, for example) and/or for the assessment of existing or emerging monitoring and evaluation (M&E) or MEL[2] systems at the national and sub-national level. The template consists of a set of questions mapped against the Article 7 adaptation principles for each of the seven CAMELS functions. These questions can be used to inform the design of adaptation actions and processes and to carry out quality assurance (QA) of these actions and processes at the national and sub-national level. They can also be used for the QA of individual adaptation initiatives (such

1 https://unfccc.int/process-and-meetings/the-paris-agreement/katowice-climate-package

2 We use 'MEL' as a general term to refer to actual or hypothetical systems that combine M&E with learning, and 'M&E' to refer to existing systems that focus on monitoring and evaluation without explicitly including learning. Existing adaptation discourses often refer to M&E systems and this language is retained when referring to these discourses and describing specific systems that are defined as such (for example, the texts of the Paris Agreement and the Katowice climate package, and existing national M&E systems).

as policies, strategies, plans, programmes and projects) to assess how well they are aligned with adaptation needs and best practice. The questions in the template can be adapted for national contexts and embedded in CAMELS to provide a formal mechanism for supporting adaptation at country level.

Consequently, this paper is likely to be of interest to those tasked with developing adaptation or resilience M&E/MEL systems at the national or sub-national level. It is also relevant to anyone designing adaptation actions, be they national or sub-national policies, strategies, plans, programmes or portfolios of initiatives, or individual projects. In such contexts, the Article 7 principles and the four criteria can be used as a framework for ensuring good practice in the design and implementation of adaptation actions, while the template can inform the development of M&E/MEL systems (for individual projects or programmes, for instance).

We do not seek to prescribe how countries or other actors should go about developing CAMELS or what metrics should be used. Discussion of and guidance on the development of adaptation M&E/MEL systems and indicators can be found elsewhere (for example, Spearman and McGray, 2011; GIZ, 2012; Brooks et al., 2013; Bours et al., 2014a, b, c, d; Brooks and Fisher, 2014a, b, c; Ford et al., 2015, 2016; Leiter, 2015; FAO, 2017; Vallejo, 2017; Klostermann et al., 2018; Lamari et al., 2018; Brooks et al., 2019; Leiter et al., 2019). Instead, we provide a flexible framework and establish some guiding principles for developing CAMELS in diverse national and sub-national contexts. We also highlight the different starting points and pathways for developing CAMELS at the national level, based on a review of selected national adaptation M&E systems, summarised in Annex 2.

2

The Paris Agreement, global warming and adaptation: a pragmatic view

2.1 The Paris goals and projected warming

Article 2 of the Paris Agreement commits countries to "[h]olding the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (United Nations, 2015: 3).

In the absence of large-scale and immediate action to reduce emissions that goes far beyond that envisaged in existing Nationally Determined Contributions (NDCs), a warming of 1.5°C is likely (66% chance) to occur between 2030 and 2052 (IPCC, 2018a). The scenarios presented in Box 1 suggest that this is likely to occur before the late 2030s, while Xu et al. (2018) argue that a warming of 1.5°C could be realised by 2030. This is consistent with an acceleration in observed warming from approximately 0.2°C per decade to 0.2°C over the five-year period from 2015 to 2019 (WMO, 2019).

Box 1 suggests that a 2°C warming is likely before 2055 in the absence of strong mitigation, with central estimates around 2040. A warming of 2°C by around 2040 is consistent with the rate of warming seen in 2015 to 2019 (WMO, 2019).

Current policy trajectories, based on commitments in countries' NDCs, are likely to result in a warming of around 3°C before 2100 (Rogelj et al., 2018; CAT, 2018). Central estimates of the date at which the 3°C threshold is likely to be reached are around the 2060s for the higher-emissions scenarios, including those incorporating some mitigation (Box 1). Delivering on current pledges and targets in NDCs is likely to limit warming to less than 3°C by 2100, with warming exceeding 3°C in the early 22nd century, based on current modelling.[3]

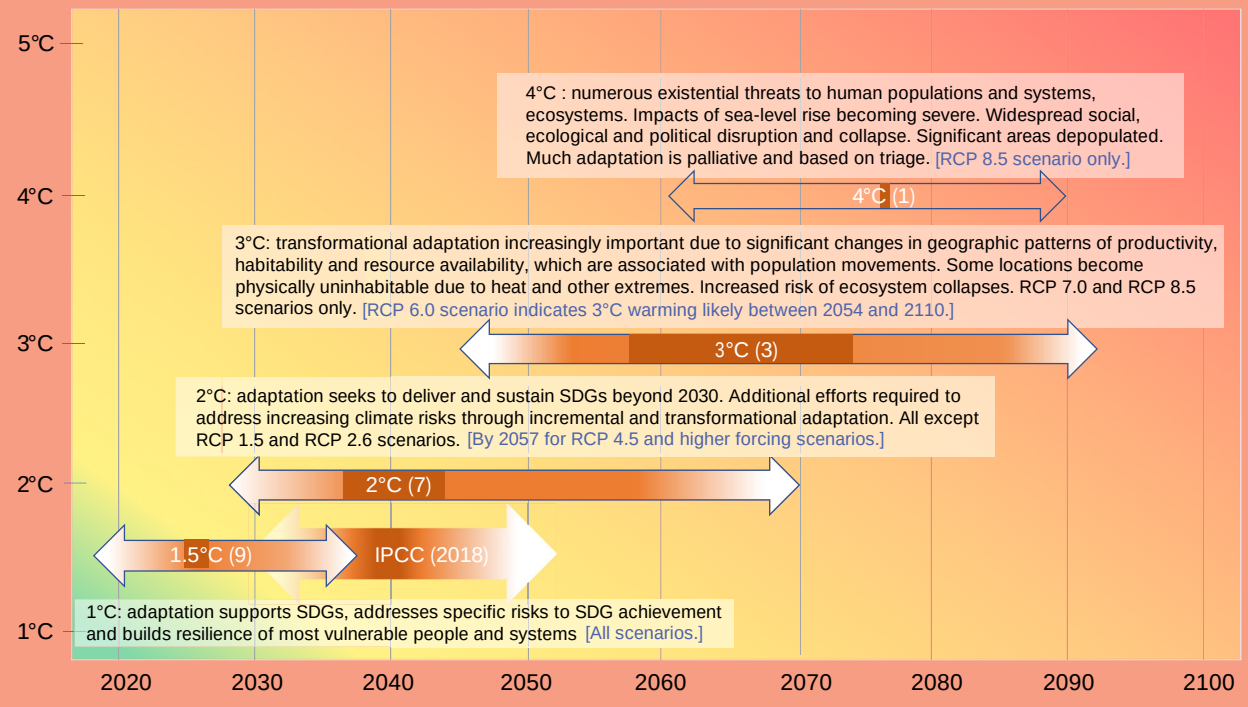
The worst-case scenario in Box 1, based on the Representative Concentration Pathway (RCP) 8.5 pathway used by the Intergovernmental Panel on Climate Change (IPCC) (2013a) (see also Annex 1), suggests a warming of 4°C before 2100. Some studies have questioned the likelihood of a 4°C warming resulting directly from anthropogenic emissions, as this would imply a rapid expansion in coal use after 2050 (Ritchie and Dowlatabati, 2017a, b). However, a warming of 3°C under current policy trajectories could trigger further warming through feedback mechanisms associated with 'tipping points' in the climate system, further elevating global temperature (Bathiany, 2018; Pattyn, 2018; Hall, 2019; Yumashev, 2019).

3 https://climateactiontracker.org/global/temperatures/

BOX 1. PROJECTED TIMING OF DIFFERENT LEVELS OF GLOBAL WARMING RELATIVE TO THE PRE-INDUSTRIAL PERIOD

The figure below shows the projected timing of various levels of global warming relative to the pre-industrial period, as simulated by the MAGICC energy balance model across nine scenarios representing compatible shared socioeconomic pathways (SSPs) and Representative Concentration Pathways (RCPs), based on data used by Arnell et al. (2019) (see Annex 1 for a more detailed description).

Boxes contain indicative summaries of adaptation strategies likely to be associated with a specific level of warming. Horizontal arrows span the range of dates within which a specified level of warming is likely (a two-thirds or 66% chance, following the IPCC (2018a) convention), with the earliest date corresponding to the 17% probability level, the latest date to the 83% level, and the darker central band indicating the range between the earliest and latest dates corresponding to the 50% level across the scenarios represented. Numbers in brackets indicate the number of scenarios used to determine the likely date range. These are the scenarios in which the specified warming is exceeded by 2100; scenarios in which this level of warming is not exceeded by 2100 are omitted. The number of scenarios is not an indication of likelihood, but reflects the number of scenarios generated using RCPs compatible with the specified warming (Annex 1). The wider arrow at 1.5°C represents the range of dates indicated in the IPCC (2018a) Special Report on Global Warming of 1.5°C. It should be noted that current policies that commit the world to a warming of around or somewhat above 3°C are broadly compatible with the RCP 7.0 pathway, while delivering on pledges and meeting targets in NDCs bring the world more in line with RCP 6.0.



Many of these mechanisms are poorly understood and their likelihood may be underestimated in climate models, but the risk of triggering such a mechanism is likely to increase significantly if warming exceeds 2°C (Cai et al., 2016; Fischer et al., 2018). It is, therefore, possible that these tipping points will be reached even under 'Paris-compliant' emissions trajectories if they involve an 'overshoot' of 2°C. Even if direct emissions remain under those set out in the RCP 8.5 scenario, tipping points may accelerate warming, driving it to 4°C or more by the end of the century, with further warming in subsequent centuries (Collins et al. 2013). A study by Betts et al. (2011) concluded that a warming of 4°C could occur as early as the 2060s or 2070s, consistent with the worst-case scenario in Box 1.

2.2 Prospects for meeting the Paris goals

Global emissions pathways compatible with the Paris Agreement need to limit global warming to less than 1.5–2°C with limited to no overshoot. These pathways require immediate action to transform energy systems,

transport and land-use on an unprecedented scale and at a much faster rate than the current transition to renewables (IEA, 2018; IPCC, 2018a; Rogelj et al., 2018; UN Environment, 2018; Tong et al., 2019). These 'Paris-compliant' pathways assume large-scale deployment of negative emissions technologies (NETs), the feasibility of which has not yet been demonstrated at scale, so are likely to be overly optimistic (Larkin et al., 2018). Estimates of greenhouse gas emission reductions compatible with remaining below the 2°C threshold typically range from 2% to 4% annually for models that rely heavily on NETs, assuming a peak in emissions before 2020 (Larkin et al., 2018). If reliance on NETs is omitted, the required reduction in emissions increases to more than 4% annually (Larkin et al., 2018). However, global CO_2 emissions from fossil-fuel use increased by an estimated 2–2.7% in 2018 (Le Quéré et al., 2018; BP, 2019), up from 1.2% in 2017, following zero growth in 2014–2016, compared with an average of 2.3% a year in 2004–2014 (UN Environment, 2018).

While the Paris targets are arguably technically feasible (Schellnhuber et al., 2016; Millar et al., 2017; Tokarska and Gillet, 2018), few countries are currently on track to meet their commitments under the Paris Agreement.[4] On current trajectories, warming is likely to reach 1.5°C by the 2030s or 2040s, 2°C by the 2040s or 2050s and 3°C by around 2090 — possibly much earlier (Box 1). The greater the increase in temperature, the more likely it is that climate feedback mechanisms associated with tipping points will further accelerate warming, making a warming of 4°C before 2100 a real possibility in the absence of radical mitigation from around 2020. Faced with the current failure of mitigation, therefore, it is prudent to plan for warming significantly above 2°C in the longer term, from the middle of the century onwards.

2.3 A pragmatic approach to adaptation

Article 7 of the Agreement establishes a Global Goal on Adaptation, "of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response in the context of the temperature goal referred to in Article 2."

The Paris Agreement thus explicitly frames adaptation in terms of the set of actions required to address the impacts of a 1.5–2°C warming relative to the pre-industrial period. It currently seems likely that actual warming will exceed this threshold for the reasons outlined above. Governments and other actors, therefore, need to ensure that their adaptation and development plans tackle a likely warming in excess of 2°C by the middle of the 21st century, perhaps far earlier (Box 1), even as they seek to meet their commitments under the Paris Agreement to adapt to a warming of 1.5–2°C.

Planning for warming of more than 2°C should not be seen as a substitute for mitigation, nor should it signal that such a warming is deemed acceptable. A rapid transition to net zero global emissions by around 2050, followed by negative emissions through the removal of CO_2 from the atmosphere, is absolutely essential if potentially catastrophic climate change is to be avoided (IPCC, 2018a). Planning for more than 2°C of warming is a necessary and pragmatic response to a potentially catastrophic failure of national and international climate policy, meaning that much adaptation is likely to be palliative and that adaptation decision-making will involve a high degree of triage (Mora et al., 2018; Spratt and Dunlop, 2019). While such a failure currently seems very likely, it might yet be avoided if governments take strong and rapid action to curb emissions in the very near term.

2.2.1 Adaptation in the near to medium term: Paris goals and SDGs

In the near to medium term, the Paris goals provide a useful context for adaptation planning and action. A warming of 1.5°C relative to the pre-industrial period is plausible by 2030 and likely soon thereafter (Box 1). This provides a useful context for linking adaptation with the SDGs, which are supposed to be met by 2030. The main function of adaptation is to secure and enhance development performance and human wellbeing in the face of climate change that threatens to halt or reverse development gains (UNDP, 2007). In the short term, to 2030, this will mean designing and implementing adaptation actions and processes to help secure the SDGs and wider development goals where their delivery is threatened by the impacts of climate change. These impacts will be those associated with a warming of up to 1.5°C. A key focus of national adaptation planning to 2030 should be the identification of specific risks to SDG achievement associated with climate-change impacts and of adaptation measures to address them (Box 1).

In the medium term, from 2030 to 2050, adaptation will need to focus on supporting development and securing human wellbeing in the context of a warming of 1.5–2°C (Box 1). This will include efforts to sustain gains delivered by the SDGs, to deliver the SDGs where the 2030 deadline has not been met (Randers et al., 2018) and/or to deliver successor development goals to the SDGs. These efforts are consistent with the Global Goal on Adaptation, which is framed by the Paris goals of limiting warming to 1.5–2°C.

4 https://climateactiontracker.org/countries/

The impacts of a warming of 1.5–2°C are detailed in a growing body of literature, including the IPCC report on 1.5°C of warming (Hoegh-Guldberg et al., 2018), and academic studies focusing on the effects on specific phenomena and systems, including temperature and precipitation extremes (Wang et al., 2017; Perkins-Kirkpatrick and Gibson, 2017; Baker, 2018; Dosio and Fischer, 2018; Kharin et al., 2018; Mukherjee and Mishra, 2018; Nangombe et al., 2018; Zhang et al,. 2018; Madakumbura et al., 2019; Russo et al., 2019), hydrology and water availability (Donnelly, 2017; Kraaijenbrink et al., 2017; Liu, 2017; Marx et al., 2018), flood risk (Thober et al., 2018), drylands (Huang et al., 2017), crop yields (Faye et al., 2018), irrigation (Bamba Sylla et al., 2018), health (Ebi et al., 2018) and infrastructure (Tobin et al., 2018). Such studies can be used to inform adaptation planning in the near to medium term, by linking adaptation actions to specific risks and impacts.[5] The IPCC (2013b) presents regional projections of temperature and precipitation under different emissions pathways, for different seasons and time periods, including near-term projections that are relevant to the timescales discussed above. The next IPCC Assessment Report will include updated projections. These projections can be used as a starting point for the assessment of near-term climate impacts.

Most current activities that carry the adaptation label seek to address familiar problems associated with climatic variability and extremes by increasing the resilience and reducing the vulnerability of people and systems to these phenomena (for example, Brooks, 2017; Pietrapertosa et al., 2018). Such approaches may deliver significant benefits and most acknowledge the role of climate change in increasing climatic variability, uncertainty and the frequency and/or intensity of extremes, as well as driving more fundamental change, such as shifts in seasonality (Brooks, 2017).

Where adaptation genuinely targets the specific (actual or anticipated) impacts of climate change, it does so overwhelmingly through incremental approaches based on the expansion and intensification of existing measures to address risks associated with climate extremes and variability (Kates et al., 2012; Wise et al., 2014; Chung Tiam Fook, 2015). The aim of such incremental adaptation is to maintain "the essence and integrity of a system or process at a given scale" (IPCC, 2018b: 542) and to "avoid disruptions of systems at their current locations" (Kates et al., 2012: 7156). Incremental approaches to adaptation thus seek to preserve or 'climate-proof' existing systems and practices, current or planned investments and development activities, and extant development models, in the face of climate change.

