WORKING PAPER

Exploring the role of climate science in supporting long-term adaptation and decision-making in sub-Saharan Africa

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Introduction

Africa faces considerable challenges in adapting to the long-term impacts of climate change. Policy-makers not only have to contend with projected changes to the region's climate, but also high vulnerability to existing climate variability and low levels of adaptive capacity in many countries and communities. Each of these factors is exacerbated by the complex interaction of wider social, economic, cultural and environmental drivers that affect the continent.[1] Added to this, uncertainties in our ability to understand and simulate localised changes in the climate, as well as large gaps in climate observation networks, further confound the decision-making process.

Ensuring that policy-makers are able to respond to the medium- and long-term implications of climate change is important in promoting climate-resilient development. Despite the inherent uncertainties that are associated with it, climate science can support planners in making informed decisions on future investments aimed at optimising the use of scarce resources available to developing country governments and subnational entities. Yet there is a lack of evidence for – and detailed understanding of – gaps in the uptake of science for long-term strategies for climate-resilient development, particularly for sub-Saharan Africa.

In helping to overcome these barriers, this report synthesises two inputs:

1. a review of articles and 'grey' (unpublished) literature on knowledge gaps and areas needed to support the capacity of African decision-makers

2. two regional activities: a workshop in London that brought together UK- and Africa-based experts working on climate science and adaptation in Africa; and a side-event to the Africa Climate Change Conference 2013 in Arusha, Tanzania, that gathered together regional scientists and practitioners, and consolidated gaps and priority activities for enhancing the uptake of science in decision-making.

The report is compiled in the context of consultative exercises to identify key gaps in science and capacity to feed into the scoping phase of the Future Climate For Africa (FCFA) programme. This initiative seeks to advance the scientific understanding of the sub-Saharan African climate on decadal timescales and, working with African stakeholders, use this science to inform long-term climate-resilient development strategies.

1. Context and learning

Climate information can be an important tool in supporting climate-resilient development in the long term.[2] Yet, who receives this information? And how is it used to inform development policy and practice?

Box 1 highlights short illustrative profiles and informational needs of three relevant regional actors that make use of long-term climate information.[3] The collection of roles, responsibilities and needs underscores the heterogeneity of i) different users (whether scientists, technical advisors or policy-makers themselves) that make use of long-term climate, and ii) actors who influence long-term development planning in sub-Saharan Africa. However, use and uptake of climate information and services to inform long-term policy-making remains relatively limited both at national and subnational levels.[4,5] Insights from both published academic and grey literature reveal a number of clear barriers, described below.

While our understanding of the drivers of African climate is improving, the climate of many parts of Africa is far from fully understood.[6] Many of the complex land-ocean-atmosphere interactions and feedbacks are poorly captured by climate models, and a number of discrepancies between observations and projections exist. There is also systematic bias in the simulation of African climate across many climate models. Examples of these can be seen in excessive projection of rainfall in Southern Africa, a southward displacement of the Atlantic Inter-Tropical Convergence Zone,[7] as well as discrepancies between modelled and observed trends in rainfall over Eastern Africa.

Inevitably, biases and discrepancies in model simulation translate into greater uncertainties in projecting climate impacts across the continent. Ziervogel and Zermoglio[9] point out that gaps in understanding of African climate impacts are also created by over-reliance on outputs from single models, creating the risk of unsubstantiated, or at best sub-optimal, inferences. Part of the challenge is that resources for research and capacity building address immediate challenges such as poverty alleviation, food security and health.

Box 1. Who influences long-term policy decisions?

Director of National Metorological Service, Agence Nationale de la Météorologie du Sénégal, Senegal

Senegal, along with neighbouring countries, is subject to Sahelian climate variability and change, the trends of which have yet to be fully elucidated. It is currently unclear whether the region will be wetter or drier in the long term, although what is clear is that climate change is likely to lead to more drought, flooding and other disasters. Continuous data in the region are rare, with politically unstable countries including Chad, Sudan and more recently Mali losing valuable climate observations.

