From vulnerability assessments to adaptation planning for SIDS and LDC: conceptual underpinnings and the role of science

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Abstract

Adaptation to climate change is becoming a high priority across all levels of decision making, from international agreements to local implementation. For Small Island Developing States (SIDS) and Least Developed Countries (LDC), challenges to this process are manifold, ranging from limitations in institutional and scientific capacity to a lack of financial resources. At the core of several of these challenges lies the national capacity to conduct science-based assessments of regional to local climate change vulnerability hot-spots - or rather a lack thereof.

This concept paper introduces a co-development based vulnerability assessment framework for enhancing SIDS and LDCs capacities to formulate science-based implementation strategies and to improve access to financial resources. The framework follows a step-by-step co-development approach. It is based on an iterative knowledge gap assessment of impacts and vulnerabilities across scales and sectors and the early and continuous involvement of regional experts and stakeholders through workshops taking place in the regions. In addition, the placement of scientific staff within regional organizations ensures direct scientific capacity building. The continuous stakeholder involvement is central to assessing adaptation requirements and needs, as well as potential constraints and barriers, and ensuring sustainable development.

The co-developed framework aims to contribute to overcoming various challenges, including (i) improved long-term validity of climate strategies, (ii) targeted and integrated adaptation policy with a lower risk of mal-adaptive measures and (iii) better access to international climate finance for implementation.

1. Introduction

Increases in anthropogenic greenhouse gases (GHG) emissions have already raised global average temperature by 0.85°C over the period 1880-2012 (IPCC 2014a), making some level of impact, and necessary adaptation responses, already unavoidable. In some cases, adaptation has occurred seamlessly (Kucharik 2008), but for most places and sectors, climate adaptation requires long-term planning and investment (Adger et al. 2003; Huq et al. 2004). Thus, adaptation to climate change has become a high priority across all levels of decision making, and climate finance for adaptation is a key issue debated in the international negotiations.

For Small Island Developing States (SIDS) and Least Developed Countries (LDCs), challenges to this process are manifold, ranging from limitations in institutional and scientific capacity to a lack of financial resources. These countries regroup the world's poorest and present particularly high level of vulnerability combined with high development challenges (Huq et al. 2004). Furthermore, these countries face greater level of exposure to natural hazard such as inundation and coastal erosion (e.g. small islands in the Caribbean sea and the Pacific ocean) and extreme high temperatures and droughts (e.g. semi-arid areas) and are more vulnerable to disaster (IPCC 2014a).

For less developed countries, climate adaptation and economic development are closely tied together: climate impacts and lack of adaptation could slow development progress down. In parallel, sustainable development cannot be done without integrating climate change (Agrawal & Carmen Lemos 2015). General development, disaster risk reduction and climate change adaptation should therefore be closely linked, in order to ensure a long-term increase of resilience to the range natural and climatic disasters the countries face, regardless of their cause (Ayers & Dodman 2010; Schipper 2009). While this integration is necessary in terms of implementation, there are a range of aspects that differentiate this continuum of adaptation responses (McGray et al. 2007), for example the level of decision-making and responsibilities or financial support for implementation (Mace & Schaeffer 2013). Access to international finance for implementation is in fact a real challenge for SIDS and LDC, for which the lack of scientific information and capacity to provide sufficiently robust attribution of climate change need to be urgently addressed. At the same time, access procedures and criteria or not always suited to represent the realities of the most vulnerable countries and remain subject to further improvements.

This concept paper introduces a co-development based vulnerability assessment framework for enhancing SIDS and LDCs capacities to formulate evidence-based implementation strategies. Specifically targeted to climate change adaptation, the framework aims to improve the regional science base for adaptation in SIDS and LDC, with the objectives of (i) successfully accessing international implementation finance in the near-term and (ii) ensuring adequate adaptation policy implementation that address current and long-term effects of anthropogenic climate change.

The paper first situates the assessment framework within the adaptation discourse and across levels of climate change decision-making (Sect. 2). Section 3 then outlines the main components of the framework and their objectives within the boundaries discussed in the preceding Section. A short discussion of the aims and goals as well as the limitations of the framework conclude this contribution.

