

Report

Investing for sustainable climate services: insights from African experience

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Cover photo: The High Impact Weather Lake System (HIGHWAY) project has developed regular weather forecasts and severe weather warnings for fishing boats and small transport vessels on Lake Victoria – as shown. Credit: HIGHWAY

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Acronyms and abbreviations

ACPC	African Climate Policy Centre
ACRC	African Climate Risks Conference
AMDAR	Aircraft Meteorological Data Relay
ASPIRE	Adaptive Social Protection – Information for Enhanced Resilience
CRISPP	Coastal Resilience and Improving Services for Potato Production in Kenya
CSIS	Climate Services Information System
DARAJA	Developing Risk Awareness through Joint Action
DFID	UK Department for International Development (ceased to exist and became a part of the FCDO in 2020)
ENACTS	Enhancing National Climate Services
FCDO	UK Foreign, Commonwealth & Development Office
GFCS	Global Framework for Climate Services
GHACOF	Greater Horn of Africa Climate Outlook Forum
HIGHWAY	High Impact Weather Lake System
ICPAC	Intergovernmental Authority on Development (IGAD) Climate Predictions and Applications Centre
IGAD	Intergovernmental Authority on Development
INGO	international non-governmental organisation
KII	key informant interview
KMD	Kenyan Meteorological Department
MHEWS	Multi Hazard Early Warning System
NGO	non-governmental organisation
NMHS	national meteorological and hydrological services
SCIPEA	Strengthening Climate Information Partnership – East Africa
UK	United Kingdom
UNMA	Uganda National Meteorological Authority
W2-SIP	WISER Support to the Intergovernmental Authority on Development Climate Prediction and Applications Centre
WISER	Weather and Climate Information Services for Africa
WMO	World Meteorological Organization

Executive summary

Effective weather and climate information services ('climate services') are essential to enable people across the world to cope with climate variability and change. These services deliver information that ranges from very short-term forecasts to warn people about imminent weather events – such as heavy rain, wind and temperature extremes – to seasonal weather forecasts and longer-term climate projections.

Accurate, timely, relevant and usable information can help people to understand their climate-related risks and act appropriately. It can support decision horizons ranging from the daily to the decadal, including plans and activities to adapt to climate change. Effective, sustained delivery of climate services are integral to achieving the Paris Agreement's adaptation goal 'of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change' (UNFCCC, 2015: Art. 7).

The Weather and Climate Information Services for Africa (WISER) programme aims to strengthen the capacity for climate services delivery in Africa. It is running from 2016 to 2021. WISER is funded by the United Kingdom's (UK's) Foreign, Commonwealth and Development Office (FCDO).¹

This paper presents the findings of a study on whether WISER projects created sustained capacity for effective climate services delivery. The study also assessed what future climate services programmes and projects can learn about sustainability from the WISER experience. The study asked:

What elements are necessary to sustain capacity for climate services

delivery? How can sustainability best be incorporated into project design and implementation? What are the enablers and barriers to creating sustainable capacity? How can the barriers be overcome?

We conclude that donor investments in climate services run the risk of delivering short-term benefits but diminishing returns after a project has ended. However, the study also showed that climate services projects are likely to sustain their effectiveness beyond the project's life, if they secure all of the following elements:

- Invest in human skills and capacity, both individual and organisational, in addition to hard infrastructure investments, such as computers and observation equipment. Secure a commitment to continue these dual-track investments over time.
- Establish high-level buy-in and accountability for providing sustainable, effective weather and climate information services into the future. This buy-in and accountability should not only be in national meteorological and hydrological services (NMHS), which are often at the forefront of delivering climate services, but also in broader government. Clearly demonstrated alignment of climate services investments with a country's broader climate services and development strategies helps strengthen stakeholder buy-in and increases the potential for these investments to be sustained. The effective cross-sectoral functioning of climate services is

¹ The UK government merged their Department for International Development (DFID) with their Foreign and Commonwealth Office in 2020. Thus, from 2016 until 2020, the WISER programme was funded by DFID.

essential to enable countries to cope with climate change. This depends on the robust performance of a publicly accountable NMHS, that is respected by and fully coordinated with other agencies.

- Secure the partnerships, protocols and processes necessary to review and respond to dynamic user needs over time (recognising that user needs for weather and climate information are not static).
- Develop and execute sustainable business models to finance climate services for the long term, which may include a blend of domestic public funding and private finance.
- Start developing a sustainability plan from the beginning for achieving the above elements. This task should be part of the conception and design of any projects for capacity strengthening in climate services; such a plan will not work well if it is devised and tacked on towards the end. Sustainability planning can be an iterative process, which project teams can consider in the broader context of how a project is contributing to a region's or country's climate services capability. For projects aiming to drive innovation and experimentation in climate services, having a sustainability plan in place from the outset may not be practical, but considerations around the potential sustainability of new innovations should nonetheless be an integral part of these projects, and inform strategies to scale them up.

Furthermore, it is perhaps obvious – but should be stated – that the climate services project must be robustly designed for effectiveness and shown to achieve measurable benefit for target beneficiaries during the project's lifetime (as well as laying the foundations for sustained impact thereafter). This requires *defining metrics of success and monitoring them to adjust and improve the effectiveness of services on a regular basis*.

These conclusions from the WISER experience reflect similar conclusions from country case studies further afield (e.g. within South and East

Asia, and South America) that are documented in the wider literature.

The WISER study suggests further practical recommendations:

- Achieving all the elements of sustainable capacity described above is necessary, but it is a tall order. Significant time and money are required, particularly for professional relationships, networks and protocols to become well established and, where necessary, formalised. Most of the WISER projects studied lasted for only 18–24 months. This was often insufficient to lay the groundwork for sustainability.
- Development partners should provide secure, predictable funding for longer time periods in countries with poor climate services capacity and where national governments wish to mobilise external financing and technical support. Evidence from WISER suggests that multi-year investment is needed to achieve all the elements of sustainable capacity outlined above, even in a country with already well-established meteorological capacity. Supplemental external funding may be needed for considerably longer periods in low-income countries with very limited human resources and physical infrastructure.
- Vital aspects of domestic inter-agency coordination and partnership among government and other domestic actors can be difficult to achieve without reforming institutional mandates. This often involves establishing new Memoranda of Agreement and/or standard operating procedures. Often the people and institutions who are championing the agenda for sustainable climate services are low-ranking in government and do not have the authority or leverage to progress institutional reform.
- Political leaders must recognise the importance of achieving excellence in climate services delivery and take up and champion the cause. Few political leaders have yet grasped the potential of climate services to permeate and strengthen almost all facets of national development in the

face of a dynamic climate and changing hazards. Well-delivered climate services are a necessary part of disaster risk management and climate resilient development, to avert or reduce (where complete aversion is not possible) losses and damage from slow- and rapid-onset weather events and climate change. Such services can also enable countries to make the best of opportunities for green economic growth. It is the work of national leaders to recognise and act on this integrated agenda.

- Although the Paris Agreement calls for climate change adaptation action to ‘follow a country-driven, gender-responsive,

participatory and fully transparent approach, taking into consideration vulnerable groups, communities and ecosystems’ (UNFCCC, 2015: Art. 7), measures to integrate gender-responsive and socially inclusive climate services are being left largely to chance. Partnerships and protocols for ensuring women, people with disabilities and other socially disadvantaged people are served effectively and equitably with weather and climate information must become part of ‘business as usual’. Doing so is a critical element of delivering excellence in – and sustainability of – climate services.

1 Introduction

Weather and climate information services (in this paper, ‘climate services’)² are part of the foundation for sustainable development in a changing climate (Figure 1). This is true everywhere, but particularly so in Africa.

On the African continent, many countries’ economies and people’s livelihoods are based on climate-sensitive sectors such as agriculture and pastoralism. The impacts of severe or extreme weather in a changing climate, such as floods, drought and heatwaves, are already felt. Changes in their frequency and intensity are increasingly attributable, at least in part, to human-caused climate change. Decisions that people make today about infrastructure and other developments that will last for decades need to take future climate change into account. Even under the most optimistic scenarios for cutting global greenhouse gas emissions and limiting climate change, sea-level rise will

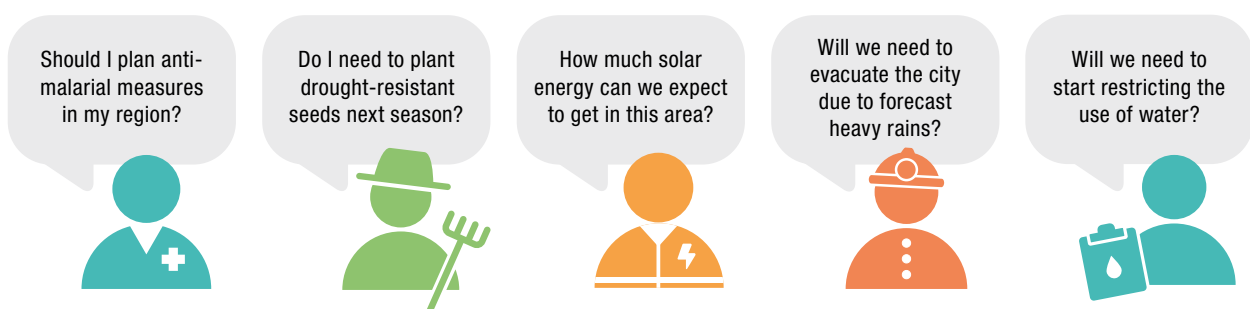
endure to some extent for centuries, due to the persistent impacts of historical greenhouse gas emissions on the oceans (see, for example, Ehlert and Zickfield, 2017 and Jones et al., 2019).

African communities, businesses, government departments and the full array of actors who invest in African development and commerce all need access to reliable weather and climate information to inform their decisions. This information can also help them to understand the potential implications of their decisions in the face of future climate change.

The Global Framework for Climate Services (GFCS) (see Box 1) aims to guide the development of effective climate services so that they advance users’ understanding of the climate and ‘facilitate climate-smart decisions that will reduce the impacts of climate-related disasters, improve food security and health outcomes, and

Figure 1 What are climate services?

Climate services provide climate information to help individuals and organisations make climate-smart decisions



Source: WMO

² Some climate service providers argue that climate services constitute the provision of information for climate-related (e.g. seasonal forecasts to multi-decadal projections) decision-making. Under this definition, any information on shorter timescales, such as those related to extreme weather events, would be considered weather services. However, studies have shown that users’ knowledge of and ability to use climate information remains limited; furthermore, many do not distinguish between weather and climate when seeking information (Street et al., 2019). For this reason, we take a broader perspective in which weather services are included within climate services.

enhance water resource management’ (WMO, 2014a: v). In line with the GFCS, the African region needs investments in its climate services that will ensure these services go from strength to strength in the future.

1.1 About this paper

This paper was commissioned to explore the following questions:

- What elements are necessary to sustain capacity for climate services delivery?
- How can sustainability best be incorporated into project design and implementation?
- What are the enablers and barriers to creating sustainable capacity?
- How can the barriers be overcome?

We seek to answer these questions through the experiences of the Weather and Climate Information Services for Africa (WISER) programme, which is in operation from 2016 to 2021.³ We focus on 15 projects that are particularly concerned with building the capacity of regional, national and subnational climate services delivery; see Box 2 and Figure 2.