Governance structures and policy incentives mean that these incremental approaches to adaptation are likely to dominate in the near term (Dolšak and Prakash, 2018, and Box 1). However, Dolšak and Prakash (2018) cite a number of instances in which incremental approaches intended to reduce vulnerability in the short term can reduce resilience and increase risks longer term. The likelihood of such outcomes will increase as climate change accelerates and impacts intensify. It is, therefore, critical that adaptation actions designed to address a warming of 1.5–2°C are screened for risks associated with such maladaptation in the longer term and that they are sufficiently flexible to be modified or substituted to address the impacts of a global warming in excess of 2°C.

2.2.2 Adaptation in the medium to longer term: beyond the Paris goals

As mentioned, adaptation strategies and measures that are appropriate for a global warming of 1.5–2°C may lock in development processes that are not viable under greater levels of warming. This could result from intensive investment in infrastructure and services in areas that will become unproductive or uninhabitable with a global warming of more than 2°C, for example, when thresholds are crossed in terms of water availability, ecosystem viability or human survivability (Clarke et al., 2015; Pal and Eltahir, 2016; Im et al. 2017; see also Box 2). Alternatively, measures to reduce vulnerability and enhance resilience in the short term may lock in practices that are unsustainable in the face of climate change in areas that are already marginal, increasing future risks and delaying and exacerbating crises (Castells-Quintana, 2018).

Those responsible for designing and implementing adaptation actions, therefore, need to consider the implications of a warming of more than 2°C from the outset, as well as the extent to which adaptation measures for the near to medium term might be maladaptive longer term. At the national level, countries should consider the implications of a post-2050 warming of 3°C or more, even as they seek to meet their commitments under the Paris Agreement to adapt to a warming of 1.5–2°C.

Given the recent focus on 1.5–2°C of warming, the literature relating to specific impacts associated with higher levels of warming is more sparse and less well organised. However, the IPCC (2013b) projections address regional patterns of temperature and precipitation change over relevant timescales, while the Working Group II of the IPCC (2014) includes general discussions of sectoral impacts. These will be updated

5 Carbon Brief summarises a wide range of global, regional and national-level climate change impacts at 1.5°C, 2°C, 3°C and 4°C of warming: https://interactive.carbonbrief.org/impacts-climate-change-one-point-five-degrees-two-degrees/

in the next IPCC Assessment Report. Other studies, including some of those mentioned above in the context of 1.5–2°C of warming, address specific impacts at higher levels of warming (Sanderson et al., 2011; Arnell et al., 2015; Donnelly et al., 2017; Perkins-Kirkpatrick and Gibson, 2017; Dosio and Fischer, 2018; Marx et al., 2018; Thober et al., 2018; Tobin et al., 2018; Weber et al., 2018).

A critical task for those involved in adaptation planning, design and implementation (including beneficiaries of adaptation support) will be to anticipate potential limits to incremental adaptation approaches, particularly if and when warming exceeds 1.5–2°C. Such limits may exist where the magnitude of local climatic and environmental changes is likely to be so great that existing systems, processes and practices cannot be sustained, because they are physically and/or economically unviable (Kates et al., 2012). They may also exist in marginal systems where even small changes in climatic and environmental conditions will make the continuation of existing systems and practices impossible or impractical (Kates et al., 2012).

Where such limits to incremental adaptation exist, transformational adaptation "that changes the fundamental attributes of a socio-ecological system in anticipation of climate and its impacts" may be required (IPCC, 2018b: 542) (Box 1). Transformational adaptation may involve replacing systems and practices that are not viable under emerging or anticipated climate change with alternatives that are better suited to new climatic and environmental conditions. These alternatives may be 'imported' from other locations where historical conditions resemble the novel conditions at the location where the adaptation is required (see, for example, Burke et al., 2009).

Transformational adaptation may require fundamental changes in governance, infrastructure, economic systems and models, power relations and behaviour (Eriksen et al., 2015; Chung Tiam Fook, 2015). While transformational adaptation may be unavoidable, planning for it may be very challenging due to its inherently disruptive nature and its potential to result in 'winners and losers' and, thus, precipitate conflict (Kates et al., 2012; Brooks, 2016). Nonetheless, where climate change poses a potential existential threat to existing systems, practices and populations (see Box 2, for example), phased approaches could be adopted in which incremental actions gradually give way to transformational actions, supported by appropriate policies, pilots and the creation of enabling environments (Rippke et al., 2016).

Critically, transformational adaptation will need to be pursued through a combination of 'top-down' science that evaluates future risks and identifies potential thresholds beyond which incremental approaches may fail and 'bottom-up' adaptation design that identifies, prioritises and pilots adaptation actions that are contextually appropriate and acceptable (Brooks, 2016). The involvement of local actors in risk assessment is also critical, for example, to address potential mismatches between modelled thresholds (of crop viability, for example) and more nuanced realities (of continued production in areas modelled as unviable, for instance). Given the potential for conflict and winners and losers, it is vital that transformational adaptation be locally owned, even when informed by a scientific understanding of climate hazards and likely risks from external actors (Brooks, 2016).

While transformational adaptation will often be extremely challenging, in some contexts, it may be desirable from a purely economic perspective and deliver benefits relative to the status quo. This may be the case, for example, where climate change means that alternative economic or livelihood activities become relatively more viable and profitable than existing activities, even where the latter are not fundamentally threatened or are still pursued (Box 2).

At the other extreme, transformational adaptation will mean the abandonment of some locations as rising sea levels, extreme heat and humidity, severe aridity, or rapidly escalating risks from increasingly frequent climate and weather extremes makes them physically or effectively uninhabitable (Pal and Eltahir, 2016; Im et al., 2017; Mora et al., 2018). These impacts will have knock-on effects on food production, commodity prices, supply chains, international trade, food security, migration, economic, social and political stability, and conflict. As well as direct impacts within their borders, countries will need to address the local consequences of multiple interacting climate-change impacts occurring in other parts of the world that pose a threat to the global systems and networks on which humanity depends (Mora et al., 2018). These impacts will intensify as warming accelerates, making adaptation to a global temperature increase of 3–4°C or more extremely challenging. Spratt and Dunlop (2019: 9) argue that "in high end [temperature] scenarios, the scale of destruction is beyond our capacity to model, with a high likelihood of human civilisation coming to an end." Under such scenarios, much adaptation is likely to be palliative and based on triage, as societies' capacity to respond is overwhelmed (Box 1).

BOX 2. TRANSFORMATIONAL ADAPTATION — TWO VERY DIFFERENT EXAMPLES

Climate change and the limits of human survivability

The wet-bulb temperature (WBT) is the minimum temperature that can be achieved by evaporative cooling. WBT values of more than 35°C are fatal for human beings, while values above 31°C are considered extremely dangerous (Im et al., 2017).

WBTs are projected to exceed 31°C in large parts of south and west Asia by the late 21st century under the RCP 4.5 pathway (Pal and Eltahir, 2016; Im et al., 2017), requiring considerably stronger mitigation than current policy trajectories suggest is likely. Under the high-emissions RCP 8.5 pathway, WBTs are projected to approach 35°C in most of south Asia and parts of western Asia and to periodically exceed this level in parts of Bangladesh, northeastern India and the coastal regions of the Arabian/Persian Gulf (Pal and Eltahir, 2016; Im et al., 2017).

WBTs approaching 35°C would render outdoor physical activities impossible, threatening agriculture and other vital economic activities in the affected areas. In high-income regions, such as the Gulf states, adaptation might be possible through urban design that allows people to remain in indoors, in climate-controlled habitats. Indeed, this might be viewed as an incremental extension of today's reliance on artificially cooled indoor spaces in the region. However, in low-income areas dependent on agriculture, particularly the Ganges and Indus river valleys, where such options are unlikely to be viable, such changes would pose an existential threat to human populations and economic activities and, thus, to human settlement/occupation (Im et al., 2017). Transformational adaptation in these circumstances is likely to involve the relocation of infrastructure, economic activities and human populations. However, relocation on the required scale will be extremely challenging given the extent of the areas affected.

'Win-win' transformational adaptation in Makueni, Kenya

An example of a 'win-win' transformational adaptation is the adoption of silk production by smallholder farmers in Kenya's Makueni County. Silk produced from the cocoons of the eri moth is replacing cotton as a raw material for textile production in Makueni, amid deteriorating climatic conditions that have adversely affected cotton production. Tokesha textiles, a social enterprise, supplies farmers with eggs, training and equipment. The farmers raise caterpillars that produce cocoons in which they pupate to hatch as moths. Tokesha then purchases the cocoons from the farmers for use in textile production. Pupae are used in chicken feed and the excreta from the caterpillars are used as fertiliser.

Caterpillars are fed on the castor plant, which survives in conditions under which cotton fails. Farmers are encouraged to plant castor on their farms to avoid harvesting it from locations where it grows naturally, such as along riverbanks. A typical enterprise can produce some 20kg of cocoons per cycle, achieving up to two cycles per month and bringing in significant income. Silk production is very low input and is more profitable than cotton or maize production, both of which are threatened by climate change. While cotton and maize production persists, silk production has replaced them as the cornerstones of livelihoods for some smallholders, giving them a meaningful regular income that is relatively insensitive to climate. This transition has been made possible by a market that supports a supply chain and by support from the private sector.

For a more detailed discussion of this example, see Brooks (2017).

3

Adaptation in the Paris Agreement

3.1 The Article 7 principles

Paragraph 5 of Article 7 of the Paris Agreement (United Nations, 2015: 9) states that:

"adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems, and should be based on and guided by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions, where appropriate."

This paragraph effectively identifies a set of key principles for ensuring the quality of adaptation processes and actions, based on ownership, equity, inclusion and governance, sustainability, evidence and policy coherence. These principles are defined concisely in Table 1, which includes a short discussion of what each principle means in practice.

3.2 Mapping the Article 7 principles to adaptation needs

The six Article 7 principles detailed in Table 1 stem from the Paris Agreement and, thus, from a policy context that is focused on adaptation to the impacts of a global warming of 1.5–2°C. However, they are equally relevant to framing adaptation to the impacts of warming in excess of 2°C, when viewed in terms of the relevance, quality, effectiveness and adequacy of adaptation. Each of these four criteria is discussed below, with reference to the Article 7 principles, the Paris goals, climate science and the SDGs.

3.2.1 Relevance

Principle 1 addresses the relevance of adaptation actions to national circumstances and development priorities. Principle 2 implies that adaptation actions should be relevant to both men and women and to gender-differentiated vulnerabilities. Principle 3 implies that adaptation should address the needs of the most vulnerable, as well as wider national (for example, sectoral) vulnerabilities. Implicit in principle 5 is the condition that adaptation actions should be appropriate for addressing the likely national and sub-national impacts of specific amounts of warming over specific timescales, inferred from climate projections and science-based studies of likely and potential impacts. Implicit in principle 6 is that adaptation actions should be relevant to wider development activities, including those intended to deliver the SDGs.

3.2.1 Quality

The extent to which adaptation actions adhere to the Article 7 principles may be viewed as a measure of their quality. Principles 2 (gender responsiveness) and 4 (addressing vulnerabilities) are particularly important in this regard. These principles are critical to ensuring that adaptation does not entrench existing inequalities (gender, for instance) and exacerbate poverty and marginalisation, for example, by preferentially supporting those with the greatest capacity to engage with adaptation initiatives and to absorb financial assistance

(Cohen et al., 2016). Principle 3 (participation and transparency) is also critical to the quality of adaptation. For example, the design of adaptation actions might incorporate mechanisms to address gendered vulnerabilities/impacts and the needs of the most vulnerable. However, unless these mechanisms are transparent and open to challenge through genuine active participation and to modification based on beneficiary feedback and evolving knowledge (for example, scientific and local), they are unlikely to be effective (Few et al., 2007). Critically, participation needs to go beyond consultation and beneficiary involvement in the early stages of adaptation initiatives (Few et al., 2007). Genuine participation means beneficiaries and other stakeholders (such as those who are instrumental to the success of the measures in question and those who may be adversely affected by them) being actively involved and influential in the identification, design and implementation of adaptation actions and processes. They must also be involved in tracking implementation, monitoring outputs and outcomes, evaluating impacts and success, learning and the dissemination of information and lessons.

Principle 5 (science and knowledge) is also critical to the criterion of quality, to ensure that adaptation is grounded in the reality of risks arising from the interaction of social and environmental vulnerability with evolving and emerging climate and related hazards to which countries and their populations are exposed (IPCC, 2018b). This principle can be linked with principle 3 through the generation and use of locally generated information on climatic and environmental trends, variations and impacts, which can complement and fill gaps in more conventional scientific knowledge (Nakashima, 2012; Risiro et al., 2012; Makwara, 2013; Chisadza et al., 2013, 2014, 2015; Basdew et al., 2017).

Table 1. The six adaptation principles embodied in Article 7 of the Paris Agreement and their implications for national adaptation activities

PRINCIPLE	IMPLICATIONS — WHAT DOES THIS MEAN IN PRACTICE?
1. Country-driven	▪ Adaptation plans, strategies, polices, actions and processes should be led, designed and developed by national stakeholders, such as governments and government agencies (rather than by external actors, such as multilateral agencies, foreign firms, non-governmental organisations (NGOs) and consultants). ▪ Adaptation actions and processes should support national development priorities.
2. Gender-responsive	▪ Adaptation should address gender-differentiated risks, vulnerabilities and impacts through gender-sensitive and gender-specific measures.
3. Participatory and transparent	▪ Adaptation planning, design, implementation and assessment should involve relevant stakeholders, including the intended beneficiaries of adaptation actions and processes, and do so in a transparent manner, with information on adaptation plans, actions and performance being publicly available.
4. Addressing vulnerabilities	▪ Adaptation actions and processes should target the most vulnerable people, locations and systems (including ecosystems) in order to address and reduce the risks that climate change poses to them.
5. Guided by best science and knowledge	▪ Adaptation plans, strategies, policies, actions and processes should be informed by scientific information relating to future warming trajectories, climate-change risks and impacts, and vulnerabilities. ▪ Adaptation actions should be commensurate with the types and levels of risk associated with the amount of global warming expected over a given timescale, and the likely/potential impacts associated with that warming. ▪ Local and indigenous knowledge should be employed to understand risks, impacts, vulnerabilities and adaptation needs, to identify and track emerging climate hazards (particularly where conventional scientific data are unavailable), to identify and enhance local adaptive responses and to track the effectiveness of adaptation actions and processes.
6. Supportive of integration	▪ Adaptation plans, strategies, policies, actions and processes should support national development priorities and the achievement of the SDGs and should be integrated into wider development plans, strategies, policies, actions and processes at the national, sub-national and sectoral level. This can be supported through activities such as climate risk screening and the assessment of wider development activities.

3.2.2 Effectiveness

The effectiveness of adaptation will be measured in terms of the extent to which it increases the resilience of people and the systems on which they depend to hazards associated with climate change and the extent to which this increased resilience secures or improves development performance and human wellbeing in the face of climate change (UNDP, 2007; Brooks and Fisher, 2014a, c).

Proxy indicators of resilience, vulnerability and adaptive capacity are a means of assessing the outcomes of adaptation actions in the short to medium term (Brooks and Fisher, 2014a, b). They can be measured at regular intervals in the absence of climate stresses and shocks to predict how well people are likely to be able to manage such stresses and shocks when they occur (assuming the proxies are based on sound evidence and data). They can, thus, be viewed as outcome-level measures of adaptation performance, representing changes in people's and systems' capacities and capabilities, in turn related to factors such as assets, access to resources, behaviour and ability to act (Brooks et al., 2019).

The ultimate measure of adaptation success will be whether development performance and wellbeing are sustained during and following climate stresses and shocks. This will require the combination of development and wellbeing indicators with weather and climate data after stresses and shocks have occurred to measure the results of adaptation actions at the impact level (Box 3). The collection of information describing how climate hazards change and evolve over time is, therefore, essential to evaluating progress towards SDG achievement and wider development goals in the context of climate change (Brooks and Fisher, 2014a, c).

Assessing adaptation effectiveness is relevant to a number of the Article 7 principles. To determine how effectively adaptation addresses vulnerabilities, risks and impacts that are differentiated by gender (principle 2), livelihood and other criteria (principle 4), the indicators, themselves, will need to be differentiated along the same lines. Stakeholder and beneficiary feedback will be essential in validating outcome and impact indicators/assessments (principle 3). Assessing how adaptation supports development will require adaptation M&E to be integrated with wider development and SDG reporting (principle 6). Interpretation of development indicators will need to be contextualised using relevant climate information (principle 5).