Improved technology and capacity for producing and using climate information are required. National and local governments need clearer and more useful climate information to prepare for the future. The Agence Nationale de la Météorologie du Sénégal (ANMS) and other meteorological agencies across Africa can be assisted to understand the information needs of the most vulnerable groups in society, sharing learning and knowledge for better decision-making. ANMS' head of climate and society notes, "information on decadal timescales can help with long-term planning. With our limited resources we need to plan carefully. Having an idea on what will happen in 10 years or so will help to better develop a long-term plan."[8]

Planning Officer, Ministry of Finance and Economic Development, Sierra Leone

While policies are formulated at the national level, they are implemented locally. Planning officers can benefit from climate information on provincial scales, for instance. In making decisions about funding allocations, information need not be perfect. Planners typically operate on five-year timescales. As such, key decisions are not necessarily made with consideration of climate change risks and impacts beyond these time horizons.

It is important that climate information is made available in a timely and meaningful manner if it is to be used to inform planning decisions. Ultimately, a planning officer needs to make the case for funding allocations and the required information must be communicated so as to allow the costs and benefits of alternative policies and plans to be assessed.

In particular, planners need information on current climate trends as well as projections. Provision of information at suitable scales on the climate-related risks in different sectors and the vulnerabilities of communities and economic assets is key to influencing planning policy and decision-making. For example, understanding the impact on equity between different groups will be of more use to a planner than the impact on gross domestic product. Integrated modelling of impacts offers a means of meeting this challenge and will enable decisions to be made with possible adaptation measures in mind.

Deputy Secretary General, East African Community (Burundi, Kenya, Rwanda, Tanzania and Uganda)

One of several long-term plans of the East African Community (EAC) aims to expand and improve the existing rail network over the next 10 to 20 years – at an estimated cost of up to US$30 billion – to increase capacity for long-distance freight between urban centres and seaports like Mombasa, Dar es Salaam and Tanga. The EAC also plans new energy infrastructure, including cross-border electrification, to scale up poverty reduction.

In implementing these plans, the EAC will require information on climate and sea level change, but while there is also a climate plan incorporating adaptation, mitigation, technology and capacity, there are challenges to overcome. Data processing and forecasting facilities in partner states are inadequate for timely and accurate forecasts and early-warning systems. Improved data rescue, capacity building and regional prediction and modelling, including Ensemble Prediction Systems, have been identified as priorities by the EAC's meteorology department.

Capacity for scenario modelling and analysing climate information for policy development and implementation is another challenge. The FCFA aims to address these specific gaps.

Of particular importance in the EAC region is resolving the apparent contradiction between predicted wetting over East Africa versus observed drying in recent decades. Decadal projections are an area of uncertainty in this region, and it will be important to understand remote drivers such as El Niño Southern Oscillation (ENSO), as well as local and regional drivers such as change in land use. Different climate futures have significant implications for the costs and benefits of delivering infrastructure plans across the EAC.

Note: Anonymised profiles are based on accounts of professional roles and user needs delivered through personal communication to the authors and wider engagements during the FCFA scoping activities.

One of the biggest challenges in supporting African-focused – and African-led – climate knowledge is limited capacity to conduct climate modelling (data generation and assessment), with few universities or qualified scientists capable of interpreting and applying model outputs relative to other regions.[10] However, the problem not only relates to the generation of new data, but also to ensuring that (as much as possible) research is relevant. Uptake of climate science relies on scientists' understanding of the information needs of different user groups, so their output can be effectively targeted.

There are a number of gaps that hinder the integration of science and decision-making, with communication being among the most prominent. While improvements in the ability to model African climate are being made,

the ability to communicate this science remains poor: messages are often contradictory and unsuitable for informing adaptation.[11]

Part of the problem is that capacity to tailor information to decisions is limited.[12] Policy-makers often request quick and certain answers, such as what are the temperature and rainfall profiles for a small town or district in the 2050s? These are simply not available, nor are they likely to be in the near future (if ever). Rather, more needs to be done to inform decision-makers on how to use, and make decisions based upon, the available science and its limitations.

The need for medium- and long-term climate information to support climate-resilient development planning in Africa is clear. This is most easily exemplified by the recent but ongoing push by African countries to generate long-term strategies for 'green growth' and other variants such as climate-compatible development, low-carbon development and climate-resilient growth.[13] Ethiopia's Climate Resilient Green Growth plan and Rwanda's Green Growth and Climate Resilience Strategy stand out as two recent high-profile initiatives, along with Kenya's Vision 2030.