The paper has been produced by researchers in WISER’s TRANSFORM team, which was tasked with helping the programme’s participants to reflect and share learning. We distil key lessons about how to embed sustainability in climate services delivery and what this experience can teach us about future programme design and implementation – in Africa and elsewhere.

Box 1 The Global Framework for Climate Services (GFCS)

The GFCS sets out five priority pillars for development by national hydrometeorological agencies and their partners, as follows:

- **User interface platform:** An effective climate services programme should have a structured means for users, climate researchers and climate information providers to interact at all levels. The present study split ‘user interface’ into two parts: (i) how well climate service providers are able to understand diverse users’ needs and (ii) investment in capacity for meeting users’ needs.
- **Capacity development:** An effective climate services programme should have the means to address the capacity development requirements of the other pillars, and to deliver the elements of the Framework.
- **Observation and monitoring:** An effective climate services programme should ensure that climate observations and other data necessary to meet the needs of users are collected, managed and disseminated and are supported by relevant metadata.
- **Climate services information service:** An effective climate services programme should have a mechanism through which information about climate (past, present and future) is routinely collected, stored and processed to generate products and services that inform often complex decision-making across a wide range of climate-sensitive activities and enterprises. In this study, we refer to this as ‘collecting and processing data’.
- **Researching, modelling and predicting:** An effective climate services programme should foster research towards continually improving the scientific quality of climate information, providing an evidence base for the impacts of climate change and variability and for the cost-effectiveness of using climate information.

Source: WMO (2014a: v)

3 Implementing partners in 15 projects were interviewed and surveyed as part of this research study. A full listing of 19 WISER projects may be found on www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/current-projects and www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/completed-projects. We omit the TRANSFORM project, which is concerned with learning and evaluation across the other WISER projects; and the forecast-based financing project, which was analytic, rather than capacity building, in nature. We omit the two projects involving World Meteorological Organization training for regional centres.

Box 2 The Weather and Climate Information Services for Africa (WISER) programme and its component projects

The goal of the WISER programme is to deliver transformational change in the quality, accessibility and use of weather and climate information services at all levels of decision-making for sustainable development in Africa. WISER was a programme of the Department for International Development (DFID), and since 2020 the Foreign, Commonwealth and Development Office (FCDO).ⁱ It has two components: one pan-African, managed by the African Climate Policy Centre (ACPC), and the other focused on East Africa and the Sahel.

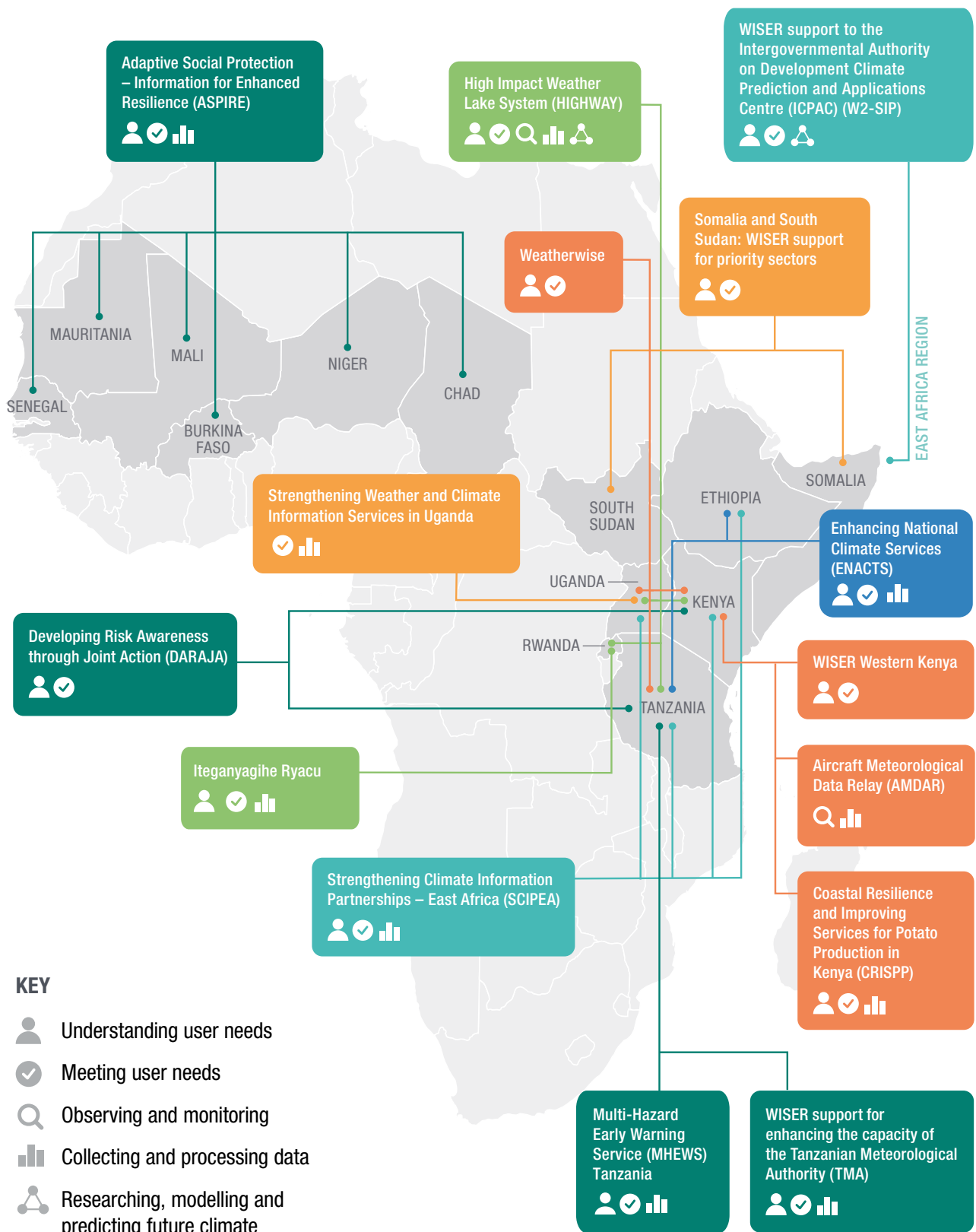
- **Aircraft Meteorological Data Relay (AMDAR)** The WISER AMDAR project sought to establish a meteorological observing programme making use of the automated reporting of meteorological atmospheric information from a fleet of aircraft.
- **Adaptive Social Protection – Information for Enhanced Resilience (ASPIRE)** explored ways of integrating climate information into social protection decision-making in the Sahel so that it can become responsive to climate shocks. It brought together social protection decision-makers and national meteorological services, enhanced seasonal forecasting in the region and trained stakeholders to use climate information.
- **Coastal Resilience and Improving Services for Potato Production in Kenya (CRISPP)** The CRISPP project brought together the providers and users of climate information to co-produce climate information services focused specifically on Kenya’s (a) potato-growing sector and (b) coastal economies. The goal was to transform the way climate information is disseminated and maximise its potential to improve lives and livelihoods.
- **Developing Risk Awareness through Joint Action (DARAJA)** worked with informal settlement communities in Dar es Salaam, Tanzania and Nairobi, Kenya to co-produce weather and climate information services to meet their needs.
- **Enhancing National Climate Services (ENACTS) – Uganda, Kenya, Ethiopia, Tanzania, Rwanda** aimed to inform development decisions that are climate-sensitive, by supporting the widespread use of timely, relevant, locally enhanced and quality-assured climate information. WISER funding particularly aided the climate information provided to the health sector.
- **High Impact Weather Lake System (HIGHWAY)** The HIGHWAY project supported the delivery of regular weather forecasts and severe weather warnings for fishing boats and small transport vessels on Lake Victoria, with the goal of supporting livelihoods and saving lives from extreme weather.
- **Iteganyagihe Ryacu – Rwanda** This project aimed to enhance and scale up the co-production of climate services for improved climate risk management and an impact-based early warning system in the country.
- **Multi Hazard Early Warning System (MHEWS), Tanzania** The MHEWS Tanzania project sought to improve the capacity of the Tanzania Meteorological Authority to reduce the impacts of extreme weather on coastal regions of Tanzania.
- **Strengthening Climate Information Partnerships – East Africa (SCIPEA)** The objective of the project was to enhance links and data exchanges among global, regional and national climate organisations, with the aim of strengthening resources and tools for seasonal forecasts.

ⁱ At the time of writing in late 2020, the FCDO had just been formed through the merger of the UK’s Foreign and Commonwealth Office (FCO) with DFID.

Box 2 (cont.)

- **Somalia and South Sudan – WISER Support for Priority Sectors** This project provided weather and climate information to priority economic sectors in Somalia and South Sudan, to reduce the impact of weather and climate shocks.
- **Strengthening Weather and Climate Information Services in Uganda** The project aimed to improve the availability, relevance and use of weather and climate information in 22 targeted districts in Uganda using local languages – with the intention of reducing the vulnerability of 198,000 farmers to climate hazards.
- **Tanzania – WISER Support for Enhancing the Capacity of the Tanzania Meteorological Authority** The purpose of this project was to enhance the Authority’s capacity to provide weather and climate information services to the country’s agriculture, energy, marine transportation, disaster and water sectors.
- **Weatherwise – Joining Forces to Communicate Weather and Climate Information for Decision-making** This project worked to strengthen the capacity of media professionals and technical experts to respond to their audience’s climate and weather information needs.
- **WISER Support to ICPAC – the Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (W2-SIP)** The W2-SIP project aimed to enhance the resilience and prosperity of the 11 East African ICPAC member states by fostering knowledge and strengthening climate services – and their uptake in regional and national policy and decision-making.
- **WISER Western Kenya** The project sought to deliver demand-led, decentralised services of the Kenya Meteorological Department (KMD) in the counties of Kakamega, Siaya, Kisumu and Trans Nzoia. It invested in improved seasonal forecasting techniques to provide better downscaled information with a longer lead time and with updates during the season, in response to user needs.

Figure 2 Location and scope of the WISER climate services projects



Note: The map includes the 15 WISER projects covered by our research study. Some projects (such as ENACTS) are or were active in other countries, too; but we only denote here the WISER-supported activities in the scope of this study. Please also note that box and line colours are to differentiate projects and do not convey meaning in themselves.

2 Methods

To assess questions of sustainability in relation to the WISER projects in East Africa, the research combined:

- a review of existing literature and frameworks for weather and climate services
- a review of both published project literature and unpublished project reports
- in-person key informant interviews (KIIs) with WISER project staff and partners, and a follow-up survey
- one-on-one virtual consultations to capture additional inputs from programme stakeholders who could not be interviewed in person.

Overall, 11 interviews were conducted by the research team at the African Climate Risk Conference (ACRC), which took place in Addis Ababa, Ethiopia, 7–9 October 2019. The survey was shared with programme stakeholders through WISER mailing lists and newsletters between December 2019 and January 2020 and generated 10 responses from six different WISER projects (DARAJA, HIGHWAY, Strengthening Weather and Climate Information Services in Uganda, Weatherwise, WISER Support for Enhancing the Capacity of the Tanzania Meteorological Authority, and W2-SIP). Survey respondents worked for national or international non-governmental organisations or civil society organisations; national hydrometeorological services, universities or other research institutions; media organisations; and private companies. Further follow-up interviews were held throughout July and August 2020 with the Met Office (the UK’s national meteorological service) and the Kenya Meteorological Department (KMD) to fill gaps.