3.2.3 Adequacy

While the Article 7 principles do not address the adequacy of adaptation actions directly, this issue is implicit in the principles. Most fundamentally, adaptation must be sufficient to address the emerging and expected impacts of climate change. As discussed in Chapter 2, this means that countries' levels of ambition must be consistent with the expected impacts of specific levels of global warming likely over specific timescales. Such ambition must recognise the likelihood that warming will exceed 2°C temporarily or permanently in the medium to long term and that the impacts of warming in excess of 2°C may require more transformational approaches to adaptation (see Box 2).

As well as being appropriate to addressing actual levels of warming and their associated impacts, adaptation must adequately support the achievement of national development goals and SDGs (principles 1 and 6) in these contexts, as described by climate projections and impact studies (principle 5). It must also adequately embrace differentiated vulnerabilities and include and engage with those at risk (principles 2, 3 and 4). For adaptation to be guided by the best science and knowledge (principle 5), it needs to be based on an understanding of vulnerabilities to, risks from and impacts of climate hazards that are likely to result from projected amounts of warming. It is, therefore, vital that adaptation is informed by climate scenarios and impact assessments, such as those discussed in Chapter 2. In such contexts, it will be important to identify the 'adaptation deficit' (Burton, 2009; Fankhauser and McDermott, 2014) or 'adaptation gap' (UN Environment, 2018)[6] between (i) the level of action countries are currently taking and the level required to address the impacts of a 1.5°C and a 2°C warming (UN Environment, 2018) and (ii) the level of adaptation action required under the Paris Agreement and the level required to address *actual* climate-change impacts in the longer term, once the 1.5°C and 2°C thresholds have been breached.

The adequacy of adaptation actions also encompasses issues of justice and equity related to the uneven distribution of climate-change risks and impacts. A key issue will be whether international support for adaptation is sufficient to deliver necessary transformational adaptation and address existential risks to systems, populations and nations (such as small island states threatened by sea-level rise, or fatal combinations of heat and humidity), as well as migration and conflict related to climate change within and between countries.

6 The UN Environment (2018: 2) Adaptation Gap Report defines the adaptation gap as "the difference between the actual level of adaptation and the level required to achieve a societal goal".

BOX 3. ADAPTATION NARRATIVES FROM DEVELOPMENT METRICS AND CLIMATE DATA

Interpretation of SDG and development indicators in the context of climate information allows us to develop narratives of adaptation performance based on the extent to which adaptation actions are helping to deliver development outcomes despite climate-change challenges.

Some of these narratives will be relatively simple and not require detailed consideration of counterfactuals or attribution. For example, where indicators of historically climate-sensitive aspects of development show improvement despite worsening climate hazards, it can be concluded that adaptation is helping to secure development despite these hazards.

Other narratives will be less transparent. For example, development indicators may show no improvement, or even a decline, where climate hazards are intensifying. While this may indicate that adaptation is inadequate, it cannot be assumed that it is delivering no benefits. Adaptation actions may be stabilising development outcomes and preventing a decline in development performance or human wellbeing. Alternatively, they may be partially offsetting the effects of climate change and preventing an even greater decline in wellbeing. In these circumstances, more detailed assessment of adaptation performance using counterfactuals or beneficiary feedback will be required.

The following figure illustrates the nine broad adaptation narratives that might emerge from an interpretation of development data in the context of climate information. In all but two of these narratives, useful conclusions can be drawn about adaptation performance without the need for detailed counterfactuals. Where counterfactuals are required, these might be developed using qualitative approaches employing information from beneficiaries and other stakeholders, for example, surveys, interviews and questionnaires that seek to establish the impacts of adaptation actions and how outcomes might have been different in the absence of such actions. Quantitative approaches may be based on historical correlations between development and climate indicators over time, or the response of development metrics to the crossing of certain climate-variable thresholds.

Matrix of explanatory adaptation narratives based on evolution of development/wellbeing and climate metrics. Basic narratives can be developed based on trends in these metrics for all cases except the top left and bottom right, which require counterfactuals.

	Amelioration of hazards	No change in hazards	Worsening hazards
Improved wellbeing	**LUCK?** Improved wellbeing may be due to hazard reduction; may be amplified by adaptation actions. **Counterfactual needed to assess impacts of adaptation actions.**	**REDUCED VULNERABILITY** Impacts of hazards reduced due to reductions in vulnerability/ increased resilience.	**SUCCESSFUL ADAPTATION** Wellbeing improves and development goals achieved despite possibly severe increases in hazards. Encompasses transformational adaptation.
Stable wellbeing	**LOST OPPORTUNITIES** Despite reduction in hazards, wellbeing does not improve — potential gains not realised	**STATUS QUO** No change in either hazard prevalence or wellbeing. If adaptation actions taken, they have little impact.	**ADEQUATE/STABILISING ADAPTATION** While wellbeing does not improve, worsening hazards do not undermine it. Adaptation has stabilised wellbeing and prevented losses.
Deteriorating wellbeing	**MALADAPTATION** Despite reductions in hazards, wellbeing worsens — development is dramatically increasing vulnerability and reducing resilience.	**INCREASED VULNERABILITY** Impacts of hazards increase despite no change in hazards themselves due to increases in vulnerability/reduced resilience.	**INADEQUATE ADAPTATION** Adaptation either not effective or not sufficient — may partially offset impacts, but maladaptation may also be occurring. **Counterfactual needed to assess impacts of adaptation actions.**

Statistical correlations in time series of climate and development indicators

Some development metrics exhibit strong historical correlations with climatic and climate-related variables. Examples are maize yields and the Water Requirement Satisfaction Index in southern Africa (Martin et al., 2000), wheat production and rainfall in Australia (Ejaz Qureshi et al., 2013), food production and monsoon rainfall in India (Kumar et al., 2004), seasonal rainfall and groundnut yield in the Junagadh district of Gujarat (Pandya et al., 2019), November–March rainfall and GDP growth in South Africa (Jury, 2002), annual rainfall and gross domestic product (GDP) growth in Ethiopia (World Bank, 2010; Hellmuth et al., 2007) and annual rainfall

and GDP growth per capita in sub-Saharan Africa (Barrios et al., 2010). These historical relationships can be used to forecast expected variations in relevant development metrics during periods of climatic shock or stress, for example, following adaptation interventions (Barrett et al., 2019). These forecasts represent counterfactuals that assume a continuation of the historical relationship between the climate variables and development metrics in question. The expected values of development metrics can then be compared with the actual measured values. If the measured values are better than the expected values, this suggests that adaptation interventions or other factors have led to a 'decoupling' of this aspect of development performance from climatic variations. This evidence can then be followed up with attribution or contribution studies to determine whether the decoupling is genuinely due to adaptation actions. For example, a decoupling of GDP growth from rainfall might be due to a smaller contribution of agriculture to GDP rather than more climate-resilient agricultural practices.

Thresholds in climate variables

In some instances, counterfactuals can be constructed using thresholds in specific climate variables. For example, McMichael et al. (2008) and Gasparrini et al. (2015) present relationships between daily mortality and mean daily temperatures for 24 and 13 cities, respectively. In many of these cities, mortality rises sharply above a certain temperature threshold, with the values of these thresholds varying from city to city. Adaptation actions in these contexts might seek to reduce mortality when temperatures exceed these thresholds. The success of such actions can be tested by examining the number of deaths once such a historical threshold has been breached (scaled by the number of days or instances above the threshold) and comparing these with what would have been expected based on historical experience. Another way of measuring the success of adaptation measures would be to examine whether abrupt increases in mortality occur at a higher threshold after such measures have been implemented.

3.3 Implications for CAMELS

The measurement of adaptation effectiveness will require the development of M&E systems that incorporate proxy indicators of resilience and more conventional development performance and wellbeing indicators. The latter will need to be interpreted in the context of climate information, so that the effects of adaptation actions can be assessed in relation to climate stresses and shocks (Brooks and Fisher, 2014a, b; Barrett et al., 2019). Adaptation M&E systems, therefore, will need to incorporate or be linked with systems for gathering and curating climate information. This will include conventional scientific information and information generated by other methods, such as community monitoring of climate hazards and their impacts.

M&E systems can be used for much more than assessing the effectiveness of adaptation actions once they have been implemented. They can also assess the extent to which such actions adhere to the six Article 7 principles (Table 1) and the criteria of relevance, quality, effectiveness and adequacy in the context of expected changes in climate, thus providing a means of assuring the quality of adaptation actions. M&E systems can also employ these principles and criteria to QA assessments, plans and policies on which adaptation actions are based. For example, such exercises might address the extent to which such documents and mechanisms address gender-differentiated vulnerabilities, the integration of adaptation with wider development goals, expected rates of warming and the role of locally generated knowledge.

The capturing and dissemination of learning will be critical to the success of adaptation, and M&E activities need to be complemented by mechanisms that ensure the resultant lessons are identified, preserved and propagated. M&E, therefore, needs to be complemented by learning in comprehensive MEL systems.

Adaptation MEL has a critical role to play in framing, managing and adjusting adaptation actions to meet escalating risks. Generating evidence from MEL information can help decision-makers learn what is working, what is not working, when adaptation limits are being approached, how and why adaptation actions succeed or fail, and how adaptation can support wider development goals (Brooks and Fisher, 2014a, b, c; Brooks, 2016; Rippke et al., 2016). This evidence will involve measuring development and wellbeing outcomes in the context of evolving climate hazards and risks described using climate data, as well as tracking proxy indicators of the resilience, vulnerability and adaptive capacity of people and systems (Brooks and Fisher, 2014a, b).

By generating such evidence, adaptation MEL has a central role to play in driving social learning and informing adaptation policies and actions. The development of CAMELS, therefore, should be a priority for countries that are serious about addressing climate change and its impacts on social and economic development and human wellbeing.

CAMELS can play a dual role, supporting and informing national and sub-national adaptation actions on the one hand and capturing and collating information for reporting at the global level on the other. The latter will be important for countries when it comes to reporting requirements under the Paris Agreement (Vallejo, 2017), as we discuss below.

The basis for developing CAMELS already exists in a number of countries, in the form of emerging national and sub-national adaptation M&E systems. The results of a review of a sample of five such national adaptation M&E systems are summarised in Annex 2. The review highlights the diverse starting points and pathways from and by which countries might develop CAMELS. Some, for example, have embedded adaptation M&E in existing development and SDG reporting systems from the outset. Others have linked adaptation M&E with monitoring, reporting and verification (MRV) systems for climate-change mitigation or developed standalone adaptation M&E systems. The extent to which distinct adaptation M&E systems are linked with wider systems for development reporting and M&E varies across countries, depending on the extent to which the development of adaptation M&E is driven by national development frameworks and mechanisms.

4

Aligning CAMELS with emerging global reporting requirements

Signatories to the Paris Agreement are expected to communicate and report on their adaptation progress through separate and distinct processes. Reporting is governed by the ETF for action and support, established under Article 13 of the Agreement. Under the ETF, countries are expected to submit Biennial Transparency Reports (BTRs). Communication is carried out through Adaptation Communications. Though distinct processes under the Paris system, Adaptation Communications may be submitted alongside or as part of a variety of documents, including BTRs. Information from the ETF and Adaptation Communications will inform a five-yearly Global Stocktake (GST).

The Katowice climate package sets out the essential procedures and mechanisms for making the Paris Agreement operational, as agreed at COP24. We summarise the procedures and mechanisms most relevant to communications and reporting in Table 2.

4.1 Adaptation reporting under the ETF

One major element of the Katowice climate package agreed at COP24 was the adoption of modalities, procedures and guidelines (MPGs) for operationalising the ETF. The 36-page MPGs provide guidance on each category of reporting under the ETF, including information on climate-change impacts and adaptation in Chapter IV. It outlines information that countries 'should' provide on adaptation in their BTRs[7] (the provision of this information is not mandatory, but is recommended). However, as most NDCs submitted to date include an adaptation component, it will be important for countries to report on progress towards the implementation of their adaptation plans.

As stipulated in Chapter IV of the MPGs, countries are invited to address nine areas of information (hereafter referred to as the ETF areas), detailed in Box 4.

ETF area F is clearly relevant to CAMELS, as is area H, with its explicit reference to lessons learned. However, the other areas listed in Box 4 are also relevant to adaptation in light of the above discussion of the criteria of relevance, quality, effectiveness and adequacy and the Article 7 principles. We discuss areas A to H in this context below.

7 As agreed in Katowice, BTRs are to be submitted by December 2024 at the latest and every two years thereafter

Table 2. Key procedures and mechanisms in the Katowice climate package relevant to adaptation

PROCEDURE OR MECHANISM	PURPOSE AND DETAILS
Adaptation Communications	To be submitted periodically by countries as a requirement under Article 7, describing priorities, implementation and support needs, plans and actions
Guidance related to Article 7[8]	Guidance related to Adaptation Communications (included in NDCs)
Biennial Transparency Reports (BTRs)	Adaptation elements not mandatory or subject to technical expert review; information should be submitted and periodically updated (may include information listed in Box 4)
Enhanced Transparency Framework (ETF) for action and support	A reporting framework established under Article 13, aimed at providing a clear understanding of climate-change action in relation to Article 2 of the Paris Agreement, related to progress on achieving NDC commitments on mitigation and adaptation and associated support, to inform the GST
Modalities, procedures and guidelines (MPGs) for the ETF[9]	Chapter IV of the MPGs sets out the information countries should submit in their reports on climate-change impacts and adaptation, as part of the ETF
Global Stocktake (GST)	A periodic stocktake of the implementation of the Paris Agreement, established under Article 14, to assess the collective progress towards achieving the Agreement's purposes and long-term goals

BOX 4. AREAS OF INFORMATION RELATED TO CLIMATE-CHANGE IMPACTS AND ADAPTATION UNDER ARTICLE 7 OF THE PARIS AGREEMENT AND THE ETF AREAS[10]

A. National circumstances, institutional arrangements and legal frameworks relevant to adaptation
B. Impacts, risks and vulnerabilities
C. Adaptation priorities and barriers
D. Adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies
E. Progress on implementation of adaptation
F. Monitoring and evaluation of adaptation actions and processes
G. Information related to averting, minimising and addressing loss and damage associated with climate change impacts
H. Cooperation, good practices, experience and lessons learned
I. Any other information related to climate change impacts and adaptation

4.1.1 Information required for adaptation reporting under the ETF

Chapter IV of the MPGs provides guidance on what information is required under each of the nine areas in Box 4, which is useful in aligning CAMELS with adaptation reporting. We describe the information specified under each of these areas in more detail below and how it relates to the criteria of relevance, quality, effectiveness and adequacy discussed in Chapter 3. We pay particular attention to how the ETF areas relate to the Article 7 principles.

8 https://unfccc.int/sites/default/files/resource/cma2018_3_add1_advance.pdf#page=23

9 https://unfccc.int/sites/default/files/resource/cma2018_3_add2_new_advance.pdf#page=18

10 Pp.33–36 of FCCC/PA/CMA/2018/3/Add. 2

Areas A–C: national circumstances, impacts, risks and vulnerabilities, adaptation priorities and barriers

Descriptions of information requirements for areas A–C are brief, encompassing:

A. **National circumstances**: information on a country's bio-geophysical, demographic and economic characteristics, its infrastructure and adaptive capacity (particularly as it relates to climate impact assessment and adaptation planning and implementation) and its institutional arrangements and governance, legal and policy frameworks and regulations

B. **Impacts, risks and vulnerabilities**: information on impacts, risks and vulnerabilities (area B), including information on current and projected climate trends and hazards, as well as the observed and potential impacts of climate change, and key vulnerabilities

C. **Adaptation priorities and barriers**: information on adaptation priorities and barriers, including domestic priorities and progress towards them and adaptation challenges and gaps.

The above information is closely related to the criterion of relevance. The information under area A describes national circumstances, while area B addresses the hazards, risks and vulnerabilities that adaptation will need to address. Area B is also relevant to the criterion of adequacy. The information under area C is directly related to national adaptation priorities and how these relate to development priorities and, thus, relates to the criterion of effectiveness (in supporting development) and the principle of supporting integration (of adaptation and development activities).

Area D: adaptation strategies, policies, plans, goals and actions for integration

To assess the relevance, quality and adequacy of adaptation actions, as discussed in Chapter 3, one needs detailed information on them. This information is also needed to report on progress in implementing these actions, as required under area E (see Box 6). The information requested by the MPGs on adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies is listed in Box 5. Much of this information maps closely to the adaptation principles in Article 7, particularly items (c), (d), (f) and (h). Item (a) makes explicit reference to the Global Goal on Adaptation, which, in turn, frames adaptation in terms of the Paris temperature goals and (implicitly) the SDGs, as discussed in Chapter 2.