Each of these requires considerable scientific and technical inputs, particularly with regards to the direction and amplitude of key climate and development trends. To date, the uptake of scientific inputs in many of these strategic documents has been relatively weak, and with heavy reliance on external consultants and science providers from outside of Africa.[14]

Access to climate science and an absence of consensus between decision-makers and practitioners also hinders collaboration. Only a few tools and portals provide climate change information that is tailored and communicated specifically to decision-makers;[15] little work is conducted on the interface between climate scientists and decision-makers.

2. Proceedings and outcomes of the FCFA consultative workshops

Alongside the literature review, we present discussions and findings from the two consultative events in London and Arusha, which explored opinions and perspectives from scientists, government representatives, and civil society and non-governmental organisation practitioners. They aimed to understand how science is taken up in the medium term and to make recommendations for overcoming barriers. Outcomes are discussed below.

2.1 The London workshop

A London workshop took place from 30 September to 1 October 2013 to explore the research priorities for FCFA and to provide climate information to support adaptation in Africa. The event was convened at the Wellcome Trust jointly by CDKN, the UK Department for International Development (DFID), the Natural Environment Research Council and the UK Collaborative on Development Sciences. The objectives were to:

- address how we can better use current information to inform decisions
- ask how research can enhance the usefulness of current information over the next five years
- look at opportunities to underpin research and model development
- decide what activities can help to integrate science into real decisions.

Findings fed directly into a subsequent regional consultation held in Arusha, Tanzania.

Structure

The workshop brought together over 60 leading climate scientists, adaptation and knowledge exchange experts, and practitioners in discussing how to make climate science more applicable to long-term decision-making. It incorporated lively panel discussions on potential entry points for FCFA, breakout sessions, showcase sessions on practical tools for bringing scientists and policy-makers together, and panels aligning the objectives, interests and incentives of climate scientists and policy-makers in promoting adaptation in sub-Saharan Africa.

Overall, the workshop saw consensus on the following key points:

- Information must be specific to the needs of users, with decision-making tools embedded in the process from the beginning.

- Involvement and interaction, from farmer to government, must be improved.
- Climate change must be understood in terms of its effect on vulnerability through health, water resources and food security.

Deliberations and outcomes

Participants agreed that actions to mitigate and adapt to climate change need to be embedded in national planning, and centralised with a firm understanding of the limitations of climate information and the importance of making decisions on decadal timescales. There was consensus regarding the advantages of introducing scientists into key ministries such as finance and development, and creating PhD fellowships to increase scientific capacity and impact. One suggestion was the adoption of a network of chief scientific advisers, such as those seen in the United Kingdom, the United States and New Zealand.

This has to some extent been replicated in Rwanda, where the science minister has been placed directly within the President's office with a view to informing cross-sectoral issues.[16] Though senior scientific advisers may not be the most relevant model in all African contexts, improving the uptake of scientific advice and links between science and policy is greatly needed. At present, many African governments leave the task of assembling scientific information and advice to national science agencies and ministries – which are often lacking in political influence, poorly resourced, and focused only on improving capacities within universities.

Practical sessions in the workshop focused on how to bring scientists and policy-makers together to discuss how to engage with non-scientists. Improving relations between scientists and policy-makers would allow scientists to share knowledge and policy-makers to understand climate information; climate scientists could also understand what outputs are useful and how they can be tailored for policy-makers.

There was simultaneously a call for greater understanding of the economic and social impacts of climate change and vulnerability, and for an acceptance of uncertainty at regional levels so that planning is framed by socioeconomics. The need to adapt the way that current projections are presented to take into account the changing character of end users' needs over time was also addressed. And participants emphasised that extreme weather events were not the only issue; gradual changes that push people towards the margins should be considered.

Participants also considered the barrier to accessing data faced by Africa, and how to improve the legal framework for organisations and individuals. This was seen as a funding issue – to improve hardware or promote research, for example – and the question of data withheld in-country. Users would benefit from raw data being accompanied by relevant background. Encouraging a bottom-up approach to using data would allow it to be combined with local knowledge.

2.2 The Arusha workshop

To complement the London workshop, FCFA convened a side-event at the Africa Climate Change Conference in Tanzania on the 17 October 2013, with roughly 80 participants from various disciplinary backgrounds.