2. Adaptation to climate change in the context of development

Societies have always been affected by impacts of climate events and coping strategies have been developed. Adaptation is thus not a new phenomenon, but has been on-going in autonomous as well as anticipatory manner for a long time (Smit et al. 2000). In addition to climatic events, other natural disasters occur, which often require similar responses or can be addressed within a common framework. Anthropogenic climate change and its direct and indirect impacts thus do not act in isolation, but add on to the effects of existing climatic variability and change as well as other natural hazards (Schipper 2009).

The following paragraphs provide a short overview of some important considerations to distinguish between the different aspects of coping with climatic impacts in order to situate the developed framework within the continuum of responses.

2.1. The adaptation continuum

Initially brought forward by McGray et al. (2007), the 'adaptation continuum' has been widely used to structure the range of adaptation responses and strategies along a continuum between those more oriented towards addressing local and immediate development worries to those strategically addressing long term potential human-environmental system threats. Figure 1 provides an adapted version of the concept outline: the four middle boxes contain the core of the initial concept, embedded into some additional considerations. Adaptation option towards the left side of the spectrum targets activities focusing on the improvement of socio-economic and livelihood conditions, such as poverty reduction. Such measures have a great potential to increase adaptive capacity and thus reduce the negative effects of climate impacts, however they are not necessarily related to climate directly. Towards the right end of the spectrum, activities specifically target activities confronting impacts of climate change. Such activities thus require a specific attribution of climate impacts to anthropogenic climate change.

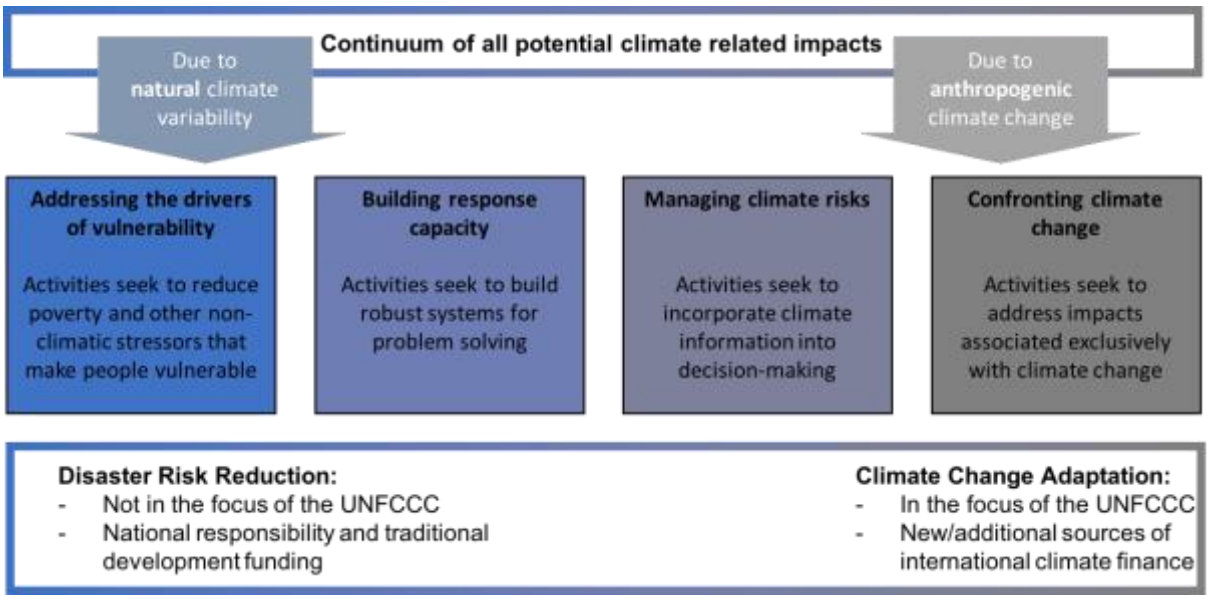

Figure 1: The adaptation continuum, adapted from McGray et al. (2007); Remling & Persson (2015)

While an integrated approach to addressing the multiple drivers of vulnerability to climate impacts, ranging from development to targeted climate change adaptation, is clearly important, there are several reasons why the distinction between different types of activity is relevant to the overall adaptation process. To further put these different adaptation activities into the context of recent UNFCCC developments, we illustrate in Figure 1 the climate drivers and associated adaptation response (top box), along with the overall policy context of responses as they relate to international processes: namely Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA). Following Remling & Persson (2015),

we also exemplify how the different activities are related to different sources of (international) funding (Fig. 1).