BOX 5. INFORMATION RELATING TO ADAPTATION STRATEGIES, POLICIES, PLANS, GOALS AND ACTIONS TO INTEGRATE ADAPTATION INTO NATIONAL POLICIES AND STRATEGIES (AREA D IN BOX 4)

A. Implementation of adaptation actions in accordance with the Global Goal on Adaptation, as set out in Article 7, paragraph 1, of the Paris Agreement

B. Adaptation goals, actions, objectives, undertakings, efforts, plans (such as national adaptation plans, or NAPs, and sub-national plans), strategies, policies, priorities (such as priority sectors, priority regions or integrated plans for coastal management, water and agriculture), programmes and efforts to build resilience

C. How best available science, gender perspectives and indigenous, traditional and local knowledge are integrated into adaptation

D. Development priorities related to climate-change adaptation and impacts

E. Any adaptation actions and/or economic diversification plans leading to mitigation co-benefits

F. Efforts to integrate climate change into development efforts, plans, policies and programming, including related capacity-building activities

G. Nature-based solutions to climate-change adaptation

H. Stakeholder involvement, including sub-national, community-level and private-sector plans, priorities, actions and programmes

Area E: progress on implementation of adaptation

The required information on implementation progress can be found in Box 6. This includes information about progress on the implementation of any adaptation actions identified under area D (Box 5), including those identified in Adaptation Communications and NDCs. Tracking adaptation implementation is important for principles 2–4, per Table 1, as it can identify who is and who is not being reached (for example, whether women and vulnerable groups are receiving adequate support and whether beneficiaries are being engaged). As well as helping countries to report on progress towards their national adaptation goals, implementation tracking can help them to (i) identify challenges such as resource and capacity gaps, (ii) determine where additional support is required, (iii) assess the extent of coordination between different actors responsible for delivering adaptation (for example, on different scales) and (iii) generate information to feed into the GST and other global reporting mechanisms, such as the SDGs and the Sendai Framework, enhancing coordination between the various reporting processes.

BOX 6. ASPECTS OF PROGRESS ON ADAPTATION IMPLEMENTATION (AREA E IN BOX 4)

A. Implementation of the actions identified in Chapter IV, area D above

B. Steps taken to formulate, implement, publish and update national and regional programmes, strategies and measures, policy frameworks (such as NAPs) and other relevant information

C. Implementation of adaptation actions identified in current and past Adaptation Communications, including efforts to meet adaptation needs, as appropriate

D. Implementation of adaptation actions identified in the adaptation component of NDCs, as applicable

E. Coordination activities and changes in regulations, policies and planning

Developing countries may also include information on the implementation of supported adaptation actions and the effectiveness of already implemented adaptation measures, as appropriate.

Tracking implementation progress can be viewed as a part of adaptation M&E, as it involves monitoring the *outputs* of adaptation actions, including the provision of goods and services to beneficiaries as part of the implementation of specific adaptation actions. However, monitoring, by itself, does not reveal anything about the effectiveness of these outputs in terms of making people or systems better able to manage climate risks. The collation of information on adaptation implementation at national level will involve aggregating and consolidating a variety of data, for example, on the nature and distribution of adaptation actions, adaptation finance and spending, the number of people supported/reached by adaptation actions and the perceived use of these actions by beneficiaries.

Area F: M&E of adaptation actions and processes

Box 7 lists the information that countries are asked to provide in relation to the M&E of adaptation actions and processes under area F.[11] This includes the results of adaptation actions, the approaches and indicators used to assess the results, details of adaptation implementation, how adaptation influences other development goals and lessons from implementation.

The information under area F is pertinent to the criteria of relevance, quality, effectiveness and adequacy and to the principles of Article 7. M&E can directly address the effectiveness of adaptation when it goes beyond the measurement of outputs (items 1 and 3, Box 7). An examination of instances where adaptation is insufficient to avert climate-change impacts (item 3ii, Box 7) directly addresses the criterion of adequacy, which is also implicit in general assessments of effectiveness and how adaptation actions meet adaptation needs and influence other development goals (items 1 and 4 ii and iii, Box 7). The latter also speaks to the issue of relevance and Article 7, principle 6 on integration. Transparency (item 4i, Box 7) is directly relevant to the quality criterion and to Article7, principle 3 (Table 1). Lessons and good practice (item 4 iv, Box 7) feed directly into the learning element of MEL/CAMELS. All information gathered through M&E mechanisms can contribute to the generation of knowledge (Article 7, principle 5).

Area F explicitly mentions assessment and indicators of resilience. Changes in resilience can be measured at the outcome level, using proxy indicators that capture the capacities and capabilities of people and systems to anticipate, avoid, cope with, recover from and adapt to evolving climate hazards and risks (Brooks and Fisher, 2014a). Critically, these proxies can be measured prior to the occurrence of climate shocks and stresses.

11 MPGs for the ETF, section IV, F, paragraph 113

BOX 7. ISSUES RELATING TO ADAPTATION M&E THAT COUNTRIES SHOULD ADDRESS IN ADAPTATION REPORTING (AREA F, BOX 4)

1. Achievements, impacts, resilience, review, effectiveness and results
2. Approaches and systems used and their outputs
3. Assessment of and indicators for:
    i. How adaptation increased resilience and reduced impacts
    ii. When adaptation is not sufficient to avert impacts
    iii. How effective implemented adaptation measures are
4. Implementation, in particular on:
    i. Transparency of planning and implementation
    ii. How support programmes meet specific vulnerabilities and adaptation needs
    iii. How adaptation actions influence other development goals
    iv. Good practices, experience and lessons learned from policy and regulatory changes, actions and coordination mechanisms

Area F also mentions assessment and indicators relating to climate impacts, which may include losses and damages (area G), as well as the impacts of climate change on achieving development goals. Indeed, in the medium to long term, the effectiveness of adaptation actions will be measured in terms of the extent to which they secure or enhance development performance and human wellbeing, as discussed in Chapter 2. This longer-term effectiveness will be measured using development and wellbeing metrics, such as the SDG indicators, interpreted in the context of information on changing climate hazards (Chapter 2). These impacts will be measured after such shocks and stresses at the impact level in results frameworks (Brooks and Fisher, 2014a, c).

Measurement of impacts will play a role in assessing when adaptation is insufficient or inadequate (see Chapter 2). This will most likely involve the identification of contexts in which adaptation fails to significantly reduce impacts, or where these impacts exceed 'acceptable' thresholds despite adaptation measures. The identification of such contexts will be critical to decisions on where and when to move from incremental to transformational adaptation approaches.

Implicit in the information gathered under the heading of implementation in Box 7 is the measurement of outputs, for example, in terms of measures implemented to improve transparency or address specific vulnerabilities and adaptation needs.

Area G: averting, minimising and addressing loss and damage

Area G specifies that countries should provide information that furthers understanding, action and support for addressing and minimising the loss and damage associated with climate-change impacts. This information should address observed and potential impacts associated with sudden- and slow-onset hazards and consider projected changes in climate risks and vulnerabilities, "drawing on the best available science". It should describe activities "related to averting, minimising and addressing loss and damage" and the institutional arrangements to facilitate their implementation. This area, therefore, explicitly addresses the Article 7 principle relating to the use of science and knowledge and overlaps with area F. Losses and damages from climate hazards are directly related to the achievement (or otherwise) of development goals (Article 7, principle 6 on integration) and measuring them is an effective means of assessing the effectiveness and adequacy of adaptation actions (Chapter 2).

Area H: cooperation, good practices, experience and lessons learned

Countries are required to submit information relating to efforts to share information, good practices, experiences and lessons learned, including as they relate to:

- Science, planning and policies relevant to adaptation
- Policy innovation and pilot and demonstration projects
- Integration of adaptation actions into planning at different levels
- Cooperation to share information and to strengthen science, institutions and adaptation
- Area, scale and types of cooperation and good practice
- Improving durability and effectiveness of adaptation actions, and
- Helping developing countries to identify effective adaptation practices, needs, priorities and challenges and gaps in a way that is consistent with encouraging good practices.

They should also share information on how they are strengthening scientific research and knowledge related to:

- Climate, including research and systematic observation and early-warning systems, to inform climate services and decision-making
- Vulnerability and adaptation, and
- Monitoring and evaluation.

Area H directly addresses the Article 7 principles relating to integration and the use of science and knowledge. CAMELS will combine M&E as described in area F (and encompass elements described under areas E and G) with learning, particularly social learning. Such systems can help countries to take stock of the implementation of adaptation measures, track and spur learning on their effectiveness, inform and improve adaptation and development policy and action, and generate inputs for reporting under the Paris Agreement.

5

A framework and template for designing CAMELS

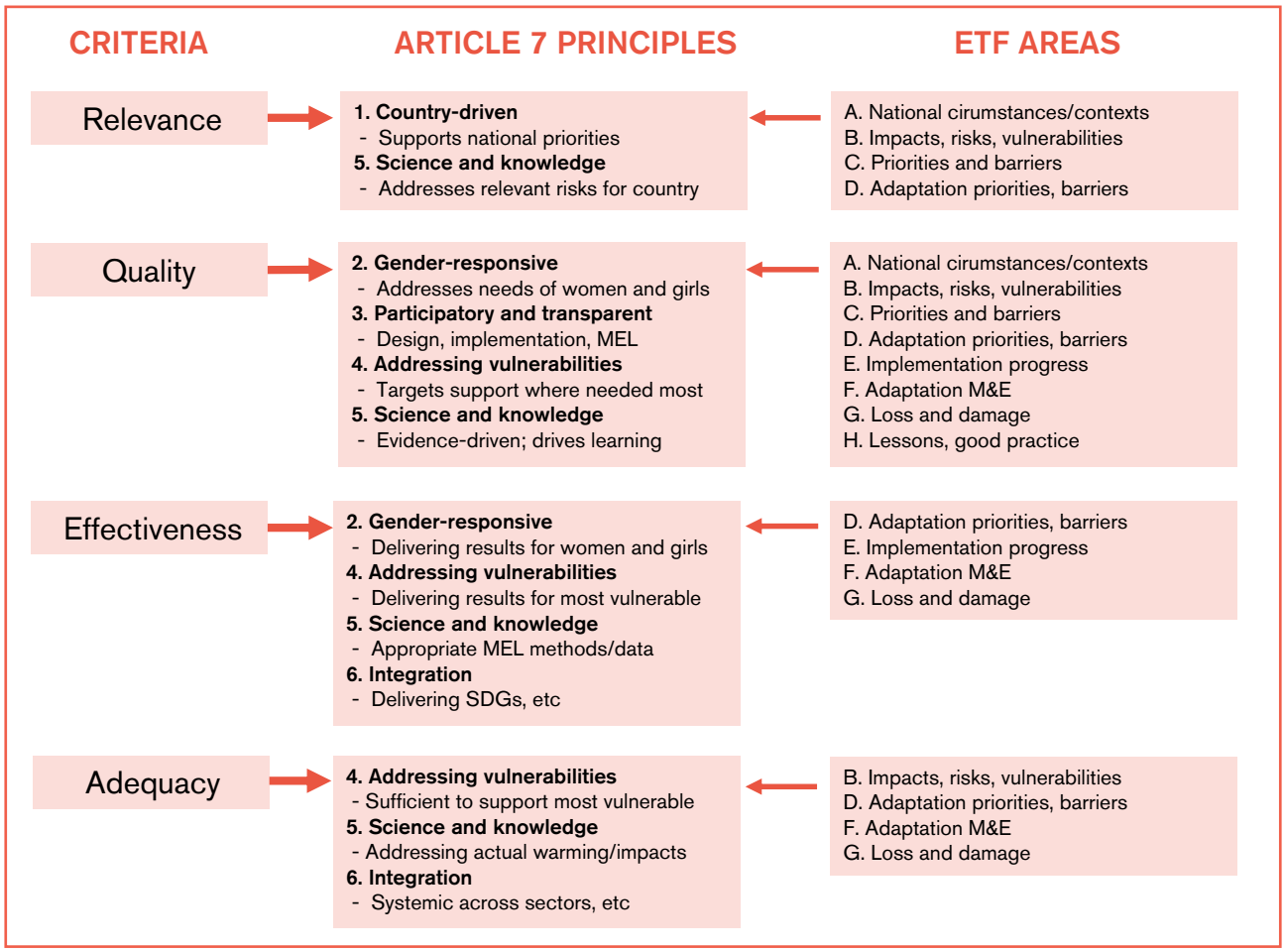
CAMELS can assist countries in planning, tracking and managing their own adaptation actions and in reporting at the global level via mechanisms such as the ETF (Vallejo, 2017). To fulfil this dual but complementary purpose, it is necessary to integrate the criteria of relevance, quality, effectiveness and adequacy with the Article 7 principles and the information required under the ETF, pragmatically in the context of projected warming that appears very likely to exceed the temperature thresholds enshrined in the goals of the Paris Agreement. Figure 1 maps these criteria to the Article 7 principles and the ETF areas.

A number of countries have already developed, or have started to develop, national adaptation M&E systems. Based on the mapping in Figure 1, we present a framework and template for the development of CAMELS. These are intended to support the development and refinement of CAMELS at the national and sub-national level. The goal is to help countries to design and implement adaptation actions and processes, to evaluate their success, to draw lessons to improve future adaptation programming and to report on adaptation at the global level.

The framework and template are also aimed at pointing the way to a more globally coherent approach to adaptation MEL, while recognising the diversity of pathways for developing MEL systems at the national level. This diversity is illustrated by the review of selected existing and emerging national adaptation M&E systems, summarised in Annex 2. As discussed at the end of Chapter 3, countries have developed national adaptation M&E systems from different starting points, with some systems embedded in wider development M&E systems from the outset and others being developed on a standalone basis, linked to varying degrees with climate mitigation and development reporting systems. Our review suggests that the embedding of adaptation MEL in wider development reporting systems can help to drive the integration of adaptation and development activities. However, initial evidence also suggests that this may result in a high degree of centralisation that can prove an obstacle to participatory approaches in adaptation MEL.

Annex 2 also provides a preliminary, light-touch assessment of the extent to which existing and emerging national adaptation M&E systems reflect the Article 7 principles. While there is significant variation from country to country, the review suggests that national adaptation M&E systems already address these principles to a greater or lesser extent, providing a solid foundation on which to develop fully 'Article 7-compliant' CAMELS. However, considerable challenges remain, particularly when it comes to developing adaptation actions and processes to address specific risks and impacts associated with specific amounts of warming over specific timescales, and to assessing the effectiveness of adaptation in relation to development goals.

Figure 1



5.1 A framework for designing CAMELS at the national level

Based on the criteria, principles and information areas discussed above and illustrated in Figure 1, we propose a framework for the design of effective CAMELS at the national level. This framework is based on seven key functions of CAMELS, summarised in Figure 2.