Complementing the in-depth qualitative data from interviews, the survey provided both quantitative and qualitative data on the various investments undertaken by projects, their perceived effectiveness and potential for sustainability. It also prompted participants’ views on some of the factors that have been posited as potential contributors to the sustainability of climate services in the reviewed literature (see a summary in the following chapter). Alongside the interview and survey information, further data was assessed from the online repository of project impact stories, blogs and news articles on the Met Office website⁴ and from four unpublished, internal Project Completion Reports (see References).

The design of the data-collection tools used in this study (semi-structured interview guide for KIIs and a survey with both closed and open questions) built on an early review of climate services delivery frameworks, academic literature and case studies. Most crucially, the structure for the study design and analysis was built around the World Meteorological Organization’s (WMO) Global Framework for Climate Services (GFCS, see Box 1) as a key framework for the effective delivery of climate services globally. We judged this to be a suitable framework, because the scope of the projects studied was regional, national or at a significant subnational scale (e.g. several counties or districts), and each project’s objectives mapped to multiple pillars of the GFCS and had a systems-strengthening and capacity-building purpose.

For each of the core pillars of the GFCS, we sought responses to the following questions through KIIs and the survey:

4 See www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser.

-
- Which actors, institutions, network or systems capacity were targeted for strengthening via the donor investment?
 - Which specific elements of the GFCS did the respective projects intend to strengthen or enhance (understanding user needs; meeting user needs; observing and monitoring; collecting and processing data; researching, modelling and predicting future climate)?
 - Are there any unintended consequences arising from the donor investment, project design and delivery? If so, what are they and are these positive or negative consequences?
 - Will the capacity created endure beyond the life of the project or programme? If so, for how long and under what circumstances?

- What are the implications of these findings for future investments and partnerships to deliver national climate services?

2.1 Limitations of the study

This study focuses specifically on investments undertaken through the WISER programme, primarily in East Africa. The empirical sections of this paper do not cover climate services initiatives beyond WISER, or beyond the East African context (with the exception of the ASPIRE project). While some of the literature we review is broader, and some of the below discussion might thus be more widely applicable, many of the findings are specific to their respective contexts and should be treated as such.

3 The sustainability of climate services: evidence and knowledge gaps

3.1 Effectiveness and use of climate services

Effective weather and climate information services are critical to better manage risks from climate variability and longer-term changes in climate-sensitive sectors. This spans agriculture, natural resource management, health, energy and disaster risk reduction, among other areas, all of which are vital to African societies and economies (Global Climate Observing System et al., 2006).

To stand a chance of being effective and sustainable in the longer run, climate services need to be relevant and accessible to users, and of high reliability. Weather forecasts and early warnings for extreme weather events have been enhanced substantively in the last decades. The WMO estimates that weather forecasts improve at least a day every decade, ‘so that today’s five-day weather forecasts are as good as the two-day forecasts around 25 years ago’ (WMO, 2015: 2). Climate forecasts, predictions and projections have also undergone radical improvements since the first World Climate Conference took place in 1979. This was helped by the development of new technologies such as radar, satellites, supercomputing and telecommunications, which enhanced observation and allowed scientists to generate better information about climates past and present (Lynch, 2008, cited in Vaughan and Dessai, 2014; Troccoli, 2010; Edwards, 2011), while presenting plausible futures based on best current understanding of climate, emissions and land use change.

However, the immense improvements in the accuracy and coverage of weather and climate information, as well as the science and technology underpinning it, have not always translated into greater use of such services for planning and decision-making. There often remains a ‘usability gap’ where the temporal and spatial scales of these services and the way in which they incorporate uncertainty do not match user needs, or where information is communicated in a format inadequate for decision-makers (Vincent et al., 2020; Opitz-Stapleton et al., 2021).

Even in cases in which these connections do exist, climate information providers often do not fully understand the contexts in which decisions are being made (McNie, 2007; Vaughan and Dessai, 2014). Furthermore, many African governments and policy-makers – with the exception of South Africa and several northern African countries – have tended to focus on short-term interventions and immediate solutions to the myriad of problems they encounter, instead of systematically incorporating climate information into longer-term planning and investment decisions (Global Climate Observing System et al., 2006).

Limited coordination across government ministries and with NMHS, civil society and the private sector has often presented an additional barrier to strengthening the relevance and expanding the use of climate services (ibid.). Overall, as Vaughan and Dessai (2014) conclude, it appears that the strongest impediments to

the use of climate services are often contextual or institutional. In many cases, boundary organisations or platforms that sit at the intersection of science, policy and practice have proven critical for raising awareness about climate services, sharing experiences on their production, delivery and use, and translating user needs.

Recent WMO initiatives such as the GFCS (see Box 1) and the Regional Climate Outlook Forums have set out to reduce the ‘usability gap’, in part by focusing on participatory processes of co-production for climate services. Many seasonal and sub-seasonal climate outlooks are now generated by regional climate outlook forums such as the Greater Horn of Africa Climate Outlook Forum (GHACOF), the Climate Outlook Forum for Sudano-Sahelian Africa (Prévisions Climatiques Saisonnières en Afrique Soudano-Sahélienne, PRESASS),⁵ the Southwest Indian Ocean Countries Climate Outlook Forum, and the Southern African Regional Climate Outlook Forum. At these forums, scientists come together with policy-makers, extension agencies, media, and private-sector actors to discuss the probability of the coming weeks and months being drier or wetter or hotter or colder than usual; along with the likely implications for key socioeconomic sectors in a respective country and region (WMO, n.d.). Complementing these efforts, the WMO has developed a strategy for service delivery and its implementation plan, aiming to ‘help National Meteorological and Hydrological Services (NMHS) raise standards of service delivery in the provision of products and services to users and customers’ (WMO, 2014a: 6).

As underscored by Vaughan and Dessai (2014), the competencies, capacities and business models of NMHS can vary greatly. But,

specifically as regards funding, it is the general consensus that some public funding is crucial to maintain scientific independence and fulfil the ‘public goods’ role provided by NMHS. NMHS also engage in commercial relationships with the private sector, e.g. providing commercial services (ibid.). Collating and analysing transactional data on spending by public and private entities, Georgeson et al. (2017) demonstrate that commercial weather and climate information services constitute a relatively small but vibrant economic sector globally.

3.2 Understanding the sustainability of climate services investments

The WMO strategy for the delivery of weather, climate and water-related services lists sustainability among the major attributes these services need to possess in order to be effective.⁶ It describes sustainable services as those that are affordable and consistent over time (WMO, 2014a). The annexes to the WMO’s implementation guidelines go into further detail about actions required over time to achieve sustainability (WMO, 2014b: 60–61). The WMO recommends:

- Sustain improved service delivery:
 - use developments in science and technology to improve service delivery
 - communicate the changes in service delivery processes to customers and users
- Develop skills needed to sustain service delivery:
 - have a service delivery champion, responsible for sustainable delivery over time, in the NMHS
 - ensure mechanisms are in place to enable staff to be educated in the principles of service delivery

5 The GHACOF and the PRESASS are the two climate outlook forums with which WISER primarily interacts.

6 The other eight attributes are: credible (for the user to confidently apply to decision making); available and timely (on the time and space scales required by the user); dependable and reliable (delivered on time and according to the required user specification); usable (presented in user-specific formats so that the client can fully understand); useful (able to respond appropriately to user needs); expandable (applicable to different kinds of services); responsive and flexible (adaptable to the evolving user needs); and authentic (guaranteed to be accepted by stakeholders in a given decision context) (2014a: 14).

- ensure mechanisms are in place for documenting the roles of staff and their individual training requirements
- involve staff in improving service delivery.

In light of the current state and ambitions of weather and climate information services in Africa, and despite the potential these services hold for enhancing economic and social well-being, few evaluations have been carried out to assess their performance (Vaughan and Dessai, 2014). This means the value and quality of climate services that are currently operational in African countries remain largely unclear (ibid.). Monitoring and evaluation data are limited, to date, concerning the effectiveness and sustainability of climate services; and about how viable past investments into the production, delivery and use of climate services have been.

In assessing and supporting the sustainability of climate services, it is critical to understand the factors that prevent the ‘ownership and growth of climate services from *within* the continent’ (Vogel et al., 2019: 6). Too often, external actors seek to identify deficits in climate services design and delivery, then endeavour to ‘fix’ these, without fully understanding the power relations that shape climate services in their current form. Further, Vogel et al. suggest that, despite good intentions, the champions of current climate services may not manage to secure long-term support for open, inclusive ways of working that engage users. This could be because policy-makers and budget-holders fail to recognise and value different types of climate information and relevant knowledge, and trust and transparency is missing among key groups of stakeholders (ibid.).

Sustainability strategies are also missing from many donor-funded interventions, meaning insufficient resources are allocated to maintaining or expanding on the initial investment. Vogel et al. (2019: 7) conclude that ‘[t]his results in reliance on ongoing international aid in order to maintain programmatic interventions (Harvey et al., 2019), often rendering African countries beholden to international partners’.

Whether and how endogenous evolution and sustainable delivery of climate services happens at scale, beyond individual case study examples

and as a result of programmatic investments from bilateral or multilateral funders, thus remains an important question.

A number of studies have started to assess factors that support the sustainability of climate services investments beyond programme or project lifespans. The following paragraphs summarise the state of knowledge on some of the major factors highlighted in the current literature as contributors to the sustainability of climate services. Overall, we note that the majority of writing to date is based on theoretical considerations, hypotheses and assumptions, complemented by a smaller number of country case studies that have documented experiences and lessons learnt (see, for instance, Harvey and Singh, 2017 in Burkina Faso; Kruczkiewicz et al., 2018 in Mali, Jamaica and India; and West et al., 2018 in Tanzania). More systematic and larger-scale monitoring or evaluation of why some climate services have been expanded or maintained post-project, or why others have not been sustainable, is still largely lacking.

Quality and effectiveness of services: the production and delivery of high-quality climate services is commonly regarded as a necessary pre-condition for the sustainability of these services. It is also essential to some of the other factors that are considered conducive to climate services’ sustainability – it provides the basis for the credibility and reliability of NMHS, thus influencing the levels of interest of partners (UNDP and GEF, 2016).

Formalised, inclusive partnerships: establishing formal partnerships with the appropriate set of stakeholders engaged in climate services has been posited as a core feature of sustainable climate services delivery across the literature (Attzs, 2008; Güingla, 2011; Kruczkiewicz et al., 2018; West et al., 2018). An evaluation of user satisfaction with climate services in Tanzania, for instance, has found that ‘the top-down nature of the programme and exclusion of local partners in its original design were considered to undermine its legitimacy and sustainability’ (West et al., 2018: 49, Table 7). In a study on sustainable climate services in Mali, India and Jamaica, Kruczkiewicz et al. (2018: 14) identified ‘multi-disciplinary working groups, agreements and

memoranda of understanding, and monitoring and evaluation processes’ as core components of the services that were considered successful. Within each of these components, the authors found that the ‘identification and inclusion of appropriate organizations and key personnel’ (ibid: 3), the level of formality of partnerships and funding were critical considerations contributing to the sustainability of services across case study contexts. Of course, which stakeholders are engaged in partnerships will depend on the specific nature of the climate services products, the types of decision-makers to which they are catering, and the wider weather and climate information landscape in which they are operating.