Structure

The side event sought to encourage debate, with a series of short position statements and plenary discussion. Six panellists each presented one key idea on the use and uptake of climate information for adaptation over the next 10–40 years. Presentations were kept short, lasting a maximum of two minutes. Participants were then asked to provide their own opinions and inputs through a group exercises. In teams of six to eight, they suggested key opportunities before ideas were fed back to the group.

Deliberations and outcomes

The aim of the Arusha workshop was to engage with African researchers and African-led research priorities in setting the agenda for future climate science and uptake of climate services. Participants agreed that the decision-making process should span international, national, local/village and individual levels, and asked whether there was a potential to introduce climate science and impacts into primary education. The role of the private sector was also considered.

Decision-making under uncertainty and planning for potential thresholds was discussed in line with the measures that must be taken to avoid maladaption.

To explore the management and sharing of future resources, participants sought to improve communication of longer timescales to build trust and understanding with users, and called for a focus on how to link climate services with users through interactive dialogue. To promote innovation and adaption, there should be support for 'communities of practice' – multidisciplinary and multi-stakeholder knowledge – with effective partnerships between institutions to overcome the gap between science and users.

One example of this can be seen in the online portal: www.weadapt.org. The initiative aims to bring together adaptation, climate science and policy-making actors with easy descriptions of ongoing adaptation activities and climate information, through its Climate Information Portal (developed in partnership with the University of Cape Town's Climate Systems Analysis Group).

3. Gaps in the uptake of climate information for long-term decision-making

Obstacles to the accessing of robust climate information relevant to decision-making are grouped into the fields of 'knowledge' and 'capacity' in the following sections, drawing on inputs from the both the literature review and FCFA scoping workshops:

3.1 Knowledge gaps

Gaps in observational data

A network of observations for Africa's climate is necessary for research and decision-making, but is in relative decline across many areas. In some locations, time-series data have been disrupted by natural disasters and conflict. Across Africa, there are many untapped historical sources of data that can and should be recovered and digitised for climate services. While funding and capacity constraints are an issue, lack of national and international leadership are the main causes of the decline of Africa's observatories; targeted investment could significantly enhance them.

An inability to access data is also a significant barrier to improving the uptake of climate information and services, as highlighted in both the workshops and the literature. A number of African meteorological agencies are reluctant to make data freely available. Where they are available, much data are only present in raw format, often requiring personnel with the right skills and training to turn them into useful information.[17]

One interesting opportunity is the potential role of the private sector. Though it is clear that open access to data is necessary, the private sector can play a role not only in helping to enhance observational networks, but also in providing and communicating projections of future climate change and its various impacts. For example, many companies take freely available climate information and provide 'pass-through' sites that allow for more user-friendly access and formats than standard weather-data sites.[18] Further partnerships with other partners such as the insurance industry, with many common interests in expanding data networks, may also be worth exploring.

Uncertainty in projections

Model projections are currently available at relatively low resolutions. For example, most general circulation models (GCM), such as those used in the Coupled Model Intercomparison Project Phase 5 (CMIP5), generally operate at a horizontal resolution of 100 km or greater. While coarse resolution is useful in exploring longer-term feedbacks, understanding localised impacts, trends in extreme events and better projections on decadal timescale will require downscaling of GCMs to resolutions in the region of 25–50 km.

Simulations at these finer scales will allow the means, variability and extremes of land-ocean-atmosphere feedbacks to be better understood, as well as the sensitivity of these to external perturbations. These are also the geographical scales of interest to decision-makers; such climate information on regional or country levels will probably increase uptake in policy processes. Much research is already underway to produce it, but the time and resources involved should not be underestimated and the challenge will be to focus efforts on the geographical areas and processes that count.

There are several regions of Africa, notably East Africa and the Sahel, where large uncertainties exist in climate projections on decadal timescales. While uncertainty is a fact of life when dealing with climate projections on these time horizons, recent discrepancies between observed drying and wetting projected by models require further investigation.

To resolve these apparent contradictions, methodologies are required to identify robust climate signals and improve understanding of remote drivers like the El Niño–Southern Oscillation (ENSO), and local and regional drivers such as change of land use. Improved model resolution in representing these drivers and processes is part of the solution, as is filling in the gaps in observational data so trends can be understood and extrapolated from.