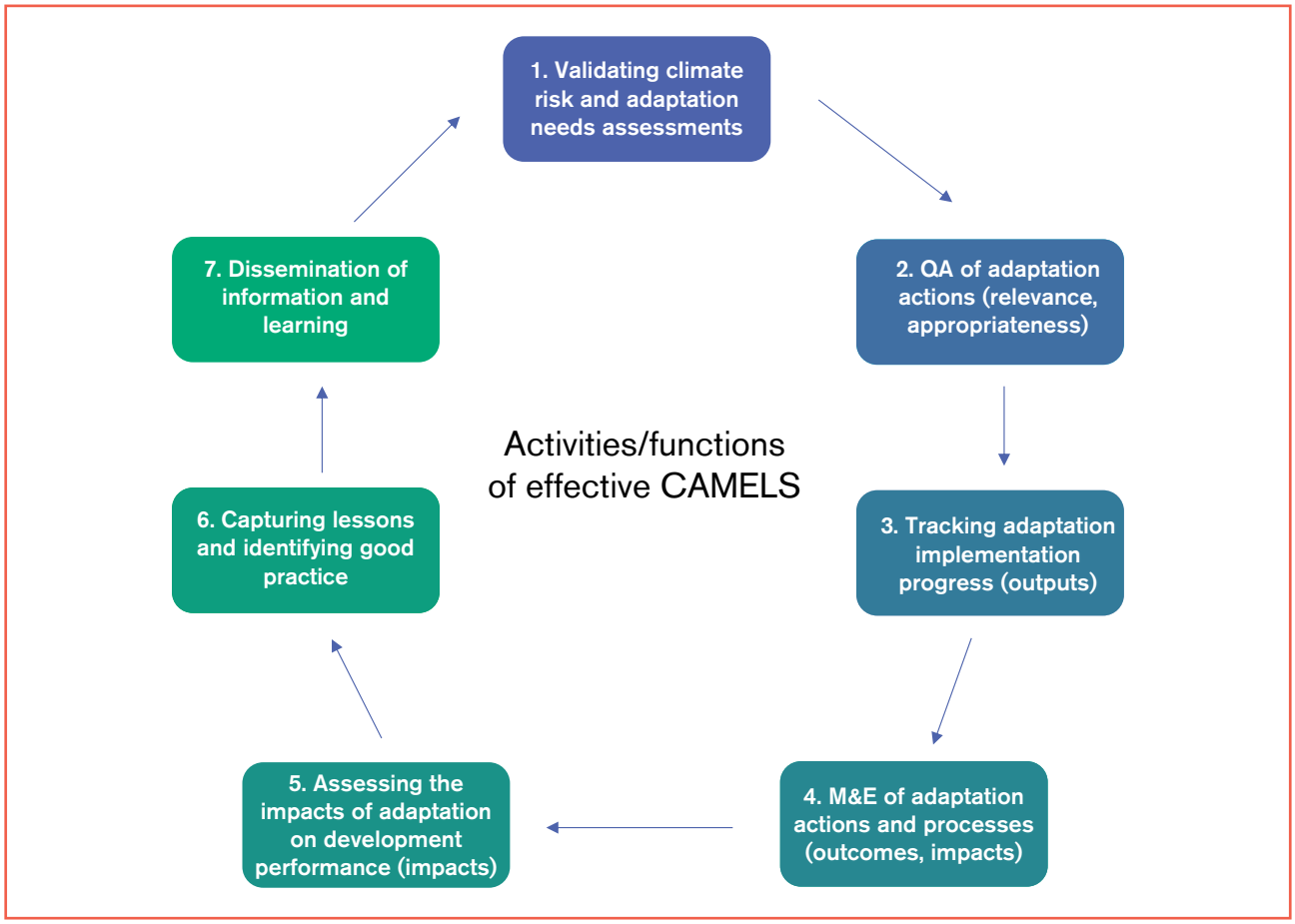
Function 1. Validating climate risk and adaptation needs assessments

CAMELS can examine how well climate change impacts, risks and vulnerabilities are assessed and how these assessments are used to identify adaptation needs. This function speaks principally to the criterion of relevance and the principles that adaptation should be country-driven and based on the best science and knowledge. It ensures that the identification and design of adaptation actions is based on sound evidence and generates evidence relevant to ETF areas A–D (Figure 2).

The identification of adaptation needs will involve the identification and prioritisation of sectors, economic activities, geographical locations, systems (built and natural infrastructure, ecosystems, institutional systems, etc.), populations and population groups that are particularly at risk from or vulnerable to climate change. This risk may be driven by underlying vulnerabilities that make people and systems highly sensitive to relatively small changes in climate and/or by the large magnitude of projected changes that have the potential to overwhelm system and populations that are resilient under current conditions. The highest risks will occur where currently vulnerable populations are subjected to large changes in climate. The above issues could be detailed in 'vulnerability profiles' prepared by governments to set out the basis and motivation for adaptation and to identify adaptation goals and targets, as proposed by Berrang-Ford et al. (2019).

The distribution of vulnerability and risk will be different for different emissions trajectories and different levels of warming. For example, some areas, groups, systems and livelihoods may be able to accommodate the impacts of a global warming of 1.5°C, but be vulnerable to the impacts of a 2°C warming. At the national level, assessment of climate change impacts, risks and vulnerabilities is likely to emphasise risks to

Figure 2



national development priorities and the achievement of the SDGs. Climate vulnerability, risk and adaptation assessments should therefore be conducted in close coordination with stakeholders working on achieving the SDGs. National adaptation MEL systems that are already aligned with or embedded in systems for SDG reporting will be in a good position to assess how well the identification of adaptation needs is aligned with SDG activities.

Assessments of impacts, risks, vulnerabilities and adaptation needs will need to draw on a variety of information sources, including observed climate trends, projected changes from climate models (where available), sensitivity studies of the impacts of prescribed changes and socioeconomic, environmental and other data representing underlying vulnerabilities, resilience and adaptive capacity. Local and indigenous knowledge will be particularly useful where observational data are limited and are essential to understanding the needs of populations and communities. Critical to assessing adaptation needs will be an understanding of what adaptation actions and behaviours are already being taken (Tompkins et al., 2018).

Adaptation needs should be identified based on existing and future climate impacts, risks and vulnerabilities.

Countries will need to decide on their level of ambition in addressing and planning for future climate change and its impacts. This will involve policy decisions on whether countries are planning for the impacts of a global warming of 1.5°C, 2°C, or more. Planning for a warming of 1.5°C is compatible with the Paris Agreement temperature goals and should be a minimum requirement, as such a warming is likely to be realised by the 2030s or, at the very latest, the 2040s. Given the low probability that warming will be stabilised at 1.5°C without first overshooting this threshold, countries should plan for a warming of 2°C by around 2050, if not earlier. As current NDC pledges are likely to result in a warming of around 3°C before 2100, amid uncertainties around future climate policy, countries may want to plan for such a warming in the longer term. The extent to which such higher levels of warming need to be taken into account will depend on planning horizons, which will be different in different sectors and contexts (see also Function 2, below).

Depending on their level of ambition, countries should attempt to identify the potential impacts, risks and vulnerabilities associated with the relevant level of global warming and, by implication, the relevant time horizon. An understanding of these impacts, risks and vulnerabilities should inform all relevant planning.

Function 2. Quality assessment of adaptation actions

CAMELS can be used to undertake critical QA of adaptation actions and the processes that support them at the national (portfolio) level or at the level of individual projects or programmes (Box 8). Such QA can be undertaken once adaptation actions have been identified, before they are implemented — in other words, before and during the design phase. This QA will address the criteria of relevance, quality and adequacy, addressing all of the Article 7 principles and many of the ETF areas insofar as they relate to the nature and design of adaptation actions. The results and effectiveness of adaptation actions will be addressed via other functions, described below.

QA of adaptation actions and processes can draw on the criteria of relevance, quality, (likely) effectiveness and adequacy, as well as the Article 7 principles, to address the extent to which they:

- Are nationally and locally owned, with adaptation design involving relevant stakeholders and intended beneficiaries
- Are grounded in scientific evidence and local/indigenous knowledge relating to emerging and potential future hazards, impacts, risks and vulnerabilities, including information from risk and adaptation needs assessments
- Address key risks and vulnerabilities that are relevant to national priorities while also supporting the most vulnerable, marginalised and very poor (Berrang-Ford et al., 2019)
- Combine generic measures to reduce vulnerability and build resilience with actions targeted at specific hazards, risks and impacts
- Address existing adaptation gaps, namely, between current conditions and what is needed to cope with existing hazards
- Meet incremental adaptation needs to protect existing systems and practices from climate-change hazards, impacts and risks, insofar as this is feasible and desirable given expected levels of warming and the associated hazards and risks
- Address actual and potential transformational adaptation needs, where existing systems and practices cannot be made viable under emerging or expected climatic conditions through incremental approaches, and
- Are coordinated and/or integrated with wider development activities to deliver adaptation across sectors and embed it within development at large.

BOX 8. QA OF INDIVIDUAL ADAPTATION INITIATIVES

While the focus here is on the development of CAMELS at the national level, CAMELS also offer a framework and key principles for assessing individual adaptation initiatives at multiple levels. QA of individual projects and programmes can be undertaken by assessing how compatible they are with the criteria of relevance, quality, effectiveness and adequacy and the Article 7 principles. Relevance can be judged in terms of the extent to which the needs of beneficiaries are addressed given the risks and impacts they are likely to experience over timescales relevant to a project or programme. Quality can be assessed by the extent to which beneficiaries are actively involved in adaptation design, implementation and MEL, as well as the extent to which this is informed by appropriate information and knowledge. Effectiveness can be judged based on the extent to which intended adaptation outcomes and impacts are delivered, based on both 'objective' indicators and beneficiary feedback. Adequacy can be assessed in terms who does and does not benefit and the extent to which adaptation actions proactively address likely climate change-related risks and impacts given the intended scope and timescale of the project or programme in question.

In this way, CAMELS can be used to establish guidelines for the design, implementation and MEL of individual adaptation projects and programmes at the sub-national level. Adhering to these guidelines could be a prerequisite for external actors wishing to support adaptation actions within a country, to drive good practice.

QA of adaptation actions should also examine how these actions are prioritised for support and implementation. This might be based on the above criteria and the Article 7 principles, but also on criteria related to equity, efficiency, feasibility and acceptability. These criteria might themselves be identified by the intended beneficiaries. Consideration will need to be given to the capacities and resources available for implementing adaptation responses, barriers to implementation and how these barriers can be overcome (Berrang-Ford et al., 2019). The greatest challenges are likely to be associated with transformational adaptation, which may involve radical changes, including the potential abandonment or replacement of existing systems and practices. Transformational adaptation is the approach most likely

to involve winners, losers and conflicts, but may be unavoidable where the impacts of climate change are greatest (see Box 3). Where transformational adaptation is necessary, a phased approach should be adopted as far as possible (Rippke et al., 2016; Brooks, 2017), the potential for conflict assessed and measures to address conflicts put in place.

The design (and implementation) of adaptation should be driven or coordinated by entities associated with national governments, devolved authorities or local communities. This does not preclude partnerships with external actors, such as donors, development agencies, multilateral agencies and NGOs. However, it is important that implementation is at least overseen by national or sub-national entities, that these external actors are not the main drivers of adaptation implementation and that external actors are working in concert with national/sub-national actors, within a clear framework of national and sub-national development and adaptation priorities. Critically, adaptation actions should be nationally and/or locally owned and not wholly dependent on external assistance, which is unlikely to be sustained. A key challenge, particularly for longer-term and transformational adaptation, will be to blend this national or local ownership with the need for guidance on future climate-change impacts from external sources.

Function 3. Tracking adaptation implementation progress

Once adaptation actions and processes have been selected, CAMELS can track their implementation progress. To a large extent, this will involve measuring the extent to which the outputs of adaptation actions are being delivered and the quality of implementation. The latter will be assessed in terms of the degree to which implementation adheres to the Article 7 principles.

Adaptation outputs will include goods and services delivered to the intended beneficiaries of adaptation interventions and the direct establishment or modification of institutional, governance and other processes and mechanisms to address climate-change impacts, risks and vulnerabilities. The latter might include mechanisms for screening policies, plans and programmes, for example. Goods and services will include capacity development activities, as well as the delivery of more tangible support (such as technology, finance, infrastructure, information and insurance). CAMELS can assess quality in terms of, for example, who does and who does not receive such support (Article 7, principles 2 and 4), the involvement of beneficiaries in implementation (principle 3) and progress on implementing mechanisms to ensure the integration of adaptation into policy and planning (principle 6). To a large extent, this is an extension of Function 2 (QA of adaptation actions) from the design phase to (and including) the implementation phase.

Where oversight of adaptation implementation is required, this should be driven by entities associated with national governments or devolved authorities (principle 1). This does not preclude partnerships with external actors, such as donors, development agencies, multilateral agencies and NGOs. However, it is important that these external actors are not the main drivers of adaptation implementation and are acting in concert with national and sub-national actors, within a clear framework of national and sub-national development and adaptation priorities.

Function 4. M&E of adaptation actions and processes

To drive learning and inform policy, CAMELS need go further than tracking the implementation of adaptation actions and processes and assess their effectiveness. While this may seem obvious, current M&E of adaptation remains heavily focused on implementation outputs (Leiter et al., 2019). In the short to medium term, effectiveness will be measured in terms of the extent to which adaptation actions and processes improve the ability of people and systems to anticipate, avoid, cope with, recover from and adapt to evolving stresses and shocks. Measurement of these short- to medium-term outcomes will rely heavily on proxy indicators of vulnerability, resilience and adaptive capacity. The identification, operationalisation and measurement of these indicators is, thus, a major element of adaptation M&E (Brooks and Fisher, 2014a, b) and a key focus of CAMELS.

Improved resilience, reduced vulnerability and enhanced adaptive capacity may be viewed as the outcomes of adaptation actions and process. For adaptation to be effective, these outcomes must in turn lead to longer-term impacts in the form of better development performance in the face of climate change. This will be measured using standard development metrics interpreted in the context of climate information (Box 2). Measurement of these impacts may be conducted within the context of dedicated adaptation M&E or MEL mechanisms, or by linking adaptation M&E and MEL with wider development MEL and, for example, SDG reporting (see Annex 2). A key function of CAMELS will be to ensure that impacts are tracked and linked with wider development reporting and learning, as we discuss below under Function 5. A key issue in adaptation M&E will be assessing the extent to which adaptation actions have contributed to observed adaptation outcomes and impacts, for example, reductions in vulnerability or improvements in resilience, as measured by proxy indicators (Brooks and Fisher, 2014a; Berrang-Ford et al., 2019).

Function 5. Assessing the impacts of adaptation on development performance

As mentioned, the ultimate measure of adaptation success will be the extent to which it improves development performance and enables development objectives, such as the SDGs, to be achieved despite climate change (UNDP, 2007; Brooks et al., 2013; Brooks and Fisher, 2014a, b, c). Therefore, in the medium to longer term, adaptation effectiveness will be measured using development metrics interpreted in the context of climate data and information (Box 2). To this end, CAMELS can provide a framework within which adaptation MEL can be linked to wider development MEL or reporting, thus enhancing the integration of adaptation into development at large (Article 7, principle 6).

Examining the links between adaptation, development performance and climate-change hazards and impacts will require significant coordination in terms of data collection, collation and analysis, across different government agencies and between government and non-governmental actors. The conscious embedding of adaptation MEL in wider development reporting systems may deliver significant advantages over standalone adaptation MEL systems in this regard. However, this may hinder stakeholder and beneficiary participation if these national systems are overly centralised or skewed towards ex-post evaluation.

Function 6. Capturing lessons and identifying good practice

M&E of adaptation actions is of limited use if it does not deliver and drive learning that in turn informs and improves policy, planning and programme. Learning, therefore, must be an integral and explicit function of CAMELS, which should include robust mechanisms for capturing lessons, including:

- The most effective ways of delivering adaptation support
- What works and what does not in terms of reducing vulnerability, increasing resilience and enhancing adaptive capacity
- The mechanisms and pathways through which the above translate into better development outcomes
- The most appropriate indicators for tracking vulnerability, resilience and adaptive capacity
- How to robustly evaluate adaptation 'success' using development metrics and climate data
- Where incremental and transformational approaches to adaptation are most appropriate, and the limits to adaptation, in different contexts
- How to ensure adaptation is equitable in terms of gender, age and other categories, and
- How the above vary across contexts.

The above might be addressed through continuous or periodic triangulation of indicators of resilience, vulnerability and adaptive capacity against development data interpreted in the context of climate information. Alternatively, lessons might be captured from individual evaluations (for example, where these play a key role in SDG reporting). Learning relating to development performance in the face of climate hazards should also be generated from development activities at large and not just from initiatives that explicitly focus on adaptation.

Learning is most likely to be captured if a single, well-resourced and effective national entity is tasked with identifying, capturing and disseminating lessons (see also Function 7). This should not preclude — and indeed will benefit from — the establishment of formal learning mechanisms and roles in other institutional contexts. The establishment of effective learning mechanisms is critical for addressing the Article 7 principles related to participation and transparency, science and knowledge, and integration. The learning generated will help to improve the effectiveness of adaptation in addressing differentiated vulnerabilities (principles 2 and 4) and in ensuring that adaptation actions are relevant and adequate.

Function 7. Dissemination of information and learning

Once lessons have been captured, it is important that they are disseminated to relevant stakeholders and beneficiaries, who will also be central to the generation of learning. Stakeholders will include planners and policymakers at the national level, staff working in specific sectors and agencies, local government staff, local communities and vulnerable groups, and entities implementing adaptation and development programmes and projects. Learning should be appropriately packaged in formats that are relevant to, and accessible by, those at whom it is targeted. Learning will be disseminated in a variety of forms, including reports, briefing notes, television and radio broadcasts, newspaper articles and orally through focus groups and other mechanisms. Lessons will need to be communicated horizontally (across sectors and other contexts) and vertically (from the local to national level and vice versa). Dissemination of learning should be followed up and reinforced with learning feedback loops, in order to determine whether lessons are being taken up and acted upon and whether learning is driving behavioural change that delivers positive resilience and adaptation outcomes. This dissemination is critical to the Article 7 principles on transparency and science and knowledge.