Co-production and shared ownership: creating shared ownership of products and processes by bringing together users and producers to co-produce climate services has been highlighted as one potential factor that could enhance the sustainability of climate services investments beyond the initial pilot project stage (Dilling and Lemos, 2011; Vincent et al., 2018; Vogel et al., 2019). There is an expectation that engagement of different stakeholders in production and delivery of climate services will increase the likelihood that the information produced is ‘credible, legitimate and salient’, and thus has a higher chance of being used for policy, planning and decision-making (Vincent et al., 2020; Carter et al., 2019). However, empirical evidence demonstrating whether co-produced climate services are indeed sustainable beyond project lifespans is restricted to a few examples (Vincent et al., 2018). In practice, it has been noted that co-production and co-delivery processes are time- and resource-intensive (Carter et al., 2019). While potentially valuable, maintaining these processes to continue and expand on climate services beyond an initial project stage can prove challenging and requires a dedicated sustainability strategy and funding plan (Harvey and Singh, 2017).

Resource mobilisation plan and credible commitments: with regards to the sustainability of climate services, ‘who will pay, and how they will pay’ for the continuous delivery and

evolution of services is a critical consideration (Engility Corporation and International Research Institute for Climate and Society, 2012). Yet, developing viable public and/or private funding models has been a major challenge to the sustainable delivery of climate services in many African countries and beyond. Case study experience from Burkina Faso, for instance, underscores the difficulties national meteorological agencies face in generating sustainable funding. The study also outlines how NGO and donor contributions in this space carry a risk of ‘creating community dependencies on unsustainable services’ and establishing ‘continuous cycle of pilots and time-bound projects at the core of national climate service delivery [thus limiting] the amount of lasting change’ (Harvey and Singh, 2017: 3). And resources, where they exist, may be earmarked for research ‘but not for the transformation of research into operational products and services’ (Brooks, 2013: 808).

To support sustainability and continuous investment, several authors have argued for the importance of more rigorously assessing the economic, environmental and social costs and benefits of climate services (Engility Corporation and International Research Institute for Climate and Society, 2012; Anderson et al., 2015; Watkiss, 2019). While the number of studies assessing the economic benefits of climate services is growing overall, most of these studies focus on agriculture and early warning systems, with very little assessment of the benefits of climate change risk management. It also appears that cost benefit studies are not systematically carried out to support sustainability considerations in relation to climate services projects or programmes. Quantifying benefits before or in the early stages of climate services initiatives could help justify investments in the longer term, but also requires that the entire value chain is considered to support sustainability (Watkiss, 2019; Brooks, 2013).

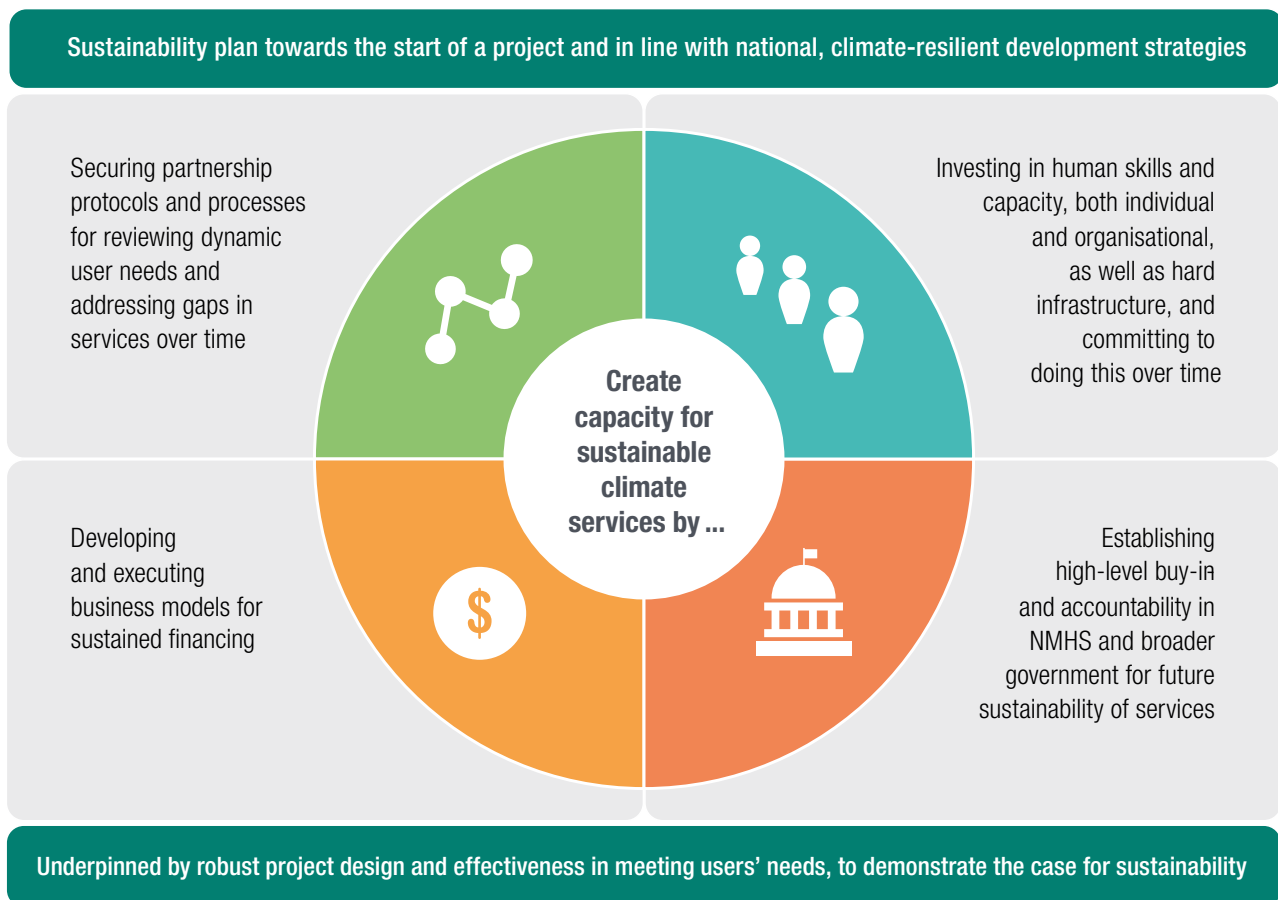
Sustainability strategy from the outset, not as an afterthought: last, lessons learned that are highlighted in the literature to date include the importance of engaging with questions of sustainability at the outset of project conception

and design, so that these can ‘influence the design of governance mechanisms, the prioritization of activities, and the scope of the service’ (Engility Corporation and International Research Institute for Climate and Society, 2012: 9). A major challenge is that many climate service provision initiatives has been set up as pilot programmes and these often do not dedicate enough attention to questions of sustainability in the early

stages, including the development of metrics for monitoring where services can be considered successful and where gaps and challenges remain.

We present a simplified framework in Figure 3, based on salient features of the WMO (2014a) GFCS implementation guidelines and findings from the broader literature about key measures for producing sustainable climate services over time.

Figure 3 Creating capacity for sustainable climate services



4 Findings from WISER: how donor investments sought to build capacity

The implementation guidelines for the WMO's GFCS cite 'capacity building' as a critical and cross-cutting dimension of climate services' development (WMO, 2014a). WISER, at the broader programme level, has the express purpose of building capacity in African climate services. This chapter describes how, in practice, the different projects sought to build capacity sub-nationally, nationally and regionally, and at the interfaces between these different scales of action.

4.1 Building capacity to *understand user needs*

User interface: an effective climate services programme should have a structured means for users, climate researchers and climate information providers to interact at all levels. (Global Framework for Climate Services)

4.1.1 What is the issue?

Scientists benefit from communications training
Climate scientists and meteorologists frequently lack awareness of how people want to use weather and climate information in everyday decision contexts. In the countries studied, the conventional professional development path for meteorologists does not typically include communications skills per se, nor communications strategy development. However, these skills around awareness,

understanding and presentation are required of meteorologists, climatologists and other climate service providers if they are to produce and maintain effective climate services. Without such skills, they may produce data that is incomprehensible to the non-specialist, presented in an inappropriate format, containing information that is not relevant or is released at inappropriate times, thus missing key moments that are most useful to the recipients. Interview respondents pinpointed communications and engagement skills as key areas where meteorologists require support. WISER and other climate services programmes funded by development partners have been active in providing on-the-job training.

Journalists benefit from climate science training and knowledge intermediaries play key roles

The story doesn't end with training meteorologists and climate scientists. Our interviews revealed that, for their part, some scientists mistrust certain sections of the mass media, whom they fault for mis-representing climate and weather information.

Journalists can accidentally misreport weather and climate information, which generates mistrust among scientists and end users alike. The media benefit from training, which knowledge intermediaries are often well placed to provide.

Communities may also share this distrust of mass media reporting, as a Ugandan example illustrates. Farmers who met in Isingiro District, Uganda to review the activities of the WISER-supported project said:

The group expressed strong willingness to demand for accurate weather and climate information from Uganda National Meteorological Authority (UNMA) and the district agricultural office to help plan well especially in understanding the onset, peak and end or reduction of rains during the rainy season. The members accepted that they have been receiving this weather information from the local radio stations, but the information given is always inaccurate and misleading. (Met Office and World Vision Uganda, 2020a)

Community members said they would be better off without the local radio stations' inaccurate reporting and would prefer communications systems that allowed farmers to hear directly from the meteorological agency:

The group requested [the UNMA] to directly send weather and climate information on their mobile phones and print translated weather forecast in the local language and share with the sub-county extension workers, Local Councils, parish chiefs and councillors to disseminate to them during community meetings, churches, markets and ceremonies. (ibid.)

Building the capacity of the media to provide accurate and timely reporting is a sound investment in the future of climate services. These intermediaries often control the means of disseminating information to the public and have the skill in using appropriate style to appeal to their audiences. If the media get it right, their influence will be hugely positive; if they get it wrong, they could be a liability and instil further mistrust.

Knowledge intermediaries such as NGOs and research institutions can play a brokering role by bringing together journalists and scientists to build mutual trust and understanding. There is an emerging consensus that engaging different stakeholders in production and delivery of climate services in this way will increase the credibility, legitimacy and salience of the

information produced and the likelihood of it being used in decision-making (Conway and Vincent, forthcoming; Carter et al., 2019).

User groups are diverse, as are their capacities and needs for types of weather and climate information

Efforts to understand user needs typically focus on user groups in the aggregate, such as geographically based communities or sectoral user groups, and do not adequately differentiate between major user groups within those communities, such as women or people with disabilities. National weather and climate information services should be socially inclusive across their entire spectrum of activities, so that all people have equal opportunity to benefit from them (Dupar and LeMasson, 2019; WISER, 2017). While this ideal should be incorporated into the co-design and co-production of user-driven climate services, few examples exist worldwide of where gender-specific considerations have been incorporated into service design and delivery (Gumucio et al., 2020). Disability and age-sensitive considerations are even less represented.

There is a significant body of research and practice demonstrating stark differences between women and men along gender continuums, as well as between those who are able-bodied and those living with disability or chronic illness, and for different age groups in weather and climate risks faced in livelihoods, assets or well-being, and also in options for managing such risks (Enarson and Chakrabarti, 2009). By contrast, climate services tend to be designed and delivered as though all users are able-bodied working men, with equal political and economic rights, with the same risk management capacities. Power differentials are often overlooked.