2.2. Climate change adaptation and disaster risk reduction

Following the definition of the IPCC (2014b), *adaptation* can be described as "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities" (IPCC 2014b). In order to further refine this definition and to distinguish between adaptation to natural climate impacts and adaptation to anthropogenic climate change, the IPCC further speaks of the *adaptation deficit*, which describes "the gap between the current state of a system and a state that minimizes adverse impacts from existing climate conditions and variability" (IPCC 2014b). Following this definition, adaptation thus follows the identification of a specific (future) climatic stressor, that the adaptation measure seeks to moderate.

Disaster risk reduction, on the other hand is aimed at "preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development" (UNISDR 2009).

As indicated in the previous paragraph, CCA and DRR are complementary approaches in practice and measures on the ground need to be integrated. However, there are also some important differences between the two. Amongst those are (i) attribution of causes of impacts and stressors, (ii) responsibilities for responding to those stressors and (iii) available funding mechanisms and sources to support the implementation of response measures. While Article 2 of the UNFCCC (UNFCCC 1992) implicitly recognizes the international responsibility to support CCA, DRR is of national responsibility and domestic preparedness for disasters is encouraged (Mace & Schaeffer 2013). Consequently, the UNFCCC acknowledges the importance of the international community to support CCA for the most vulnerable and climate finance and provision of financial support are important components of the international climate negotiations and agreements (see e.g. UNFCCC 2015; UNFCCC 2010).

To distinguish CCA from DRR – in other words, to identify adaptation options, which qualify as options to specifically *confront climate change* - attribution of climate impacts to their anthropogenic cause is important. International climate finance, such as resources made available through the Green Climate Fund, specifically target these kinds of measures and require climate change attribution for successful project funding (Green Climate Fund 2015). These additional and new sources of finance will be an essential building block in achieving longer-term resilient and sustainable development. One of the main impediments for SIDS and LDC at present is the lack of scientific information and capacity to provide sufficiently robust attribution of climate change.

3. Improving scientific evidence for climate change adaptation planning: the IMPACT vulnerability and adaptation framework

In order to improve scientific evidence in SIDS and LDCs in the context of planning for climate change adaptation and to support access to international climate finance for adaptation, the IMPACT project, which focus on the Caribbean and Pacific SIDS and West

Africa, aims to improve regional scientific capacities through the co-development of tools, targeted to the regional needs and realities[1].

The concept of the IMPACT vulnerability and adaptation framework focusses on national to regional capacity building with regard to developing national adaptation plans that are in line with regional development priorities as well as with international requirements to access climate finance mechanisms. It thus aims to reconcile requirements of adaptation situated in the right part of the adaptation continuum (Fig. 1) with other planning and implementation objectives. Nonetheless, the framework targets the emerging international climate finance architecture in that it (i) aims to support stakeholders in more successfully accessing financial support for their adaptation strategies and (ii) identifying improvements of the international funding mechanisms in order to make them more applicable to the implementation realities on the ground.

A central element of the proposed framework is its co-development structure, combining conceptual and empirical knowledge with continuous input and guidance from stakeholders and experts involved in adaptation planning and implementation in SIDS and LDC regions. A strong link with the international climate negotiations process as well as the Green Climate Fund (GCF) board is required in order to ensure the envisaged outcome remains relevant in the context of the international process.

In addition, the framework ties in closely with existing information, tools and approaches available across the regions. In parallel to the conceptual framework, regionally-specific and globally-linked databases are being developed, which identify available information of all framework components, but also major gaps in data and information. The differentiated set-up across regions, linked through an overarching global umbrella, facilitates a better exchange of data and information across the most vulnerable regions (for details on the envisaged database structure please see Lissner et al. 2017).

3.1. Structure of the framework

The framework follows a step-by-step co-development approach (Lissner et al. 2017). It is based on an iterative knowledge gap assessment of impacts and vulnerabilities across scales and sectors and the early and continuous involvement of regional experts and stakeholders through workshops taking place in the regions. The IMPACT project is an international project, working with regional partner institutions in the Caribbean and Pacific SIDS and in West Africa. It is thus well placed to incorporate regional priorities and ensure a mutual learning process. In addition, the placement of scientific staffs within regional organizations ensures direct scientific capacity building and integration of scientific development across regions. Furthermore, the continuous stakeholder involvement is central to assessing adaptation requirements and needs, as well as to identifying potential constraints and barriers, and ensuring sustainable development. The proposed framework is structured along four main conceptual clusters, embedded within a co-development structure (Fig. 2).