The national body tasked with identifying, capturing and disseminating learning recommended under Function 6 should be responsible for ensuring that relevant learning is transmitted horizontally and vertically and fed into global learning mechanisms, such as the Paris Agreement transparency mechanisms (principally Adaptation Communications and the ETF, the latter via BTRs). This national body is, therefore, likely to play a key role in adaptation reporting and the preparation of Adaptation Communications, either directly or by providing relevant information to other bodies responsible for reporting up to the global level.

The following table serves as a template for the design and function of CAMELS. It suggests questions to ask when designing and assessing the function of CAMELS in relation to the primary areas that CAMELS address and in accordance with the adaptation principles set out in the Paris Agreement.

5.2 A design and assessment template for CAMELS

Based on the above model, we present a template for the design of CAMELS at the national level, which can be found in Annex 3. This template is based on a small set of (1-4) questions addressing each of the Article 7 principles, for each of the seven functions discussed above. The questions are designed to address the criteria of relevance, quality, effectiveness and adequacy and to speak to the ETF information areas, as far as is appropriate for each principle. The questions should either be asked by CAMELS (for example, during the validation of risk and needs assessments, or the QA of adaptation actions and processes) or relate to the design of CAMELS (for instance, the extent to which MEL processes are participatory and transparent).

These questions can be used as a guide when developing CAMELS and/or to assess the comprehensiveness and quality of existing CAMELS, which should adhere to the Article 7 principles.

CAMELS should be nationally owned and country-driven, for example, and managed by well-resourced national entities with clear mandates and sufficient authority (principle 1). The mandates of such entities might include the QA of adaptation actions and processes, the collation of sub-national MEL information and data, the tracking of adaptation performance/success at the national level, the alignment of adaptation MEL with SDG reporting and the generation of information for adaptation reporting at the global level (for example, under the ETF).

CAMELS should probe adaptation effectiveness in relation to actual or anticipated climate hazards and risks, using sound methods and data (principle 5). They should incorporate data and indicators that capture vulnerabilities, risks and impacts that are differentiated by gender and other factors relating to, for example, livelihoods and marginalisation (principles 2 and 4). They should employ participatory methods and incorporate beneficiary- and stakeholder-generated information, with MEL information being in the public domain (principle 3). CAMELS should support the integration of adaptation and development activities, for example, promoting the role of adaptation actions in delivering progress on the SDGs (principle 6).

6

Conclusions

The Paris Agreement frames adaptation in terms of the actions needed to address the impacts of a global warming of 1.5–2°C. While meeting the Paris temperature goals may be technically feasible, doing so will require systemic action on a massive scale, effectively immediately. Such action is not on the horizon and it currently seems likely that warming will exceed 2°C by the middle of the 21st century. Governments and other actors, therefore, must plan for warming in excess of 2C if they are to secure national development goals and the wellbeing of their citizens in the face of climate change.

The Paris Agreement and the deadline for meeting the SDGs provide a framework for adaptation action in the short term, to 2030, by which time adaptation will need to support progress towards SDG achievement in the context of a warming of around 1.5°C. A warming of 2°C is likely by the 2040s and will frame adaptation to secure and maintain SDG gains, to achieve SDGs where their delivery is delayed, and deliver successor development goals in the medium term. In the short term (to around 2030), adaptation is likely to continue to be based on incremental approaches, given existing policy incentives and immediate development needs. Beyond 2030, incremental approaches will need to be complemented more and more by transformational adaptation that seeks to replace or abandon existing systems, processes and practices that are not viable under future climatic conditions. Critically, adaptation actions and processes to address the impacts of a warming of 1.5–2°C by the 2030s–2040s will need to be compatible with appropriate responses to higher levels of warming, avoid future maladaptation, and be sufficiently flexible that adaptation responses can be modified to address additional warming.

While it is imperative that countries accelerate their actions to meet the Paris temperature goals, they must also plan pragmatically for the Paris thresholds to be exceeded temporarily or permanently. Current policies are likely to result in a warming of around 3°C by the 2060s or 2070s. Modelling suggests that meeting commitments and targets in NDCs may delay a warming of 3C until after 2100, but climate feedback mechanisms that act to amplify warming may result in the 3°C threshold being crossed before 2100 even if these commitments and targets are met. The same feedback mechanisms mean that a warming of 4°C or more before 2100 cannot be ruled out under scenarios in which the Paris temperature limits are breached.

Responses to warming of 3–4°C or more will require the large-scale deployment of transformational adaptation measures. In the worst-affected contexts, these will include the relocation of people, systems and economic activities from locations that become physically or functionally uninhabitable due to rising sea levels, increased aridity, fatal combinations of heat and humidity, or an increase in the frequency and severity of climate hazards, resulting in unacceptable levels of disaster risk. Transformational adaptation must blend the assessment of emerging and future risks by external actors (such as climate scientists) with local ownership of adaptation responses through the co-production of knowledge and adaptation plans. This will require the active participation of beneficiaries of adaptation support and other stakeholders in risk assessment, adaptation design and implementation, and MEL of adaptation actions and processes.

There is an urgent need for frameworks that support countries in meeting their adaptation obligations under the Paris Agreement, while also preparing for warming that breaches the Paris temperature thresholds. These frameworks need to facilitate adaptation that supports progress towards the SDGs and wider development goals in relation to the Paris goals and likely adaptation needs given actual future levels of warming. They should also support countries in meeting their reporting commitments under the Paris mechanisms, principally the ETF.

In this context, the development of CAMELS can help to frame and inform adaptation planning, design, implementation, monitoring, evaluation and learning within countries, while also supporting reporting at the global level. We have proposed a framework for the development of CAMELS based on the adaptation principles embodied in Article 7 of the Paris Agreement, viewed through the lens of relevance, quality, effectiveness and adequacy. These four criteria ensure that the Article 7 principles address the potential magnitude of warming (beyond the Paris thresholds) and link adaptation actions to specific risks, impacts and needs. They also seek to ensure that adaptation is inclusive and transparent, based on sound data and methods, and actively supportive of development needs, priorities and goals. As well as addressing the Article 7 principles and the four criteria, the CAMELS framework addresses the information required for reporting under the ETF.

Our proposed CAMELS framework is based on seven key functions, namely, (i) the QA of climate vulnerability/risk and adaptation needs assessments, (ii) the QA of adaptation actions and processes[12] to ensure they are compatible with the Article 7 principles and the criteria of relevance, quality effectiveness and adequacy, (iii) tracking adaptation implementation, (iv) M&E of adaptation actions and processes to assess their effectiveness at the outcome and impact levels, (v) assessing the impact of adaptation actions and processes on development performance and linking with SDGs, (vi) capturing lessons and identifying good practice, and (vii) disseminating information and learning.

Based on the above framework, we have proposed a template for the development and assessment of CAMELS, comprising a set of 1-4 questions related to each of the Article 7 principles, for each of the seven CAMELS functions. We propose that those tasked with developing national and sub-national M&E/MEL systems use the framework and template to inform the development of CAMELS that (i) are appropriate to these national and/or sub-national contexts, (ii) can help inform the design and implementation of adaptation actions and processes that are fit for purpose in the context of rapidly accelerating climate change, (iii) address countries' adaptation commitments under the Paris Agreement, including reporting requirements under the ETF, and (iv) drive adaptation learning and help build adaptation capacity at the national, sub-national and global levels.

A number of countries are already developing national M&E systems. A review of a subset of these systems indicates a general but variable compatibility with the Article 7 principles. Nonetheless, these systems provide a solid foundation on which more comprehensive CAMELS can be built to provide both structure and accountability for the development of effective adaptation actions and processes at the national and sub-national level. These emerging national MEL systems are being developed from different starting points and via different pathways. The framework presented here is intended to be sufficiently flexible to accommodate the diverse ways in which national MEL systems are evolving, while ensuring a level of consistency at national level that will facilitate coherent reporting at the global level. Critically, this should not compromise countries' capacities to develop nationally appropriate MEL systems that support them in addressing the emerging and expected climate-change risks and impacts associated with warming beyond the Paris temperature thresholds.

12 A key aspect of QA of both assessments and actions is to ensure that they identify and address specific vulnerabilities, risks and impacts associated with likely levels of warming over specific timescales and are not limited solely to generalised descriptions of vulnerability and generic vulnerability reduction/ resilience building that do not link risks and actions to specific climate hazards.

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Annex 1. Methodology for estimating date ranges within which warming thresholds are likely to be breached

The temperature projections used to identify the date ranges over which the 1.5°C, 2°C, 3°C and 4°C warming thresholds are 'likely' (66% probability) to be breached (Box 1, main text) are those of Arnell et al. (2019). These projections have been generated using five different SSPs and seven RCPs.

The five SSPs represent different plausible 'storylines' or narratives of future social and economic conditions and governance with no climate policy, based on assumptions about population, economic growth, urbanisation, education, resources, technology, political trends and consumption (O'Neill et al., 2017; Arnell et al., 2019).

The seven RCPs include revisions of RCP 2.6, RCP 4.5, RCP 6.0 and RCP 8.5 (with the number indicating the radiative forcing of the additional greenhouse gases in 2100, in watts per square metre, or Wm^{-2}) and three new pathways with a radiative forcing in 2100 of 1.9, 3.4 and 7.0 Wm^{-2} (O'Neill et al., 2016; Arnell et al., 2019). RCP 8.5 represents a 'high-end' or worst-case scenario. Emissions scenarios with no specific assumptions about mitigation produce radiative forcings between those of RCP 6.0 and RCP 8.5 (Clarke et al., 2015; Arnell et al., 2019).

An individual SSP is combined with a compatible RCP in an integrated assessment model (IAM) to translate the socioeconomic conditions represented by the SSP into a pathway of energy use and emissions characteristics that delivers the radiative forcing specified by the RCP by the end of the 21st century. The result is an SSP-RCP scenario that describes future energy use compatible with a given climate forcing in 2100, for a world described by a particular SSP. Six IAMs have been used for this purpose.

Here, we use nine SSP-RCP scenarios based on seven SSP-RCP combinations and two variants used to examine (i) lower near-term climate forcing from aerosols, ozone precursors and methane for a high forcing in 2100 of 7.0 Wm^{-2} and (ii) aggressive mitigation from around 2040 for an emissions pathway that follows the high-end RCP 8.5 until that date. These nine scenarios have been chosen as they will be used as the 'marker scenarios' for the climate modelling that is being undertaken for the forthcoming IPCC Sixth Assessment Report.

The projections of global warming (the increase in global mean surface temperature) used here were generated using a probabilistic implementation of version 4.2 of the MAGICC simple climate/energy balance model (Lowe et al., 2009; Lowe and Bernie, 2018) by Arnell et al. (2019). This generates 1,863 temperature projections based on different but plausible values of key parameters,[1] each of which is associated with a relative probability (Arnell et al., 2019). The likely date range for crossing a given warming threshold is then defined by the years in which that warming is reached at the 17% and 83% probability levels.

The SSP-RCP scenarios used here and the IAMs used to generate them are summarised in Table A1.

1 Equilibrium climate sensitivity, ocean diffusivity and carbon-cycle feedback strength.

Table A1. SSP-RCP scenarios used to derive likely date ranges for the crossing of warming thresholds, as represented in Box 1 in the main text. The name of each scenario incorporates the name of the IAM (e.g. GCAM4) followed by the name of the SSP (e.g. SSP4) and (except where specified) a number representing the additional radiative forcing in 2100 resulting from greenhouse gas emissions under the RCP used (e.g. 34 to indicate 3.4 Wm^{-2}). Descriptions based on Bernie (2019, personal communication).

		WARMING THRESHOLDS LIKELY TO BE BREACHED BY 2100 UNDER EACH SCENARIO			
SCENARIO	**DESCRIPTION**	**1.5°C**	**2°C**	**3°C**	**4°C**
AIMCGE_SSP3_70_Baseline.nc	A 'no climate policy' baseline scenario for the Asia-Pacific Integrated Model/Computable General Equilibrium (AIM/CGE) IAM and SSP3 combination that produces a radiative forcing of around 7 Wm^{-2}, which has been adopted as the RCP 7.0 scenario. A warming of more than 4°C is not likely before 2100, but is possible at some point after 2100. Close to the current global emissions trajectory.				
AIMCGE_SSP3_LowNTCF.nc	As above, but with lower near-term climate forcings from aerosols, tropospheric ozone precursors and methane, the purpose of which is to examine the regional climate patterns associated with these short-lived climate forcings. A warming of more than 4°C is not likely before 2100, but is possible at some point after 2100, though later than in the first scenario.				
GCAM4_SSP4_34.nc	A scenario incorporating stronger mitigation than at present, but which still results in a warming of more than 2°C.				
GCAM4_SSP4_60.nc	A weak mitigation scenario that results in a radiative forcing of around 6.0 Wm^{-2}. A warming of more than 3°C is not likely before 2100, but becomes likely by around 2110. This scenario is arguably close to an emissions trajectory compatible with current commitments under NDCs.			~2110	
IMAGE_SSP1_19.nc	A strong mitigation scenario that results in a radiative forcing of around 1.9 Wm^{-2}, which is likely to limit warming to less than 1.5°C.				
IMAGE_SSP1_26	A strong mitigation scenario that results in a radiative forcing of around 2.6 Wm^{-2}, which is likely to limit warming to less than 2°C.				
MESSAGE_GLOBIOM_SSP5_34-OS.nc	A scenario incorporating stronger mitigation than at present, but which still results in a warming of more than 2°C.				
REMIND-MAGPIE_SSP5_85_Baseline.nc	A 'no climate policy' scenario for this IAM and SSP combination, which results in a radiative forcing of around 8.5 Wm^{-2} by 2100, in which warming exceeds 4°C and continues beyond 2100.				

Annex 2. Review of national M&E systems against Article 7 criteria

Paragraph 4 of Article 7 of the Paris Agreement provides us with a normative statement on the desirable attributions of adaptation. This has been used to derive the six Article 7 principles of adaptation, described in Chapter 3 of the main text. Here, we present the results of a desk review of five national adaptation M&E systems against these six principles, based on readily available documentation. The countries reviewed are ones that demonstrate an interesting trajectory in sub-national, national, global or SDG-level M&E and which are addressing specific methodological and operational challenges in the design of their national systems. The review is not intended to be exhaustive or to provide an 'assessment' of countries' adaptation M&E systems, but to illustrate how the Article 7 principles are or are not reflected in current national adaptation M&E systems. We refer here to M&E rather than MEL or CAMELS, as this is how the systems are described in the corresponding documentation.

The M&E systems reviewed are:

- **Colombia's National Results-based Management and Evaluation System — *Sistema Nacional de Evaluación de Resultados de la Gestión Pública* (SINERGIA)** is a government-wide M&E system with two distinct components: (i) a system of performance indicators (around 500) that track progress against the President's goals, and (ii) an agenda of impact evaluations of government programmes and interventions.
- **South Africa's National Monitoring & Evaluation of Climate Change and Developmen**t is closely associated with the planning process in government and the climate change M&E system that comprises two complementary systems: (i) a climate-change response M&E system that covers climate-change risks, impacts and vulnerability, as well as the M&E of adaptation, mitigation and tracking of climate finance, and (ii) a greenhouse gas inventory report.
- **Morocco's sub-national M&E** system was designed for three pilot regions, so that adaptation within key sectors could be effectively tracked and evaluated. The M&E system was integrated with the existing Regional Information System on Environment and Sustainable Development (SIREDD). Key selected indicators focus on the implementation of adaptation measures and the impacts of these measures by observing and documenting changes in vulnerability.
- **The Philippines' National M&E Systems Integration of Climate and SDG Indicators** are primarily geared towards measuring adaptation and focuses on evaluating the outcomes of the country's adaptation plans through its Results-Based Monitoring and Evaluation System (RBMES), which comprises 102 indicators on activities and outputs set against immediate, intermediate and ultimate outcomes in seven priority areas. The RBMES distinguishes between three types of indicator: (i) output (critical), (ii) immediate outcome, and (iii) intermediate (key).
- **Uganda's National Monitoring and Evaluation of Climate Change and Development** recently adopted the integrated M&E strategy for the second National Development Plan (NDPII), as well as the uptake of the Tracking Adaptation and Measuring Development (TAMD) methodology.

Below, we provide a high-level summary of the findings of the review across the various countries, with tables summarising the situation for each principle in each country.

Principle 1: Country-driven

In the absence of detailed information on the processes by which national adaptation M&E systems are designed, it is useful to examine how they are aligned with national development priorities and plans and wider development M&E. Colombia's SINERGIA addresses adaptation M&E within the context of evaluating progress on the SDGs. In the Philippines, the body responsible for adaptation M&E works closely with the National Economic and Development Authority. South Africa's wider climate-change M&E system, which includes adaptation, is linked with SDG targets and indicators and has been designed to report against a variety of frameworks. In Morocco, adaptation M&E includes indicators derived from national sustainable development initiatives and the SDGs.