In developing impact-based forecasts, climate service providers should consider the different risk profiles, decision contexts and capacities to access and use information. This should include assessing which media and communications channels people have at their disposal (see Section 4.2 on building capacity to *meet* user needs). Additionally, the labour force of institutions that provide climate services should represent the diversity of people they serve – and

be inclusive and non-discriminatory in their working culture.

Existing and potential users of weather and climate information need to know what is available in order to benefit

If users do not know what information to ask for (as well as how to access it), then a meaningful two-way conversation between climate service providers and users cannot take place. Users in government and industry, as well as at household level, often have an unrealistic or uninformed sense of what information meteorologists and climate scientists can provide (see, for example, Conway et al., 2017). Users must understand what information is available (or could be available) so that they can articulate their demands clearly, understand the nature of climate risk and respond appropriately. Scientists must understand better what kind of information users need to support everyday decisions. A process of mutual education is required.

4.1.2 How did WISER projects build capacity to understand user needs?

NMHS and users learned together in the short term

Personnel from several NMHS engaged intensively with end users and developed a new understanding of what users want, but one-off trainings were less useful than ongoing initiatives.

As described in Box 2, almost all of the WISER projects studied aimed to build the capacity of NMHS to understand the needs of end users. These ranged from the CRISPP project, which brought together weather and climate information producers from the KMD with potato growers and processors to design new climate services products for the potato sector,⁷ to the HIGHWAY regional project for Lake Victoria, which convened government, media and community groups to

define the needs of fishing communities on the lake who had been losing lives and property to severe and sudden storms.⁸ Training for meteorologists did not achieve the desired results from a one-off event. Project leaders said that a medium-term commitment to group training and individual mentorship was needed to get solid results.

Knowledge intermediaries were active in helping users to articulate their needs and tailoring climate services for them

Knowledge intermediaries played key roles in convening meteorologists and climate scientists directly with end users of weather and climate information. For example, Columbia University (United States) was both a data analyst for the ENACTS project in Ethiopia and Tanzania – working with the NMHS to create climate services products – and also a knowledge intermediary. The university facilitated in-country workshops to convene NMHS and public health professionals to define how weather and climate information could be integrated with knowledge about the conditions for mosquito breeding to trigger early actions to stop the incidence of malaria.

Other WISER projects involved a constellation of knowledge intermediaries who obtained information products from an NMHS and then tailored the information directly for community members or for local journalists who broadcast to communities. In several projects, NGOs gave on-the-job training to local journalists to help them report weather and climate information more accurately.

The social enterprise Resurgence, working with Kounkuey Design Initiative, the Centre for Community Initiatives, the Met Office, the KMD and the Tanzania Meteorological Authority, piloted radio weather forecasts in informal settlements in Dar es Salaam and Nairobi for the DARAJA project. This involved trial broadcasts,

⁷ See www.metoffice.gov.uk/about-us/what/working-with-other-organisations/international/projects/wiser/crispp. Accessed 1 June 2020.

⁸ See presentation at the ACRC, October 2019, Addis Ababa, Ethiopia (www.africanclimaterisksconference2019.org/) and ACRC (2019: 172).

soliciting regular feedback from listeners and ongoing training of radio presenters.⁹ More than 700 household surveys by the project informed the NMHS how to produce more fitting products to suit the needs of end users.¹⁰

The WISER Weatherwise project took a similar approach: here, BBC Media Action gathered feedback from rural radio listeners on the weather bulletins provided by community radio stations. They organised call-ins and focus groups to help journalists understand whether the information was relevant to people's everyday lives. One of the project leads said:

[these] journalists don't have formal training, like they are not graduates at the university. It's just a passion that maybe they've worked there for a few years so their capacity to produce weather and climate radio content was extremely low (KII, October 2019).

Subsequently BBC Media Action hosted residential training courses for journalists and scientists. This was an opportunity to train scientists on how to communicate more effectively and to train journalists to produce highly accurate content.

Support extended to on-the-job mentoring: BBC Media Action helped the journalists to spot and develop stories and even occasionally accompanied them to the field to identify and interview sources. 'As opposed to just broadcasting from the studio, you go out and get the views of the community, you interview a scientist, you talk [to] an agriculture expert,' said an interviewee. 'Those were the kind of things that we were encouraging them to do and at the same time training them on how to conduct those interviews, so that we could raise their confidence and ability to feel that they can be able to do it' (KII, October 2019).

The scientists were ... struggling to communicate effectively to audiences.

They said that they were being told that they used too much jargon, and they feel that the media politicises weather and climate information, so they were very reluctant to work with the media. There was a strong sense of building relationships between scientists and journalists so that they can trust each other. The outcome they are looking for is to provide accurate, contextually relevant information that can be used for practical decision-making. (KII, October 2019)

Notwithstanding the benefits reported by the meteorologists who participated in communications trainings, it is not assumed that they should take on full-time communications roles played by others in the broader landscape of climate services delivery. Rather, as the GFCS itself suggests and as we explore in Chapters 5 and 6, transdisciplinary cooperation and collaboration among actors is important to get the best from people's different educational backgrounds and areas of skill and expertise.

Users deepened their understanding of how to apply weather and climate information

Dialogues among scientists, intermediary organisations and target populations have educated end users about the type of weather and climate information available, its limitations, and how to think about uncertainties and probabilities when considering financial investments (whether at the household, community or firm level). For example, the Strengthening Climate Services in Uganda project has resulted in communities 'now able to demand this information and they know where to access it', according to Caroline Okello, the project Grants Manager for World Vision Uganda. She added: 'This simply wasn't in place two years ago' (WISER, 2020a).

The MHEWS project, which developed more accessible, picture-based and colour-coded

9 See www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/business/international/wiser/wiser0155_daraja_flyer.pdf.

10 See www.resurgence.io/solutions/climate-risk-visualisation-and-communication/daraja/ and Mikic (2019).

weather alerts for fishing communities in Tanzania, was able to show through follow-up research that ‘people are now more familiar with the benefits of weather information and how to receive it’ (Apergi et al., 2020: 21). Community involvement in developing warning products during the inception phase ‘has led people to believe in the product 100%’ and the social media platforms used as one channel for the alerts are showing a marked increase in user engagement (ibid.).

The Weatherwise project worked with pastoralist communities in northern Kenya and also with communities around the lake regions of Kenya, Uganda and Tanzania. Both activities solicited the different information needs of particular communities (e.g. farmers, lake fishermen and pastoralists) and also informed community members how weather and climate information could help them: ‘They didn’t see [weather information] as a need, so part of our [role] is also creating demand for it,’ said a media knowledge intermediary (KII, October 2019).

The DARAJA project, working in informal settlements, trained local communities to better interpret weather information so they can plan ahead for heavy rainfall events by, for example, ensuring their drainage systems are kept clear (Norman, 2019).

There is a heavy donor emphasis on attaining process indicators such as holding training workshops, but an apparent lack of impact assessment, i.e. did the information go the last mile to meet the elderly woman in Turkhana who needs it? (KII, October 2019)

4.2 Building capacity to meet user needs

An effective climate services programme should have a structured means for users, climate researchers and climate information providers to interact at all levels. (Global Framework for Climate Services)

4.2.1 What is the issue?

Even when meteorologists and climate scientists understand what type of information is most useful to end users and efforts have been made to enhance trust, the information may not be presented in languages or formats or via media channels that are accessible or usable to diverse people. The people who could and should benefit from climate services have a vast array of educational and literacy levels, and economic and sociocultural status, all of which affect their ability to:

- access weather and climate information; do they have a disability, such as a visual impairment or deafness which prevents them from seeing or hearing information in the format presented? Are they excluded from access to media by their inability to afford a radio or TV, or by cultural restrictions on their access to media on the grounds of age, gender, marital status? Are they excluded by their economic activities and livelihood routines? For example, there may be certain times of day when women and men are in the fields, forests, out fishing or away fetching water; commuting to work by foot, cycle or public transport; in the house; or in communal spaces, including places of worship. All of these routines are relevant to the timing and channels by which vital weather and climate information can reach target populations (Dupar and LeMasson, 2019).
- understand and use weather and climate information; is the target population literate or would visual imagery be more appropriate for conveying key information? Do they have a mental disability that affects their interpretation of information? Is the information presented in a local language or dialect they understand or is it in a national/official language that they do not speak/read?

Climate services that fail to properly assess diverse user needs and capacities to access information will not deliver information that is useful or timely to their specific decision-making contexts. Gender, disability, age and educational attainment all need to be considered when

designing and communicating information so that services are effectively communicated and delivered, users trust them, and their value is demonstrated. Demonstrating value and utility to decision contexts is an important element of service sustainability.

How did WISER projects build capacity to meet user needs?

Projects invested significantly – during project lifetimes – in tailoring weather and climate information for specific social groups, including those who had been vastly under-served in the past

Tailored communications included those used in the Strengthening Climate Services in Uganda project, which translated weather and climate information into 22 local dialects. Information was disseminated via emails to local partner organisations who promoted the information further and translated into local dialects. The project managed to reach at least 189,000 farmers across 20 different districts (WISER, 2020a). This included working intensively with agricultural advisory boards and their agents, to inform farmers not only what the forecast was going to be (in the short-term-to-seasonal timeframe), but also what the implications were for farming activities. The chairperson of a district farmers' group explained:

Modern water and soil conservation practices are used during the wet and dry seasons and the advisories provided in the Seasonal Forecasts have become more significant in our farm management... Many local farmers regularly visit us for free knowledge and practical skills (WISER and World Vision Uganda, 2020b).

An independent study of Tanzania's MHEWS project found that capacity development and training for staff of the Tanzania Meteorological Authority had gone some way towards improving their effectiveness at meeting end users' needs. For instance, the project innovated new, user-friendly formats for severe weather forecasts and 'impact-based forecasting' in

particular (communicating how predicted weather would affect communities), by using pictorial symbols and colour-coded systems. However, even when the content is improved in this way, there is room for misinterpretation. Researchers discovered that, despite receiving training, some media continued to report elements of the forecasts inaccurately, which suggests that ongoing training may be needed (Apergi et al., 2020).

Countries improved their information and communication technology – but still have large unmet needs

In some of the least developed and most fragile contexts where WISER projects worked, basic radio broadcast capability did not exist before the projects. Donor investments have in some cases materially improved the physical infrastructure capacity of media outlets reporting weather and climate information (at least for the short-to-medium term).

At least two WISER projects funded the equipment for radio stations to be able to record information and broadcast it more effectively. The Somalia and South Sudan project provided solar power to the Voice of Freedom community radio station so that it would have reliable power to broadcast weather forecasts in five languages across its catchment (Esipisu, 2019). Similarly, the Weatherwise project enhanced capacity by providing community radio stations with recording and work-station equipment to be able to assemble their stories. The Weatherwise project leads considered this a strong sustainability aspect of the projects:

We provide them with equipment that they can use, and that equipment stays with them after the project has ended. We are leaving that capacity at the station after the project has ended. We have now a group of journalists who are really interested in weather and climate, reporting and content production. They have the equipment to be able to do it and we've provided them with the training. (KII, October 2019)

The shelf life of the equipment and its maintenance requirements are not explored in the research and would need further enquiry, but initial technical support for set-up and training were supplied by the Weatherwise project.