[1] https://www.international-climate-initiative.com/en/projects/projects/details/impact-495/?no_cache=1?b=2,0,0,0,0,1&kw=Science-based

3.1.1. Biophysical impacts and attribution of climate change

The IMPACT framework specifically aims to improve the scientific basis for climate change adaptation. Attribution of climate impacts to climate change is thus a crucial component of the framework. Due to various reasons outlined below, SIDS and LDC are often inadequately represented in climate models and climate impact modeling assessments. Firstly, in the case of SIDS, for example, these are by definition small in land mass thus the current resolution of global and regional climate models are often unable to represent the governing climatic mechanisms in these regions (Australian Bureau of Meteorology and CSIRO 2014). Secondly, current generations of climate impacts models overlook LDCs and SIDS due to the lack of data for validation of these tools in the regions. Thirdly, impacts models may not adequately represent specificity of SIDS and LDCs, such as crop types and cropping systems in the case of crop models (Waha et al. 2015).

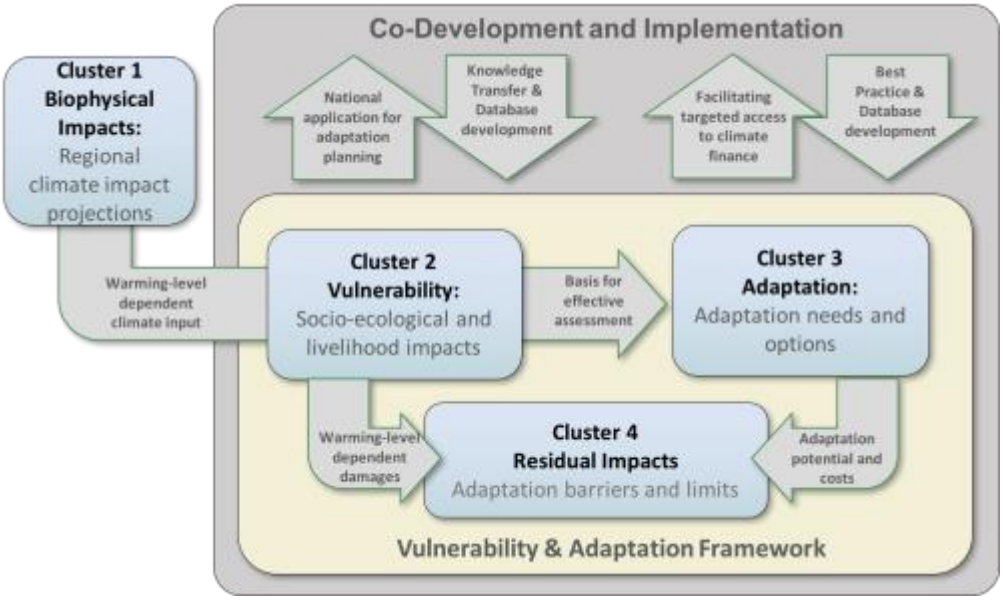

Figure 2: Overview of conceptual clusters of the assessment framework, their relationships and nesting within the co-development structure

Improvements of climate model projections in SIDS and LDCs will improve attribution evidence. These include projected changes in key climate variables as well as targeted approaches to improve the knowledge base for biophysical impacts, especially in the area of agricultural production.

3.1.2. Socio-ecological impacts and vulnerability

Climatic risks do not translate directly to socio-economic vulnerabilities, but interact in numerous ways with local vulnerability and exposure. To identify regionally specific adaptation needs and costs, also with regard to different trajectories of climate change, an integrated socio-ecological assessment module allows linking climate change signals to livelihood realities as a prerequisite to identify adaptation potentials and costs.
The socio-ecological impact module focusses on understanding the pathways by which biophysical climate impacts, such as changes in water availability or yield changes impact

socio-ecological systems. Such impact pathways can differ substantially across regions as well as sectors.

Often, impact assessments focus on the sectorial level. However, the most vulnerable groups are often not well represented in such an approach, as their livelihoods act outside of common sectoral boundaries. The framework therefore aims to explicitly incorporate livelihood specific impact-pathways, which are relevant for SIDS and LDC. Linking to the assessment of warming-level dependent climate impacts, this includes also an improved understanding of what such different temperature levels entail for socio-ecological systems and impacts. The anticipated outcome of this conceptual cluster identifies impact hot-spots within the context of the regionally specific setting in order to identify priority areas and directions for adaptation.