Prediction of rainfall patterns is of particular interest to decision-makers in African countries that are dependent on natural resources, agriculture and tourism. It is the distribution and variability of rainfall that is at the core of the uncertainty between observed and modelled trends for East Africa and the Sahel. Convection modelling can improve understanding of weather and climate systems, influencing areas of Africa on scales ranging from tens to thousands of kilometres, including storm systems.

Impacts and vulnerability

The probable impacts of climate change on people's lives and assets also need to be clearer. To date, impacts assessments have been largely limited to particular sectors of interest and geographically localised. There is a need for more and improved integrated impact assessments, coupled with available climate models, to gain a holistic understanding of the climate risks to adaptation. National decision-makers need information at times and on spatial scales important to them – about population groups exposed to disaster risks and disease vectors, for example, or sectors like agriculture and tourism, or natural resources like fisheries affected by rising sea levels.

As well as socioeconomic impacts, improving existing models with biophysical models representing soil, hydrological and vegetation can improve the assessment of human-environmental interaction, including land use. Models of river basins such as Hydromet can be coupled with climate models to better understand the interactions between ENSO and rainfall. This provides insights into flooding, groundwater and water availability, and has implications for water security, infrastructure and crops.

Decision-makers need case studies where climate science has proved critical, allowing them to build the case for investment in mitigation and adaption. The evidence base for the costs and benefits of mitigating or adapting to climate change is relatively weak. Where tangible examples are lacking, cost–benefit analyses of climate-related decisions will allow a range of planning options and development scenarios to be explored.

3.2 Capacity gaps

Ability to generate and interpret climate information in Africa

The development and refinement of climate models, including those relevant to assessing the African climate, typically take place in international centres outside Africa. Though partnerships with external data centres exist across Africa, they are limited in their ability to support national meteorological services in Africa.

Internationally-renowned centres for climate analysis and modelling do exist in Africa, such the University of Cape Town's Climate Systems Analysis Group (CSAG). However, most are found in South Africa, as well as a few isolated regional centres – like the Africa Centre for Meteorological Applications for Development in West Africa and the IGAD Climate Prediction and Application Centre in East Africa.

Making decisions under uncertainty

The exact nature of future climate change will never be certain. Gaps exist in how to incorporate and use data in decision-making while recognising different sources of uncertainty. Projections at the local, subnational and national levels are generally more uncertain than global projections[19] and present critical gaps in understanding. Reluctance to acknowledge uncertainty limits the ability to analyse the African climate and how best to frame adaptation.

Climate science and information needs to be communicated to users at the appropriate time. This is a prerequisite for effective medium-term adaptation strategies. Various barriers and challenges currently divide scientists and end-users. Climate information is produced in various formats and on different scales, and it is important to marry data and models with the right scenarios.

The starting point for the tailoring and communicating climate data to widely different users – from subsistence farmers to policy-makers and planners of infrastructure – is some awareness of the key research or policy questions involved. This will guide interpretation of the results. As the number of end-users of climate data grows and they become increasingly diverse, climate science must be helped to fulfil its potential in terms of impact on the ground.

4. Recommendations for addressing knowledge and capacity gaps in Africa

This chapter makes recommendations for the uptake of science for informing long-term decisions on climate resilience. Three priority areas are presented in the following sections.

4.1 Generating new knowledge and promoting African-led science and scientific capacity

Plenty of big questions remain regarding the extent and impact of climate change in Africa, such as those highlighted in Chapter 3. What is clear is that knowledge gaps span a considerable range of subject disciplines: discrepancies between observations and model outputs; outputs that simulate regional climates at scales relevant to decision-makers (below a 25 km resolution); and estimates of local economic impacts of climate change.

Each of these requires an advance in current knowledge. Recent developments such as improved representation of tropical convection in weather and climate models are promising, and continued funding of basic science will remain key. Many of these will have few obvious links to policy, despite their invaluable contribution to understanding regional climates.

Investment and activities aiming to enhance the uptake of science in Africa should above all be African-led as far as possible, responding to the demands of African policy-makers and drawing on African scientific establishments. In practice, the current lack of an ‘infrastructure of collaboration’ should be addressed through multidisciplinary platforms and digital infrastructure to allow institutions to store climate-related data and share knowledge. This would require better computational power to expand existing databases or support new ones.