The aforementioned independent study of the MHEWS in Tanzania found that the project had increased the availability of forecast information to coastal communities, but nonetheless it faced challenges in reaching all users in remote areas:

Suggestions for improving coverage and use of the early warning system include collecting phone numbers and registering them so that more users can receive information via SMS; distributing mobile phones where necessary; and investing in infrastructure to increase electricity and internet access. (Apergi et al., 2020: 7)

In under-served areas, users may be charged by their network provider to receive MHEWS text messages and calls, which creates another financial hurdle to receiving weather and climate information.¹¹

The needs are great for communications infrastructure to reach geographically and socioeconomically diverse communities with adequate climate services. The hard infrastructure investments by WISER projects in this generation – augmented at the time by training support – boosted access for targeted communities. However, the time-limited nature of external donor funding and lack of sustainable business models (discussed further in Chapter 6), together with the considerable needs among populations still not reached by services, means there is much work to do yet.

Projects used no- and low-cost communication channels effectively, but could not reach all users this way

In some cases, the investment in physical communications infrastructure was next to nil,

as projects managed to piggyback on existing channels. Several projects were able to utilise existing very low-cost communications channels among key actors in the climate services value chain – that is, those actors relaying the hydrometeorological information from its scientific source between individuals and agencies to the final end user. This is an attractive option for sustainability and value for money, where this option exists.

Examples of this approach include the CRISPP project in Kenya, which involved a consortium of the Met Office, Global Climate Adaptation Partnership, KMD, the Kenyan Red Cross Society, Inforkomm and NIRAS. KMD tailored forecasts to meet the needs of diverse communities in Kenya’s coastal areas – producing daily, weekly and seasonal forecasts as well as a marine forecast for people operating within in-shore waters. The Kenyan Red Cross Society deployed its huge network of staff and volunteers to engage with communities and understand how people are using forecasts. The project reached 300,000 households, with new, tailored climate services such as improved marine forecasts. It emphasised services that can be delivered at zero cost for KMD, focusing on social media, radio bulletins and the networks available through the Kenyan Red Cross Society (KII, October 2019). These included email shots from County Meteorological Directors to community contacts, Facebook postings and use of existing SMS communications networks.

At the project end, an unaddressed challenge was how to reach fishermen already at sea with severe weather alerts. This important gap highlighted by the project shows how cost-effective programming and short timescales can deliver important wins but may bring to light challenges in reaching information users in the ‘last mile’ – who also urgently need access to climate services. Another deficit flagged by project managers was the necessity for some information users to have access to/be able to afford mobile phone ‘data bundles’ to access

11 Personal communication with Supporting Pastoralism and Agriculture in Recurrent and Protracted Crisis (SPARC) knowledge programme, October 2020.

email and websites when they are not in an office setting (WISER, 2020b).

The HIGHWAY project – which provided information on the Lake Victoria area – focused on improving the quality of weather forecasts that were already being broadcast on NMHS websites and via television. Although the NMHS considered their forecasts to be of high quality, user groups disagreed and said they did not explain the impacts of weather sufficiently.

Also, not all users had access to the internet, and the television broadcasts were aired at times when decisions had been made and fishermen were already on the lake. The project allowed users and NMHS to identify and address these gaps: now television broadcasts are better timed and incorporate impact information that is more meaningful and can be applied by users for everyday decisions (Carter et al., 2019).

The needs of women and minority groups

Gendered, disability and age-specific climate vulnerability and risk assessments are becoming increasingly important in climate adaptation decision-making and action, yet climate services do not always provide the necessary information to such efforts. This can be partially attributed to the under-representation of women and disabled people in the institutions providing climate services in the East African countries studied. This goes for both NMHS and for intermediary institutions such as media houses. As a consequence, the notion that personnel in climate services institutions should represent the populations they serve is still some way from being attained in the region. In this regard, gender balance and women's empowerment and promotion through both NMHS and intermediary knowledge institutions should be important future foci for the support of government and development partners.

'Most journalists we work with are ... male,' said a spokesman from a media knowledge intermediary, who was involved in organising journalist mentoring and training on climate coverage (KII, October 2019).

This gender bias among climate service providers is reflected in their relative lack of interest in adopting intentional gender-responsive approaches to climate services delivery. Here, 'gender-responsive' refers to intentional measures that can be taken at all stages of the project cycle, from climate impact and information needs assessment through delivery and monitoring and evaluation, to ensure that women have equal opportunity to benefit from services as men.

It is clear that the meteorological profession and knowledge organisations involved in climate services would benefit from training on the different impacts of weather and climate on men and women – due to existing inequalities.

The conclusion, therefore, is that the gender and social-inclusion elements of the climate services projects studied were inadequately planned and implemented. The sustainability of engagement with women and other under-served sections of society, such as people who are discriminated against on the basis of their age, ethnicity, disability, religion or sexual orientation, was already on an insufficient footing. The basis of project engagement was too weak to be sustained, and these weaknesses should be roundly addressed in any new generation of climate services investments. Even when organisations tried in good faith to make mid-course corrections to be more inclusive of women in climate services provision (e.g. journalistic reporting and in direct engagement with communities), project managers reported that these measures did not fully succeed in levelling the playing field.

4.3 Observing, monitoring, collecting and processing data

An effective climate services programme should ensure that climate observations and other data necessary to meet the needs of end users are collected, managed and disseminated and are supported by relevant metadata

4.3.1 What is the issue?

The GCFS (see Box 1) proposes that an effective climate services programme should have ‘a mechanism through which information about climate (past, present and future) is routinely collected, stored and processed ... to generate products and services that inform often complex decision-making across a wide range of climate-sensitive activities and enterprises’ (WMO, 2012: iii). It calls this a Climate Services Information System (CSIS).

The CSIS is the operational core of climate services (WMO, 2014b). The CSIS is recommended to have, at minimum, climate data rescue, management and mining; climate analysis and monitoring; climate prediction; and climate projection functions. These are intended to be supported by advanced global centres, working in collaboration with regional centres and national and local NMHS.¹³ This core scientific function is thus meant to be driven globally, regionally and nationally in a mutually reinforcing way.

The current generation of WISER projects was created to respond to deficits in the CSIS of African countries – both individually and at East African regional level. For instance, WISER support to the IGAD Climate Prediction Centre through W2-SIP was explicitly designed to support ICPAC’s Strategic Framework (ISF) 2016–2020, which lists among its strategic outcomes: ‘Enhanced regional capacity in climate monitoring, prediction and downscaling of climate information for applications in various sectors’ (see ICPAC, n.d.).

4.3.2 How did WISER projects build capacity to observe, monitor, collect and process data?

Several investments were targeted at bringing NMHS records into the digital era and/or filling data gaps in national records

The WISER Strengthening Climate Services in Uganda project involved the Ugandan National Meteorological Authority (UNMA) changing the format of its seasonal forecasts to better meet users’ needs. In practice, this meant changing the type of information targeted towards farmers so that it would be more useful in guiding their planting and harvesting decisions (WISER, 2020a). The information included 10-day as well as monthly and quarterly forecasts. The project is credited with having substantially increased the accuracy of the forecast information, according to one impact report (ibid.), although the longer-term impact of the project is still to be assessed and its specific contribution to this improvement further evaluated. Furthermore, this project has involved a significant digitisation component: taking historic climatological data published in hard copy and sitting on shelves and converting it to digital format for greater access and use in analysing interannual to multi-decadal climate patterns (KII, October 2019).

In Tanzania, Ethiopia, Kenya, Rwanda and Uganda, the ENACTS project – in which WISER invested in Ethiopia and Tanzania – worked to join up global, national and local data to create blended weather and climate service products to inform decision-making in key sectors such as health. Nationally, meteorological agencies depend on weather stations to collect and report data, but sometimes historical records (the regular time series data needed to give a complete understanding of climate trends) have gaps and inhomogeneities. There can be low station density – too few stations over large

12 Investments into observations and monitoring functions could cover equipment such as sensors or rain gauges, training, logistical operations, software, or other aspects.

13 ‘These functions comprise processes of data retrieval, analysis and assessment, re-analysis, diagnostics, interpretation, assessment, attribution, generation and verification of predictions and projections and communication (including exchange/dissemination of data and products) that will be carried out over a global-regional-national system of inter-linked producers and providers’ (WMO, 2014b: iii).

distances to capture local climates – due to a lack of resources. Global climate information sources can provide more seamless data (from satellites or models) over time, but their data is ‘coarser’ in resolution and have biases that are ideally corrected against direct observations. ENACTS created a bridge by combining the best available global and local data to create high-quality information for Tanzania and other ENACTS countries (Dupar and Thomson, 2019; Thomson et al., 2019).

New observation and monitoring technologies helped bring NMHS up to date

In Rwanda, the Iteganyagihe Ryacu project aimed to strengthen the capacity and processes for Meteo Rwanda and local government to co-produce and deliver seasonal climate information services to Rwanda’s farming population and provide timely early warning services. The WISER programme funded integration of new Doppler radar technology into the existing meteorological infrastructure (such as automatic weather stations and satellite receivers) in order to provide early warning messages to the residents of remote areas. The enhanced technology was particularly targeted at areas that experience heavy and damaging rain showers. The system provides information at seven-minute intervals (NECJOGHA, 2019); under this project, Meteo Rwanda partnered with a private phone company to transmit forecasts to farmers at least daily. This significantly enhanced the reliability of the forecasts and rendered the information far more useful to farmers, particularly smallholders. A Meteo Rwanda official commented that the use of Doppler radar technology ‘stems from the fact that unpredictable weather patterns have sometimes rendered traditional forecasts unreliable’ (Twahirwa, 2019).

In Kenya, the AMDAR project fitted a fleet of Kenya Airways aircraft with the data acquisition equipment for collection of weather data, relaying that information to the KMD servers

and at the same time uploading to the WMO’s Global Telecommunications System for data sharing (see Box 2 on the AMDAR system). Once integrated into the KMD system, the data is used for analysis, forecasting and aviation products. It also benefits other sectors such as agricultural and fisheries sectors.

Investments targeted the more effective processing of meteorological data

At regional level, ICPAC established a task force to advise and oversee the implementation of the objective seasonal forecasting approach for its East African members. It developed a fully objective seasonal forecast system that uses predictions only from climate model ensembles. ‘A predetermined algorithm is scripted and applied to produce the forecasts,’ explained an interviewee from the Met Office who was supporting the project, ‘so anyone with access to the same global forecast data would produce the same forecast using the scripts’ (WISER, 2019a). The new objective approach has been used to generate seasonal forecasts for the Greater Horn of Africa Climate Outlook Forums (GHACOFs).

The HIGHWAY project has developed enhanced early warnings to prevent deaths and damage due to severe convection and strong winds in the Lake Victoria Basin. This three-year project was led by the WMO and brought together international, regional and national partners, including the NMHS of Kenya, Rwanda, Tanzania and Uganda, the Met Office, East African Community, Lake Victoria Basin Commission and US National Center for Atmospheric Research. HIGHWAY made investments in new observation and monitoring equipment across the Lake region. It also supported a ‘field campaign’ in which the existing weather and climate monitoring network was enhanced with short-term increased capacity (weather balloons, etc.) to gather data on extreme weather events during that period, in order to help analyse the surface-to-atmosphere processes driving storms.¹⁴

14 See HIGHWAY Field Campaign Web Portal: catalog.eol.ucar.edu/highway (accessed 4 September 2020). According to the website, ‘the Mini-Field Campaign was designed to maximize the use of existing observations along with modest enhancement of the observations where possible, to improve scientific understanding of weather over the Lake Victoria Basin.’ Two Enhanced Observation Periods were undertaken in 2019.