3.1.3. Adaptation needs and strategies

The identification of regionally and locally specific adaptation options, focusing on confronting climate change as outlined in Figure 1, requires a profound understanding of climate projections, as identified in Cluster 1, but also a good understanding of the prevailing socio-economic conditions and consequent climate change vulnerability (Cluster 2). As climate change adaptation needs to be integrated into the wider development realities and priorities, it also requires an understanding of the regional development priorities and adaptive capacities, informed by regional experts. Cluster 3 of the framework therefore requires the engagement of regional stakeholders and decision-makers to bring together the 'top-down' modeling information with 'bottom-up' regional priorities and realities. This cluster initially focusses on the identification of adaptation options and costs in-line with stakeholder development priorities. In further iterative steps, it assesses the warming-level dependent vulnerability reduction and adaptation potential of regionally devised adaptation strategies and options, to channel output towards concrete solutions on a country level. Such information can provide important input, e.g. for in-country NAP processes or the development of adaptation investment plans.

As an essential component to facilitate access to international climate finance, this cluster focusses on the identification of concrete measures and strategies, in-line with country priorities and based on robust information on projected changes in climate, biophysical impacts and socio-ecological vulnerability.

3.1.4. Limits and barriers for adaptation: residual impacts

While improving the science-base about risks, vulnerability and adaptation options and strategies is an important step towards developing climate change adaptation strategies and this increasing resilience to climate change, it is also clear that with accelerating climate change countries also face limits and barriers to adaptation. There are therefore residual impacts that countries are likely to face, which cannot or have not been avoided. In the context of the UNFCCC, these residual impacts are referred to as Loss and Damage. A range of factors that can hinder adaptation have been identified, including: *adaptation constraints*, where options would be available but are not being implemented; *soft adaptation limits*, where given objectives cannot be protected, or if their protection would require an unacceptable effort; *hard adaptation limits*, where no adaptive actions are possible to avoid

intolerable risks (all definitions based on IPCC, 2014b). Some of these limits may change over time, context and region, while other physical limits are likely to be fixed.
Based on the analysis steps of Clusters 1 through 3, Cluster 4 focusses on understanding the potential for regional Loss & Damage based on the assessment of warming level dependent impacts and regional adaptation potentials.

While the overall focus of the presented framework is on the regional level (Pacific and Caribbean SIDS, West African LDCs), the framework aims to be applicable especially for strategy development at the national level. However, for most of the framework components, the linkages between (i) global, regional and national as well as between (ii) national, local and household level need to be accounted for.

4. Discussion and Conclusions

Coping with climate change has many dimensions across many levels. Integrative strategies are essential in order to cope with the fundamental challenges that countries, especially in the vulnerable SIDS and LDCs, face. Understanding the full chain from mitigation-related temperature pathways to warming-level dependent biophysical and societal impacts, their interactions with the socio-ecological sphere within countries and across scales are an important step towards increasing resilience and shifting towards sustainable development patterns.

The framework outlined in this paper ties into this overall analysis chain by incorporating several different viewpoints and providing entry-points for linking the inputs and outputs of the analysis to the other important pieces of the puzzle. Nonetheless, the framework clearly focusses on one central aspect: the improvement of scientific evidence for SIDS and LDCs to confront, and when possible avoid, the negative impacts of climate change through science-based adaptation strategy development. With a view on the importance of finance to facilitate implementation, the framework closely ties to the access criteria of international climate finance, such as the GCF.

Of course, within the continuum of adaptation and the responses needed to increase resilience to natural and climatic disaster, this type of adaptation only provides part of the picture. Therefore, a close integration of climate-focussed adaptation into existing and planned development strategies and priorities as well as other disaster risk management strategies is essential. This also holds for the dimension of climate finance: international agencies, such as the GCF, provide only a small building block of support to resilience building and sustainable development, targeted specifically at impacts attributable to climate change.

Finally, the Sustainable Development Goals (SDGs) illustrate the many dimensions, which would ideally be taken into account to embark on more sustainable development pathways. They provide an excellent starting point to facilitate and track the integration of policies related to building resilience across scales and across causes with a view to contributing to a transition towards sustainability.

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