More needs to be done to understand the limits of applying climate information to national planning. Resources are required to support young scientists, providing employment opportunities to encourage their involvement in the development of climate data in Africa. Where gaps in scientific capacity exist, strategic partnerships with the international community are needed.

An example of this can be seen in CORDEX Africa – the Coordinated Regional Downscaling Experiment in Africa – an initiative launched under the World Climate Research Programme to advance knowledge of regional responses to climate change and feed it into research and policy. CORDEX also engages in training, outreach and communications.

Capitalising on its success, opportunities may exist to expand similar collaborative arrangements in related scientific fields, such as refining the economics of adaptation and multidisciplinary research on drivers of vulnerability.

4.2 Promoting better use and uptake of existing research

While the generation of new information and knowledge is key, much can be done to make better use of existing research for Africa. Though Africa lags behind Europe and North America in terms of the quality and availability of climate data and research capacity, there is a wealth of knowledge and information that has yet to reach the policy sphere. In recognising this shortfall, efforts to promote more effective use of climate information in African decision-making can contribute through prioritising two actions:

Better translation of existing research

Many African governments lack the technical capacity and staff to interpret the latest climate information and make it relevant to policy. Support in improving the dissemination and communication of climate information is needed, for example through translating academic outputs into short non-technical and palatable formats, or direct technical support from scientific intermediaries.

Improving the effectiveness of the science-policy interface

Identifying the in-country demand for information and the needs of different user-groups is required to design the format and channels for outputs to be accurately targeted. More must be done to shift users' needs by considering gradual changes in the climate that push people towards poverty.

Another key area will be mobilising scientific knowledge for policy. This is particularly relevant in the context of medium- to long-term decisions when the danger of maladaptation is most apparent, particularly in the context of large transformational policies.

4.3 Maximising value added

There is enormous scope for filling the gaps in science to ensure information on medium-term climate change is integrated into decision-making. It requires concerted action by academic institutions, private companies, civil society, governments and boundary organisations. Scoping for FCFA points to two recommendations:

Leverage influential stakeholders

Responsibility for adaptation within developing country governments has, to date, predominantly rested with environment or natural resources ministries. While this might seem like a natural fit, they are typically weak and lack the power of more influential ministries. The result is that climate change has received scant attention within the policy documents that matter most: national development plans and sectoral strategies.

Engaging powerful finance and development ministries in embedding adaptation and flexible forward-looking decision-making into longer-term development plans will be crucial to the delivery of meaningful adaptation.[20]

Care should be taken to ensure that research and capacity building provide input to policy that can deliver real, even transformational, change. In practice, this means research tailored for policy should accommodate complex national and regional governance structures.

It also means that activities should be, where relevant, demand-led. For example, policy-makers and technical officials can be engaged in research itself, identifying the scope of research questions and making suggestions for design and delivery. Above all, if meaningful change is to be realised, research and capacity-building must be linked to national planning.

Communicate to stakeholders

A common barrier identified across each of the report's consultative inputs (workshops, scientific literature and CDKN experience) is the breakdown of communication and engagement across different stakeholders. Communities of practice often act in silos, whether in academia, government or civil society, with implications for the transfer of knowledge between different groups. Reasons for this are numerous, involving differences in incentives, priorities and language.[21]

It is here that FCFA and other activities like it may be able add tremendous value in drawing on the experience of DFID and CDKN in bringing together different stakeholders from across academia, civil society, government and the private sector. A number of tools and approaches can be used in facilitating meaningful two-way engagement and learning. For example, serious games, learning dialogues and participatory planning of scenarios are just some of the activities that might promote communication between stakeholders.

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About CDKN

The Climate and Development Knowledge Network (CDKN) aims to help decision-makers in developing countries design and deliver climate compatible development. We do this by providing demand-led research and technical assistance, and channelling the best available knowledge on climate change and development to support policy processes at country and international level. CDKN is managed by an alliance of six organisations that brings together a wide range of expertise and experience.

About ODI

The Overseas Development Institute (ODI) is the UK's leading independent think tank on international development and humanitarian issues..

About SouthSouthNorth

SouthSouthNorth finds evidence-based, locally tailored solutions to climate and development challenges in partnership with leading organisations. SouthSouthNorth contributes to global knowledge in order to achieve climate compatible development in practice.

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