As a package, these activities sought to boost the availability of observations and data and tackle organisational barriers that prevented people from working together effectively. HIGHWAY trained forecasters on how to develop and deliver regular weather forecasts and warnings to fishing boats and small transport vessel operators. Innovative nowcasting and forecasting products were co-designed to improve early warnings of high-impact weather in the region.¹⁵

In Tanzania, WISER invested in two complementary projects to strengthen CSIS at national level: first, the development of the MHEWS, and latterly, direct funding to the Tanzania Meteorological Authority for a project to develop climate information targeted at specific productive sectors, entitled ‘Enhancing Capacity of Tanzania Meteorological Authority in Provision of Climate Services in Agriculture, Energy, Marine Transport, Disaster and Water Sectors’ (WISER, 2019b). The former packaged weather information to establish an impact-based five-day weather forecast service for coastal areas in Tanzania, as well as a series of alerts (Apergi et al., 2020).

New standard operating procedures were established for the collection, processing and tailoring of data

Many projects developed new standard operating procedures for the collection, processing and tailoring of data into new climate services products to meet newly defined user needs. These procedures set the stage for sustained effectiveness, but, like other innovations supported by the projects, require bolstering with other elements of sustainability. Additional efforts needed include long-term budgetary allocations and organisational commitments to staff development to sustain the human resource for implementing the standard operating procedures and adapting to future needs.

An example of new standard operating procedures produced is the CRISPP project’s coastal component. Here, the project developed forecasting templates for routine use by the KMD for: county-specific seasonal forecasts, county-specific monthly forecasts, county-specific weekly forecasts, region-wide daily forecasts and a region-wide daily marine forecast. These were new products for the coastal counties of Mombasa, Kwale, Kilifi, Taita Taveta, Lamu and Tana River (WISER, 2020b).

The MHEWS project in Tanzania aimed to develop early warning systems products including developing and implementing standard operating procedures; developing preliminary thresholds that would trigger an alert; and improving forecasters’ tools and capability (WISER, 2015).

The HIGHWAY project had similar aims but at a regional scale: it worked across Lake Victoria, which is shared by Tanzania, Kenya and Uganda. HIGHWAY brought together the NMHS of the individual countries with regional bodies, such as the East African Community. They collaborated on data-sharing to drive improved early warning systems, including nowcasting of conditions on the Lake. By virtue of the number of governing and operational entities involved, the project had to develop robust procedures and train NMHS personnel in the procedures’ use.¹⁶

As with the other investments in capacity building made by the WISER projects, the advent of these standard operating procedures lay the groundwork for a sustained legacy. But these procedures alone are insufficient. They need to be reinforced with budgets to implement them, including upfront investments in training people and continued commitment to train new staff. They also need to be underpinned by sustainable business models that assure future financing – all of which are discussed in Chapter 5.

15 See Met Office (2020); presentation at the ACRC (www.africanclimaterisksconference2019.org/); and ACRC (2019: 172).

16 HIGHWAY project description at <https://public.wmo.int/en/projects/high-impact-weather-lake-system-highway-project> (accessed 4 September 2020) and HIGHWAY grant application, 2015 (unpublished).

5 Findings on the key elements of sustainable capacity

The review of literature on the sustainability of climate services and key elements of the WMO GFCS implementation guidelines indicate that the following foundation-stones of sustainability must be planned for and intentionally developed throughout the lifetime of a climate services project in order for its benefits to endure:

- securing partnerships and protocols for reviewing dynamic user needs and addressing gaps in services over time
- investing in human skills and capacity, both individual and organisational, as well as hard infrastructure and provision for its continuation over time
- establishing high-level buy-in and accountability in NMHS, and more broadly in government, for future sustainability of services
- developing and executing business models for sustainable financing.

There are two further, vital, underpinning elements to sustainability. First, there should be a sustainability plan from the start of the project or developed early on; such a plan will not work well if it is devised and tacked on towards the end of the project. Naturally, adequate time and resourcing are needed to develop such a plan, monitor progress and manage it adaptively to suit changing circumstances. The principle here is not to create a rigid or prescriptive sustainability plan, but one that is ‘fit for purpose’.

It is perhaps obvious – but should also be stated – that climate services projects and programmes must be robustly designed for

effectiveness and shown to achieve measurable benefit for target beneficiaries during the project’s lifetime (as well as laying the foundations for sustained impact thereafter). This requires defining metrics of success and monitoring them to adjust and improve the effectiveness of services on a regular basis. These elements are necessary; it is effective climate service delivery that needs to be sustained. Being able to demonstrate the benefits of climate services investment fuels the political, financial and behavioural commitments needed to perpetuate the service.

Sustainability planning can be an iterative process that is in tune with a country’s broader climate services and development strategies. For example, NMHS may be implementing several donor-funded capacity strengthening projects at once. In this case, a project team that is working on capacity strengthening for one element can consider what its legacy would be in the context of wider regional or national climate services capability.

A focus on sustainability planning should not stifle innovation either; innovation in the sector is vitally needed. Again, taking a strategic view of a country’s overall climate services development should enable a NMHS to test pilot activities and innovations – while still keeping a firm institutional focus on how proven components of the service can be sustained effectively and allowing space for ongoing operational improvements.

The study of the WISER climate services projects revealed that many projects exhibited one or two of these elements of sustainability. We provide some examples in Section 5.1.

5.1 Securing partnerships and protocols for reviewing dynamic user needs and addressing gaps in services over time

In effective sustainable climate services, routine protocols are developed for assessing user needs, and partnerships between organisations with complementary skills can ensure the assessments are effective and Memoranda of Agreement can cement mutual commitment to revisiting user needs over time. (WMO, 2014a)

The WISER projects significantly developed relational capacity among individuals working to deliver climate services. Many of these were informal professional relationships among individuals, which, while valuable, can also be fragile. We did not find evidence of Memoranda of Agreement being developed between governmental and non-governmental institutions. Without sustainable financing to the non-governmental intermediaries delivering climate services, their future is less secure, and sustained institutional partnerships with government seem unlikely.

Donor investments have boosted relational capacity among climate services actors. For instance, the Weatherwise project introduced journalists to health and agriculture extension workers, who use climate information. These specialists ‘continue to be sources’ for the journalists,

because an agriculturalist or a health worker is someone who can give you content beyond climate stories. We have a WhatsApp group where they share stories, they share news or press releases where they can talk about: ‘this is happening in your region, what’s happening in yours?’ We’ve brought them closer (KII, October 2019).

Journalists who participated in a residential week-long training with climate scientists and meteorologists said that ‘through [the

researchers] and as we write stories, we get to learn so much about this whole subject of climate change. So, we’ve grown as journalists in our work’ (ibid.).

Enhancements in relational capacity have not only happened within projects but across climate services projects, too. The DARAJA project, which has been working in informal settlements, has connected with the Weatherwise project working in other parts of Kenya and by the project managers meeting each other. This has led to Weatherwise trainers getting involved in up-skilling journalists working in urban informal settlement areas (KII, October 2019).

But is this type of relational capacity building highly sustainable? Just as physical capital investments require operations and maintenance over time, so too do human and social capital need investment over time. This goes for both individuals’ capacity development and the relational aspects of peer learning and knowledge exchange.

The WMO implementation guidelines that relate to the sustainability of effective climate services stress the importance of securing Memoranda of Agreement among the different delivery partners, so as to cement institutional commitment and capacity (WMO, 2014a). Establishing these formal protocols ensures that commitments are bigger than any one individual.

The skills developed by WISER projects tended to focus on individuals rather than institutions. We suggest:

- To achieve any kind of lasting benefit to the sector, there is an assumption that people stay in the field of journalism or other knowledge intermediary roles, and do not switch careers completely, once they are trained up. However, turnover in media organisations and between portfolios is commonly high (Dupar, 2016).
- There is a value in bringing scientists and journalists together to enhance the professional networks of both sides, but, likewise, this benefit can drop off after a few years if there is a lot of churn on both sides and if the participants don’t self-motivate to maintain the connections.

- Trainings for journalists and other knowledge intermediaries on climate change are founded on the assumption that producers and editors are happy to run weather- and climate-related content once journalists have been trained to produce such content to a high standard (Dupar, 2016). That assumption is flawed: weather- and climate-related reporting is not always well recognised by producers and station managers for the valuable public good that it is (KII, October 2019).
- Even when trained in today's weather and climate science, journalists and communicators need to refresh their knowledge frequently, at least every year or so. This is because scientific understanding is changing so quickly – as are, unfortunately, greenhouse gas emission concentrations and land-use change, and their implications for climate change that impact ecosystems, economies and societies. The emergent solutions to climate change are also developing at pace and journalists need to keep their knowledge up to date to cover them accurately.

There is a need for capacity-building projects that address and mitigate some of these risks through smart project design. For example:

- High turnover in media positions can be partly mitigated by working with *alliances* of journalists, because these membership organisations embed the strengthened skills for weather and climate communication in institutionalised networks, rather than solely in individuals. In such networks, there may be a greater chance for skill sharing and peer-to-peer exchange among the less experienced and more experienced network members, and there may be a higher chance of members sharing new information and scientific contacts with each other after the end of a project.
- The frequent 'blocker' on weather and climate content created by uninterested media producers and editors can sometimes be addressed by inviting these personnel to engage directly with scientists or government

officials on the importance of weather and climate information, although we recognise that it is often difficult to do this effectively in practice (Dupar, 2016).

- Alternatively, knowledge intermediaries have suggested that more focus-group research could be undertaken and feedback gathered from audiences on their interest in weather and climate information to make the case to producers and editors for its importance (KII, October 2019). Public polling on climate change issues is a growth area with great potential for public–private partnership, to support the assessment not only of media markets for climate information, but also markets for broader climate-smart goods and services.

Ultimately, the need for journalists to continuously brush up their knowledge and skills as climate information communicators cannot be achieved via a short-term project alone. Their skills need ongoing investment to ensure that climate information reporting, including on climate change, is both frequent and accurate. This goes for topping up the skills of established journalists and communicators as well as educating the cohort of early career communicators as they enter the sector.

One senior mentor for journalists disclosed that even after a distinguished career of covering climate change issues for 18 years, he does not fully understand some climate topics because of their technical complexity. The general lack of trust between scientists and journalists can only be addressed by long-term initiatives to create joint trainings, briefings and other forms of facilitated interaction among the parties (KII, October 2019).

The implication for donors and development partners, as well as governments, is that they cannot consider previous capacity-building projects as a 'job done' because in order to communicate effectively about climate information, including climate change – to galvanise and support appropriate climate action – the goal posts are always moving. Human capital must be considered an area for continual attention and targeted investment,

as regards the understanding and skill of journalists and other communicators as well as the communication skill of climate scientists, and the relations between the two groups.