COUNTRY	RESULTS REVIEW — COUNTRY-DRIVEN
Colombia	SINERGIA is one of the earliest established development M&E systems and heralded as one of the most sophisticated in Latin America. It is not a CAMEL and is exclusively focused on development. However, SINERGIA has made strides towards embedding the SDGs in the Colombian National Development Plan, undertaking evaluations related to 13 SDGs, including SDG 13, to date. Further efforts to incorporate the SDGs into the domestic agenda include the establishment of a national taskforce to help create the policy framework and mechanisms for implementing, monitoring and assessing the SDGs (Dag Hammarskjöld Foundation, 2018).
South Africa	There are linkages between the national climate-change M&E system currently being developed, the South African NDC goals and the SDG climate-action targets and indicators. These also link to reporting against the United Nations Convention to Combat Desertification (UNCCD) strategic objectives, expected impacts and indicators. These elements have all been expressly incorporated into the design of the system and the information collected allows for multi-reporting through the different frameworks while remaining closely aligned to national priorities.
Morocco	A sub-national M&E system is currently used in three regions: Souss-Massa, Marrakech Safi and Beni Mellal Khénifra. This monitors and evaluates vulnerability in key sectors, including water, biodiversity and forests, agriculture and tourism. The system supports the monitoring of adaptation actions and helps to recalibrate actions where necessary. The M&E system was integrated with the existing Regional Information System on Environment and Sustainable Development (SIREDD) and indicator lists were developed to take into account climate-change indicators from the National Strategy on Sustainable Development and the SDGs. (GIZ, 2017a). The sub-national M&E links to the NAP process, as regional climate-change plans have been developed in two of the three regions covered by the adaptation M&E systems as part of the NAP process.
Philippines	In the Philippines, there are close times between development reporting and climate change and integration for reporting against the SDGs. The national M&E system is primarily geared towards measuring adaptation and focuses on evaluating the outcomes of adaptation plans through its RBMES, which comprises 102 indicators on activities and outputs set against immediate, intermediate and ultimate outcomes in seven priority areas. The Climate Change Commission, responsible for developing and implementing the RBMES, works with the National Economic and Development Authority (NEDA), which oversees performance and results monitoring for the Philippine Development Plan (PDP) (GIZ, 2014), as well as reporting against the SDGs. The PDP Chapter on Monitoring stipulates close inter-agency collaboration for reporting and the NEDA Secretariat coordinates with the relevant government institutions. Under the RBMES, the immediate outcome indicators — mirroring the immediate outcome areas for each National Climate Change Action Plan (NCCAP) priority theme — are to be re-evaluated against the SDG indicators to ensure alignment of reporting requirements (GIZ, 2017b).

COUNTRY	RESULTS REVIEW — COUNTRY-DRIVEN
Uganda	Uganda's climate adaptation M&E framework is still under development. However, the government has put in place a number of provisions, including a policy and institutional framework to foster monitoring, reporting and evaluation for both development and climate change. The policy foundation for development M&E ties into the Uganda Vision 2040 and elaborated upon in the National Policy on Public Sector Monitoring and Evaluation (2011) and NDPII 2015/16–2019/20. These provide for mainstreaming climate change in national, sector and local development plans and budgets and for the establishment of systems for monitoring and reporting on the implementation of climate-change interventions. Climate-change actions and M&E are provided for in Uganda's National Climate Change Policy (NCCP) 2015 and its NDC. However, there is no mention in the NCCP of the SDGs, so adaptation actions are not explicitly linked. There is no planning of adaptation actions to correlate to specific timescales in any of the policy documents. The NDPII states that the SDGs are to be localised, but this has not been reflected in the formulation of the indicators. Standard National Climate Change Indicators and Reference Sheets have been developed in a participatory manner and were launched in 2018 to operationalise climate-change monitoring and reporting by sectors and local governments. The indicators — outputs and outcomes levels — were built around the indicators developed as part of the TAMD pilot project conducted by the International Institute for Environment and Development (IIED) and the Africa Climate Change Resilience Alliance (ACCRA), in addition to the performance measurement framework (PMF) developed by the Climate Change Department, with support from the French Development Agency (AFD). However, these standard indicators have yet to be integrated into the existing M&E tools and instruments used by sectors for monitoring and reporting.

Principle 2: Gender-responsive

Gender is addressed to varying extents by all of the MEL systems examined. Colombia requires gender-disaggregated M&E indicators in certain categories of project, while South Africa and Morocco have signalled an intention to develop gender-sensitive indicators. The Philippines recognises that vulnerability is differentiated by gender and has proposed gendered vulnerability and risk assessments and discussed equity and differentiated responsibilities. The Philippines is seeking to incorporate the voices of women and men in adaptation design, while in Uganda, local participation in indicator development has been based on the use of gendered focus groups.

COUNTRY	RESULTS REVIEW — GENDER RESPONSIVENES
Colombia	Certain categories of 'gender' or 'women's equality' projects are required to include sex-disaggregated M&E indicators (UN Women/EvalPartners/IOCE, 2015).
South Africa	Under the National Climate Change Response Monitoring and Evaluation System Framework, there is no mention of gender equality. In 2018, the Department of Planning, Monitoring and Evaluation (DPME) developed a draft framework setting out an approach to the development of a proposed gender-responsive planning, monitoring and evaluation framework. This included measures aimed at mainstreaming gender equality within existing national systems, including budgeting systems, procedures and performance-based budgeting initiatives and the development of a country gender indicator framework linked to normative frameworks, including the SDGs (Department of Women, Republic of South Africa, 2018).
Morocco	Indicators were developed for each of the sectors covered by the pilot, premised on theories of change (causal chains) to help identify contribution / attribution. Gender aspects were considered when developing the chain to ensure gender-sensitive indicators were included (GIZ, 2017a).

COUNTRY	RESULTS REVIEW — GENDER RESPONSIVENES
Philippines	The NCCAP 2011–28 recognises gender equality as an issue that cuts across sectors and levels of implementation and this is acknowledged throughout the plan. Indeed, one of the guiding principles of the NCCAP is that adaptation measures should be based on equity and in accordance with differentiated responsibility. It accords special attention to the protection of the poor, women, children and other vulnerable groups. The voices of women and men are an integral dimension of the design, implementation, monitoring and evaluation of policies and programmes. Specifically, the NCCAP envisages gendered vulnerability and adaptation assessments that integrate gender analyses to identify the specific vulnerabilities of men and women (CCC, 2011). The RBMES states that gendered vulnerability and risk assessments are to be conducted.
Uganda	While one of the NCCP's stated policy priorities is to mainstream gender considerations into adaptation actions, recognising that gender-sensitive indicators need to be developed, there is little evidence this has taken place as yet. In the bottom-up development of the indicators using the TAMD framework, groups at the community level divided local participants into gender groups to ensure theories of change were devised that considered the adaptation needs of women and men and increased women's participation in the process. As noted, the TAMD indicators have not yet been integrated into the broader framework.

Principle 3: Participatory and transparent

The extent to which adaptation and adaptation M&E are participatory and transparent varies from country to country. In South Africa, the definition and measurement of vulnerability is described as being stakeholder-driven and evaluation reports are made public and subject to QA. In Morocco, adaptation indicators are based on participatory consultation and stakeholder workshops are held to develop adaptation visions and impact-vulnerability chains. In Uganda, the development of national climate-change indicators has been highly participatory, involving a variety of stakeholders. Colombia has enacted measures to make evaluations transparent, but the centralised approach and use of external consultants may mitigate against participation.

COUNTRY	RESULTS REVIEW — PARTICIPATION AND TRANSPARENCY
Colombia	There is limited evidence of evaluations being participatory. To safeguard impartiality and maintain neutrality within the government, external consultants are contracted to conduct evaluations, with the National Department of Planning (DNP) taking more of a management and oversight role. SINERGIA carries out a number of evaluations per year. The cycle of evaluations starts with setting the annual evaluation agenda. Each sector in national government is asked which policies and programmes should be subject to an evaluation and, to help with transparency, the agenda is made public (Overseas Development Institute, 2017).
South Africa	As a principle underpinning vulnerability assessments, the definition and measurement of vulnerability is to be the result of a consultative, stakeholder-driven process, rather than the result of technical analysis. However, there is little substantive detail on how this is to take place under the National Climate Change Response Monitoring and Evaluation System Framework. To ensure transparency under the national evaluation system, all evaluation reports go to the cabinet and are then made public (unless there are specific concerns around security). This may include media briefings and publication via the DPME website and via parliament. Evaluations also undergo quality assessments and are stored in an evaluation repository (South African Presidency, 2014).

COUNTRY	RESULTS REVIEW — PARTICIPATION AND TRANSPARENCY
Morocco	The approach is an indicator-based system, created through a participatory consultation process to select indicators and create ownership among system users. Workshops were convened at which key stakeholders agreed a common vision for adaptation for each of the regions and developed climate-change impact and vulnerability chains for key sectors (water, biodiversity and forests, agriculture and tourism). Based on this vision, indicators were then selected through multi-stakeholder dialogue, including indicators to monitor changes in vulnerability, the implementation of the adaptation measures and their impacts across the pilot regions.
Philippines	The review produced limited evidence of how participatory the M&E system is, or the transparency measures in place.
Uganda	In 2015, the Ministry of Water and Environment/Climate Change Department (MWE/CCD) started to develop the Standard National Climate Change Indicators (SNCCI), which were completed and launched in 2018. The process benefited from a lot of work done by the IIED pilot project on TAMD and the indicators were developed by MWE/CCD to facilitate the mainstreaming of climate change across sectors. The process of developing the SNCCI was highly participatory, involving M&E actors at the national and sub-national (district) levels, as well as NGOs, development partners, academia and researchers. In particular, the adaptation indicators were generated at community level and validated at sub-national and national levels with support from partners including, but not limited, to ACCRA, IIED and the United States Agency for International Development's (USAID) Feed the Future Enabling Environment for Agriculture initiative.

Principle 4: Addressing vulnerabilities

South Africa plans to identify, assess and track vulnerability using context-specific indicators, while Morocco has already classified vulnerability indicators and undertaken such assessments with significant stakeholder involvement. The Philippines has identified vulnerability indicators and set out a strategy for vulnerability assessment. Uganda has signalled its intention to address climate vulnerabilities. It is unclear whether specific climate-change vulnerabilities are addressed in Colombia's SINERGIA system.

COUNTRY	RESULTS REVIEW — ADDRESING VULNERABILITIES
Colombia	It is unclear from the desk review how this principle is being operationalised in Colombia through SINERGIA.
South Africa	A specified strategic objective of the National Climate Adaptation Strategy (2017) is to develop a national M&E system to track vulnerability. Chapter 5 sets out the National Vulnerability Assessment Framework (NVAF), offering substantive guidance on sectoral vulnerability and adaptation options. Site- and location-specific information on M&E is to be generated from this. The overall aim is to develop a good understanding of the key vulnerabilities of different sectors and to identify appropriate adaptation options. The NVAF includes a model and instructive guidance for undertaking the assessment.
Morocco	While the institutions for monitoring vulnerability and adaptation remained the same (as they were integrated into existing environmental monitoring systems), regional studies were conducted as part of the pilot for including adaptation M&E with a view to better understanding vulnerability. The indicators that were devised were based on climate-change impact and vulnerability chains developed for each of the chosen sectors. The indicators that were selected were chosen through a multi-stakeholder consultation with system users. The indicators are now being used to monitor changes in vulnerability in the pilot regions (GIZ, 2017a).

COUNTRY	RESULTS REVIEW — ADDRESING VULNERABILITIES
Philippines	It is acknowledged in the RBMES that effective M&E will partly depend on establishing baselines and counterfactuals based on vulnerability assessments. As part of developing the RBMES, key indicators were identified for elements of risk, vulnerability, exposure and hazard for each of the thematic priorities identified under the NCCAP. The RBMES states that vulnerability or risk assessments are to be undertaken for each intervention. At the implementation stage, the goals and objectives of that intervention are considered in terms of the impact on vulnerable groups that need to be protected or assisted. The spatial or geographic distribution of these groups is then identified along with the causes and degree of vulnerability.
Uganda	To facilitate climate-change M&E, the government engages in climate-change budget tagging to identify government spending that produces climate-change benefits and co-benefits for climate change. Climate relevance is established for adaptation projects if the project objective includes a clear reference to climate-change risks or vulnerabilities. However, it is not clear from the evidence reviewed how vulnerabilities are assessed. The NCCP expressly earmarks the most vulnerable sectors as priorities for adaptation actions and seeks to mainstream adaptation into the sectoral policy frameworks through a number of specific sectoral strategies. It further states the need for the CCD and other ministries and agencies to develop PMFs with clear indicators and targets for assessing the performance of NCCP implementation, but there is no reporting of actions to develop these indicators.

Principle 5: Guided by best science and knowledge

From our limited desk review of adaptation M&E systems, Morocco arguably appears to be the most advanced in the use of information/data relating to climate hazards and extreme events. South Africa's National Adaptation Strategy, which frames adaptation M&E, includes information on climate projections. The Philippines has signalled its intention to build capacity in the area of climate science and has specific provision for integrating new information and indigenous knowledge. Colombia exhibits a high level of technical capacity around indicators and M&E in general, but it is not clear how this relates to adaptation. There appear to be significant capacity constraints in Uganda. None of the countries reviewed appears to be framing adaptation in terms of escalating needs related to different levels of warming over specific timescales.

COUNTRY	RESULTS REVIEW — GUIDED BY BEST SCIENCE AND KNOWLEDGE
Colombia	The recently published national system of adaptation indicators shows the use of science in indicator development (Romero-Ruiz, 2016).
South Africa	In the National Climate Change Adaptation Strategy (2017), there is a short subsection in 'Annex 1: Evidence and Impacts of Climate Change in South Africa', entitled 'Projections of Future Climate in South Africa', but there is little to suggest that adaptation ambitions have been considered relative to different timescales or against different temperature-rise scenarios. This finding is echoed in our review of the National Climate Change Response Monitoring and Evaluation Framework. Furthermore, there is little in the reviewed documents to suggest that indigenous and local knowledge will be integrated.
Morocco	The adaptation indicators have been incorporated as a specific component into the SIREDDS, which also includes climate-change mitigation, extreme events and damage and loss indicators. SIREDDS also contains a database that captures a mix of standard indicators that will be aggregated at the national level and region-specific indicators that are tailored to the context of the particular region. It also includes a decision dashboard and spatial-temporal monitoring of key climate indicators.

COUNTRY	RESULTS REVIEW — GUIDED BY BEST SCIENCE AND KNOWLEDGE
Philippines	The RBMES states that annual monitoring information is to be used to set priorities and that new information and knowledge should be integrated as new evidence emerges. There is also specific scope for the inclusion of indigenous knowledge and the continued updating of scientific information over the proposed lifespan of the system. A number of the monitoring activities envisioned for each sector state that science-informed options are to be implemented. There is also a priority area within the RBMES for 'knowledge and capacity development'. Here, there is to be (formal and informal) capacity building around outputs on climate-change science, with a view to achieving enhanced knowledge on climate science among woman and men to address climate change.
Uganda	Capacity issues are apparent at the sub-national level, with capacity constraints and technical shortcomings including lack of data collection, management skills and equipment. All districts lack specialised and designated M&E personnel. There was a low level of knowledge and understanding that limited the level of integration of climate change into the district planning and reporting processes. Other capacity-related constraints included low levels awareness on the need for and importance of M&E, and a lack of capabilities for establishing systematic linkages between budgets, workplans, programme objectives and outcome indicators.

Principle 6: Supportive of integration

Adaptation M&E is aligned with national mechanisms for addressing climate change in all the countries reviewed. In Colombia and South Africa, this involves national-level adaptation M&E systems. In Colombia, a national adaptation M&E system coexists with the centralised SINERGIA system for tracking development at large and the SDGs, including SDG 13 on climate change. In the Philippines, adaptation-relevant indicators are integrated with national development M&E systems. Adaptation M&E in Morocco and South Africa is linked with national development M&E, but is not fully integrated. In Uganda, there is no unified national adaptation M&E system, although adaptation M&E is framed by national development goals and mechanisms.

COUNTRY	RESULTS REVIEW — PARTICIPATION AND TRANSPARENCY
Colombia	While there are efforts Colombia to develop a dedicated adaptation M&E system — the National System of Adaptation Indicators (SNIACC) — there have been problems aligning and integrating the indicators with the relevant policies and plans (Cruz, 2019).
South Africa	The government has developed a comprehensive national climate-change response M&E system that incorporates international MRV requirements. Synergies between it and the newer National Climate Change Adaptation Strategy (2017) were assessed to ensure explicit linkage. Indeed, the Department of Environmental Affairs emphasised the need for the ongoing assessment of M&E synergies across frameworks and policies, as well as in developing new plans and strategies. Links between the national M&E system, South Africa's NDC goals and the SDG climate-action targets and indicators, as well as reporting against the UNCCD strategic objectives, expected impacts and indicators, have all been expressly incorporated into the design of the system and the information collected enables integration and multi-framework reporting.
Morocco	Morocco has taken steps to link various levels of adaptation M&E. Adaptation indicators have been integrated into its existing regional environment and sustainable development monitoring systems, SIREDDs, and will be aggregated at the national level. In 2015, there was an exercise to harmonise data across the regional SIREDDs with a view to creating a national information system (GIZ, 2017a). This links to the NAP process, as regional climate-change plans have been developed in two of the three regions covered by the adaptation M&E systems as part of that process, informed by data from the SIREDDs. (Furthermore, it is envisioned that the SIREDDs will eventually form an integrated information system spanning all regions, with specific indicators that will inform adaptation policies and programmes, including the NAP, allowing for vertical integration.)

COUNTRY	RESULTS REVIEW — PARTICIPATION AND TRANSPARENCY
Philippines	The CCC works closely with the NEDA, which is in charge of overseeing performance and results monitoring for the PDP (GIZ, 2014), as well as reporting against the SDGs. The PDP Chapter on Monitoring stipulates close inter-agency collaboration for reporting and the NEDA Secretariat will coordinate with the relevant government institutions. The RBMES states that the immediate outcomes are to be re-evaluated against the SDG indicators to ensure alignment of reporting requirements (GIZ, 2017b). The government has also tried to establish a results-based management system for development through the PDP, introducing results matrices in 2010. Each matrix corresponds to a thematic chapter of the PDP, sets baselines, targets and assumptions, and includes objectives with corresponding indicator frameworks for the various levels of results (goals and outcomes) targeted in that particular chapter. Institutional ownership of M&E is also planned. The indicators included in the results matrices help guide public-sector management at each stage and the matrices are the primary mechanism for M&E of the development plans. Climate-change indicators have been incorporated into the most recent PDP (2017–22) in 'Chapter 11: Reduce Vulnerability of Individuals and Families' and 'Chapter 20: Ensuring Ecological Integrity, Clean and Healthy Environment'. The results matrix for PDP Chapter 20 actually integrates two SDG indicators (13.1.1 and 13.2), demonstrating efforts to align the country's development aspirations with the SDG on climate change (Philippine Daily Inquirer, 2017).
Uganda	Uganda's NDC is aligned with the Uganda Vision 2040 and the NDPII, as well as some sectoral development plans and strategies prioritised in the NCCP and Implementation Strategy. Despite the existence of different frameworks, tools and other opportunities for M&E at various levels of governance, a specific M&E framework for climate change has not been fully realised and integration has yet to be completed. The government's intention to incorporate programme monitoring and reporting into existing monitoring and reporting systems has yet to come to fruition. One major challenge is that there is a tendency to focus on financial reporting at the expense of other monitoring and reporting across government.

Annex 3. Template for the design and function of CAMELS

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Function 1. Validating climate risk and adaptation needs assessments		
Country-driven	1. Are assessments conducted and risks, impacts and vulnerabilities prioritised by national entities, for example, via NAPs, national adaptation programmes of action (NAPAs), NDCs, etc.	Yes/no – if yes then how?
	2. Have the national entities identified the level of ambition set for adaptation, i.e. planning for 1.5°, 2°, 3°C of warming?	Yes/no
Gender-responsive	1. Are gender-differentiated vulnerabilities, risks and impacts identified/acknowledged in adaptation plans?	Yes/no – if yes then how?
	2. Is greater differentiation anticipated as warming trajectories rise?	Yes/no
	3. Are the specific adaptation needs of women and girls addressed in adaptation plans?	Yes/no
Participatory and transparent	1. Are the assessments and prioritisation of risks, impacts and vulnerabilities informed by stakeholders including vulnerable groups and communities?	Yes/no – if yes then who?
	2. Do feedback mechanisms exist to update assessments of risks and needs and to influence prioritisation?	Yes/no
Addressing vulnerabilities	1. Are the differentiated vulnerabilities assessed and addressed in risk assessment, for different sectors, locations, groups, livelihoods, etc.?	Yes/no – if yes then how?
Guided by best science and knowledge	1. Do the assessments of risks and adaptation needs use science-based climate information (observations, trends, projections, sensitivity studies/'what if' scenarios?	Yes/no
	2. Are the assessments of risks and needs informed by local and indigenous knowledge/experience of vulnerabilities, risks and impacts?	Yes/no
	3. Is the level of adaptation ambition qualified by scientific information on timescales, risks, impacts?	Yes/no
	4. Do the assessments acknowledge dependence of risks/ vulnerabilities on emissions and warming pathways?	Yes/no
Supportive of integration	1. Are risks and needs identified across sectors through multi-sector cooperation?	Yes/no
	2. Are all relevant ministries and departments involved in identifying risks and needs and actions?	Yes/no
	3. Are national and sectoral strategies, plans, policies, programmes screened to identify climate-change risks and adaptation needs?	Yes/no

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Function 2. QA of adaptation actions		
Country-driven	1. Are the adaptation actions and processes identified and prioritised by domestic stakeholders at national and sub-national level? 2. Are the adaptation actions and processes consistent with the level of ambition identified by the country, e.g. adaptation for 1.5°, 2°, 3°C?	Yes/no Yes/no
Gender-responsive	1. Do the adaptation actions and processes address the vulnerabilities of women and girls and include measures to address the specific impacts of climate change on women and girls?	Yes/no
Participatory and transparent	1. Do/did the intended beneficiaries of adaptation initiatives (including the poor, marginalised, most vulnerable) contribute to the identification, prioritisation, design and implementation of adaptation actions and processes? 2. Are feedback mechanisms in place to update adaptation actions and processes in light of new evidence and experience?	Yes/no Yes/no
Addressing vulnerabilities	1. Do the adaptation actions and processes support the most vulnerable sectors, activities, systems, locations, groups, livelihoods, etc.?	Yes/no – if yes then how?
Guided by best science and knowledge	1. Do the adaptation actions and processes address specific climate risks and impacts as identified from observational data, climate projections, sensitivity studies and scenario planning exercises? 2. Are the adaptation actions and processes informed by local and indigenous knowledge where appropriate (i.e. when targeting communities and specific groups)?	Yes/no Yes/no
Supportive of integration	1. Are there processes and mechanisms established to ensure integration of adaptation into policy, planning and programming, including mechanisms to screen for climate-change risks and ensure appropriate risk and vulnerability assessment?	Yes/no – if yes then what are these?
Function 3. Tracking adaptation implementation progress		
Country-driven	1. Is adaptation implementation carried out and/or overseen by national entities, e.g. national-level bodies and entities associated with devolved authorities? 2. Is tracking adaptation implementation funded by national government? 3. Is tracking adaptation implementation carried out/managed by national organisation(s)? 4. Is tracking of adaptation implementation integrated into existing M&E/reporting systems?	Yes/no Yes/no Yes/no Yes/no
Gender-responsive	1. Are the outputs of adaptation actions tracked using gender-disaggregated information? 2. Do mechanisms exist whereby women and girls can feed back on how well adaptation actions are being implemented and to what extent support/benefits are reaching them?	Yes/no Yes/no – if yes then how?

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Participatory and transparent	1. Are there processes/mechanisms through which tracked adaptation implementation is publicised?	Yes/no
	2. Are the results of adaptation implementation tracking put in the public domain, delivering accountability?	Yes/no
	3. Do recipients of adaptation support have a meaningful role in tracking how effectively and equitably adaptation actions are implemented?	Yes/no
	4. Is there sufficient flexibility for adaptation actions to be adjusted based on feedback from those they are intended to support?	Yes/no
Addressing vulnerabilities	1. To what extent is adaptation support aimed at the most vulnerable and marginalised tracked?	High/medium/ none
	2. To what extent is adaptation support targeted at priority risks and vulnerabilities (locations, sectors, activities, systems, population groups, etc.) tracked?	High/medium/ none
Guided by best science and knowledge	1. Does the tracking of implementation incorporate how recipients are being affected by climate risks and impacts?	Yes/no
	2. Can recipients feed back information on the relevance of support received, based on their needs and the risks and impacts they are experiencing?	Yes/no
Supportive of integration	1. How well tracked is adaptation integration into individual policies and plans and across sectors?	Good/some/ none
	2. Is the implementation of policies specifically designed to drive adaptation tracked?	Yes/no
Function 4. M&E of adaptation actions and processes		
Country-driven	1. Do national frameworks(s) and system(s) for adaptation M&E exist and have they been designed and implemented by national entities?	Yes/no
	2. Is adaptation M&E mandated and guided by national policies and legislation?	Yes/no
Gender-responsive	1. Do the adaptation M&E systems track adaptation outcomes using gender-disaggregated data/indicators and (where appropriate) gender-specific data/indicators?	Yes/no
	2. Do adaptation M&E systems incorporate feedback from women and girls?	Yes/no
Participatory and transparent	1. Is the M&E of adaptation informed by feedback from recipients (direct and indirect) of adaptation support?	Yes/no
	2. Are the results of adaptation M&E publicly available for comment by those whom adaptation actions are intended to support?	Yes/no
Addressing vulnerabilities	1. Does the M&E assess how adaptation actions are affecting the resilience of vulnerable groups, locations, livelihoods, etc., and of the poorest and marginalised, using appropriate context-specific indicators?	Yes/no

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Guided by best science and knowledge	1. Do adaptation indicators capture the extent to which people and systems are supported to be more resilient to specific climate (change) hazards and risks?	Yes/no
	2. Are resilience and related indicators identified through empirical approaches based on evidence of what makes people and systems better able to prepare for, cope with, recover from and adapt to relevant climate hazards?	Yes/no
	3. Are resilience and related indicators validated using information on the impacts of climate hazards?	Yes/no
Supportive of integration	1. Does the M&E track how well adaptation is integrated into policy and the coordination of adaptation across sectors?	Yes/no
Function 5. Assessing the impacts of adaptation on development performance		
Country-driven	1. Is development performance in key climate-sensitive areas/ sectors (that represent national development priorities/SDGs and the priorities of devolved authorities) tracked in relation to relevant climate hazards?	Yes/no
	2. Is the tracking of relevant development and climate metrics conducted by a national body (this might be a body already tasked with SDG reporting)?	Yes/no
Gender-responsive	1. Are climate-sensitive development outcomes for women and girls identified and assessed periodically/continuously?	Yes/no – if yes then how?
	2. Are development outcomes tracked using gender- and climate-sensitive development/wellbeing indicators and gender-disaggregated development wellbeing indicators?	Yes/no
Participatory and transparent	1. Are climate-sensitive development outcomes addressed and assessed in an inclusive manner, incorporating information and feedback from recipients of development and adaptation support?	Yes/no
Addressing vulnerabilities	1. Are development outcomes for the poor, marginalised and most vulnerable, and for vulnerable systems (including ecosystems), explicitly addressed and assessed?	Yes/no
	2. Are vulnerabilities addressed in a way consistent with national and sub-national development priorities, while considering the needs of the poorest, most vulnerable and marginalised?	Yes/no – if yes then how?
	3. Are context-specific indicators used to track development outcomes and wellbeing for the poorest, most vulnerable and marginalised, as well as vulnerable systems?	Yes/no – if yes then how?
Guided by best science and knowledge	1. Are the links between climate and development outcomes established using scientific and statistical approaches and information?	Yes/no
	2. Are climate data collected that capture the behaviour of the climate hazards most relevant to development outcomes?	Yes/no
	3. Are development performance/wellbeing indicators interpreted in the context of relevant climate data to assess adaptation effectiveness, using baselines and counterfactuals as relevant and appropriate?	Yes/no

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Supportive of integration	1. Do the MEL systems address the extent to which development policies consider climate-change risks and are they formulated in the light of these risks to promote adaptation and avoid maladaptation?	Yes/no
	2. Do the MEL systems address the extent to which adaptation policies support development goals and policies and achievement of SDGs?	Yes/no
Function 6. Capturing lessons and identifying good practice		
Country-driven	1. Is a national body tasked with identifying and capturing lessons on adaptation?	Yes/no
	2. Do national-level mechanisms exist to feed adaptation M&E into policy development?	Yes/no
	3. Is evidence from adaptation M&E fed into national fora?	Yes/no
Gender-responsive	1. Are gender equality and related development issues prioritised as learning themes?	Yes/no
	2. Does the analysis of indicators include a focus on what works in building the resilience and delivering good adaptation and development outcomes for women and girls?	Yes/no
	3. Are lessons identified and captured that are specific to adaptation issues related to women and girls?	Yes/no
Participatory and transparent	1. Are 'townhall meeting-style' processes held to identify key lessons at the local levels?	Yes/no
	2. Do civil-society groups and open government mechanisms capture lessons and identify good practice?	Yes/no
Addressing vulnerabilities	1. Are trends in vulnerabilities and impacts identified?	Yes/no – if yes then how?
	2. Does the analysis of indicators include a focus on what works in building the resilience and delivering good adaptation and development outcomes for particularly vulnerable locations, groups, activities, etc.?	Yes/no
Guided by best science and knowledge	1. Are good practices in vulnerability and risk assessment in different contexts identified and captured?	Yes/no
	2. Are lessons on where adaptation has (not) secured development outcomes and supported SDGs captured, based on analysis of development and climate data and relevant resilience and related indicators?	Yes/no
	3. Are knowledge gaps identified and measures to address them pursued?	Yes/no
Supportive of integration	1. Has the good practice of ensuring lessons reach policymakers and inform policy been identified?	Yes/no
	2. Are climate-change impacts on development performance results tracked?	Yes/no
Function 7. Dissemination of information and learning		
Country-driven	1. Do national agencies have the responsibility for disseminating learning and associated information?	Yes/no
	2. Have domestic mechanisms been established for directing learning into relevant processes at the national, sub-national and international level?	Yes/no
	3. Are/will the lessons identified inform reporting under Paris mechanisms?	Yes/no
	4. Is there an adequate incentive structure to reward uptake of learning?	Yes/no

ARTICLE 7 PRINCIPLE	QUESTIONS ADDRESSED BY CAMELS OR RELEVANT TO THEIR DESIGN	ANSWERS
Gender-responsive	1. Are the lessons relating to adaptation and resilience for women and girls disseminated to women and girls?	Yes/no
	2. Do women and girls receive the information they need about adaptation, in the formats in which they need it?	Yes/no
Participatory and transparent	1. Have mechanisms been established to engage stakeholders (including women and girls, the most vulnerable, marginalised groups and others) to ensure information is relevant, accessible and useful?	Yes/no
Addressing vulnerabilities	1. Are lessons related to vulnerable groups, locations and systems disseminated to the relevant stakeholders?	Yes/no
	2. Do relevant stakeholders receive the information they need, in the formats in which they need it?	Yes/no
Guided by best science and knowledge	1. Does the disseminated knowledge and learning include appropriately packaged information on climate trends, projections and risks to increase awareness and understanding of risks and adaptation needs?	Yes/no
	2. Are mechanisms in place to feed scientific information from relevant agencies (such as meteorological and hydrological services) to stakeholders and to feed locally generated information from stakeholders back to these agencies?	Yes/no
Supportive of integration	1. Have mechanisms been established to ensure relevant information and learning inform policy reviews and policymaking?	Yes/no
	2. Are lessons communicated to policymakers and planners about which adaptation actions most effectively deliver SDG outcomes in the face of climate change?	Yes/no

Current trends suggests global warming is likely to exceed 2°C by mid-century. The Paris Agreement and the 2030 deadline for meeting the SDGs provide a framework for adaptation action in the short term, but beyond that, incremental approaches will need to be complemented by transformational adaptation involving the radical restructuring, replacement or abandonment of systems, processes and practices that are no longer viable under new climatic conditions. There is an urgent need for frameworks to help countries meet their adaptation obligations under the Paris Agreement while preparing for warming that breaches the Paris temperature thresholds. Countries will need to track their adaptation activities to determine what does and does not work, identify good practice, and capture lessons that can inform adaptation planning, design and implementation. They will also need to report on these activities at the global level. We have created a framework for developing climate adaptation monitoring, evaluation and learning systems, or CAMELS, that can support countries in all of these tasks.

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