Another possibility, not covered here, would be to undertake a feasibility study of business models for fee-paying membership networks in Africa to support capacity building work for journalists and other knowledge intermediaries. The Climate Knowledge Brokers Group – an initiative by the Climate and Development Knowledge Network (CDKN) during the period 2012–2016 to build the capacity of knowledge intermediaries – investigated revenue generating models. At the time, convening was supported by donor funding and members could not afford to self-fund through a membership fees model.¹⁷

Regarding communications training for climate scientists and meteorologists, there is less available evidence from the WISER projects. Data came from only two interviews and was therefore too small to be significant: more investigation is required. This minimal anecdotal feedback showed:

- Government scientists can vary widely in their willingness to engage with the media on delivering weather and climate information. Some find it hard to shift their scepticism about the mass media, even after participating in project activities designed to foster collaboration. Knowledge intermediaries in WISER projects found national government officials in Kenya and Tanzania were generally uninterested in engaging with the media, eschewing contact even after taking part in short course trainings.
- However, NGOs in Kenya found this to be more of a national- than county-level phenomenon. ‘It is easier to work to improve mutual understanding between scientists and community radio presenters at county level,’ said one senior mentor. It seems that at county level, government officials are more

familiar with and relaxed about interacting with local radio stations.

Institutional arrangements for data sharing among parties, and communication of weather and climate information (e.g. Memoranda of Agreement) were put in place among governmental and commercial bodies and did not involve NGOs. The existence of such agreements was – perhaps naturally – linked inextricably to the existence of sustainable financing options (business models).

Although NGOs were proven to have important roles in helping to define community needs for weather and climate information, to convene these information-users with scientific providers of information and to translate, interpret and tailor communications among these parties, NGOs did not figure among the Memoranda of Agreement identified in this research study.

Several projects (e.g. HIGHWAY, MHEWS, CRISPP) included the development of Memoranda of Agreement and standard operating procedures in their project plans. However, their plans fell short as they encountered barriers with specific actors (e.g. the disaster management department not wanting to engage with the NMHS). For future design, a way must be found to overcome the barriers; perhaps by including all relevant actors, such as all relevant government departments, in the formal project team.¹⁸

5.2 Investment in human skills and capacity, as well as infrastructure

Commitment to the ongoing professional development of staff is essential. Not only is hard infrastructure (e.g. measuring and monitoring equipment, information and communications technology) needed for the delivery of climate services to be modern and efficient, but this must be matched with a commitment to frequently update staff skills in managing, operating and

¹⁷ As evidenced in CDKN internal monitoring and evaluation documents and annual reviews for DIFD. Co-author Mairi Dupar was the Knowledge Management Lead for CDKN during this period.

¹⁸ Personal communication with Met Office, September 2020.

deriving technically accurate and useful results from the infrastructure.

The skill and accuracy of climate forecasts – much dependent on the standard operating procedures and the people who use them – are at the root of whether users trust climate services and want to collaborate with NMHS and other scientists (WISER, 2020b). ‘Enhancing the accuracy of climate information delivered has proven to be critical in building trust amongst the various groups of users, including the intermediary institutions, a challenge which was noted at project outset,’ noted CRISPP managers (ibid.: 13).

Across the board, more intensive, dedicated training is needed for climate services providers on gender and social inclusion – without applying this expertise, climate services will not deliver credible or useful information, except to a very limited set of users.

Several of the WISER projects surveyed said that they had consulted with the national Ministry responsible for women’s rights, or with women’s groups, to inform the provision of climate services.¹⁹ That said, the projects suffered from glaring gaps in socially disaggregated data on the differential access and use of climate services by women and men of different age groups and abilities. Despite the offer of technical assistance partway through project delivery to rebalance activities to be more gender-responsive, it was evident that gender-blind delivery models could not be easily redesigned and corrected to be more inclusive mid-course.²⁰ A commitment to gender equality in outcomes – a foundational element of sustainability – was fundamentally missing from projects’ initial designs and this was a missed opportunity.

Notwithstanding, there is a role for governments as well as the managers of externally funded climate services projects to incorporate explicit, gender-equal and ability-inclusive outcome objectives in organisational mandates and project log frames from the start. Payment milestones should be conditional upon the achievement of gender and social

inclusion-linked objectives. In a project context, in particular, weak mandates cannot be tacked on when a time-limited project is already well underway, and without robust accountability mechanisms. More purposeful gender integration efforts are required in the future. Women’s inclusion should form a part of project design (including a more fundamental revision of log frame objectives, if mid-course corrections are taken) and needs to be a more dedicated part of delivery. Recommendations for improving gender and social inclusion in climate services are noted in the conclusion of this report.

5.3 Establishing high-level buy-in and accountability in NMHS, and more broadly in government, for future sustainability of services

Not only is a ‘champion’ for climate service delivery required in an NMHS itself, but commitment is also needed across government and its financial decision-makers.

The need for a climate service delivery champion is demonstrated by the counterfactual – the problems encountered by projects when they lacked such a champion. For example, the ASPIRE project aimed to connect Adaptive Social Protection agencies e.g. of the World Bank, with the climate services of NMHS in Sahelian countries. But the project failed to identify a champion in Senegal to engage with the initiative, and so pivoted towards engagement in Niger, where an embedded officer with the NMHS was very active (WISER, 2020c).

In Kenya, progress on the CRISPP project was difficult at times too: ‘Over the course of the project, coordination with KMD proved to be more difficult than anticipated, due to the lack of a project focal point to coordinate efforts from within the organisation’ (WISER, 2020b: 11). CRISPP project managers found, in retrospect, that the initial selection and training of ‘intermediaries’ in the focal counties – personnel appointed to package and communicate

19 Survey results, January 2020.

20 Internal WISER TRANSFORM discussions.

weather and climate information – went well at first. However, reviews carried out in the final year found that some intermediaries did not maintain the expected volume of activity over time. Managers concluded that accountability procedures should be developed within the department to ensure that delivery commitments are consistently being met (ibid.).

5.4 Developing and executing business models for sustainable financing

Broadly speaking, there are three options for financing climate services once a donor-funded project ends:

1. Continuation of activity with further external funding. This is arguably a form of short-to-medium-term sustainability and appears to be feasible for institutions or project consortia with a strong business development ethos and capacity. For example, the ENACTS project, led by Columbia University (US), has successfully sustained activity over more than six years by lumping and splitting donor funds (including WISER funding) to expand the development of climate services ‘map rooms’ (accessible visualisations of climate impacts on different economic sectors) for different countries and sectors. However, for many indigenous African initiatives, this financing model is not sustainable and drains resources for proposal-writing which are otherwise needed for the direct business of service delivery.

2. Budget mainstreaming by the host governments. This needs to incorporate the array of climate services design and delivery functions discussed here (understanding user needs, meeting user needs, observing, monitoring and processing data) and include ongoing financial commitment to new climate services products developed by projects which are demonstrated to be highly effective. This has the potential to be the most sustainable of options, where there is cross-government, cross-party recognition of and commitment to these functions. The reality is that the countries where climate services are poorly performing or under-resourced are countries with high levels of debt, low levels of

domestic revenue and now – in 2020 – facing faltering economic growth or recession, due not only to climate shocks but also to Covid-19 and related trade and global economic disruption.

It has been argued that the lack of sustained host-country government financing for weather and climate services is short-sighted, given the diverse and tangible benefits that society derives from them. They deliver social and environmental benefits, in addition to financial ones. The benefit-to-cost ratio for weather and climate services investments is typically 5:1 (Watkiss, 2019). If the case for the socioeconomic benefits of investing in climate services were more definitively made, this could attract investments to the sector (ibid.). However, in data-poor environments it can be exceptionally difficult to marshal adequate data to make this definitive case. Furthermore, in such countries, only large-scale disaster losses arising from extreme events are recorded; slow (creeping) onset events and small or localised losses are rarely recorded. Consequently, such countries lack a robust baseline against which to measure the socioeconomic benefits of climate services. It is critical to understand small losses, from which harm builds up incrementally and erodes people’s resilience over time.

3. Commercialisation of all or part of the service. This might happen, for example, through charges to intermediaries such as radio stations or to ultimate end users. However, notwithstanding various initiatives in Africa to commercialise the delivery of climate services (see Wilkinson and Kirbyshire, 2018), it is difficult to generate a viable business model except where users are themselves profit-making commercial entities. Indeed, Webber and Donner (2017) caution against commercialised climate services in developing countries to ensure the delivery of accessible and usable products for practitioners.

Our research has not revealed a proven revenue generation model where commercial fees are successfully levied on dispersed, individual household users or low-income community institutions, as they simply do not have the financial means to pay. Some have argued that the delivery of climate services to low-income household and smallholder users should be seen

as a public good for which the public purse is responsible (ibid.). It may also be observed that discrete climate services products may be developed and sold at profit on a commercial basis to a segment of users, and the revenues generated from that activity may cross-subsidise the public good provision (the sale of product to KenGen in Kenya, described below, is an illustrative example).

In the discussion that follows, we consider the ways in which the current generation of WISER projects sought to attract sustained public financing, or sought to commercialise certain aspects of climate services, and the prospects for these different routes to financial sustainability.

5.4.1 New climate services products and processes were absorbed into NMHS' standard operations

Some WISER projects were successful – over the project lifetime – in persuading NMHS to absorb the new climate services products and processes they developed into NMHS' standard operations. Thus, to some degree, the projects guaranteed the sustainability of the products and protocols as long as the NMHS themselves continued to be adequately funded.

The SCIPEA project developed new climate services products for Kenya's electric power utility KenGen and the Food Security and Nutrition Working Group. The Working Group is a regional platform of United Nations (UN) agencies, government departments and donors, providing up-to-date food security and nutrition situation analysis and early warning of extreme events.

The new products were sufficiently successful that they have become a routine part of the KMD's output. Because the SCIPEA activities finished some 18 months before the time of writing, stakeholders and the authors were in a better position to evaluate their legacy.

The SCIPEA project fostered a collaboration between the KMD and KenGen, which led to a new climate services product that delivers earlier seasonal forecasts to the utility. This enables KenGen to alter its operation of hydropower reservoirs in anticipation of the forecast rainfall levels. It has resulted in Kenyans suffering far fewer power outages, even during drought spells.

Thanks to the clear successes of this customised package, including avoided economic losses from power interruptions, KMD has continued the collaboration with KenGen beyond the SCIPEA project's end in late 2018.

SCIPEA also created a new climate services product for the Food Security and Nutrition Working Group, based on humanitarian and development agencies' feedback. Specifically, SCIPEA supported the KMD to provide 'regular updates to the seasonal forecast, produced on a monthly basis, and for the forecasts to contain information directly related to food security. As a result, SCIPEA developed and trialled new ways of looking at climate forecasts, including judging the impact of poor rain performance across two consecutive seasons'. This customised product is credited with saving many thousands of lives and livelihoods from drought conditions and the product has been hardwired into the KMD's work programme ever since (Ochieng, 2018; KII, October 2019).

The Tanzania Meteorological Authority indicated that many of the activities started by WISER projects were now being mainstreamed in its routines:

The investment into a climate services information system will be sustained because all activities were done under the supervision of [Authority] which is the designated authority in provision and regulation of all matters related to weather and climate services in the country. After the project, the Tanzanian Meteorological Authority will continue to provide these services (being the meteorological support to sectors) as it is doing with Multi Hazard Early Warning System, MHEWS product (Survey response, January 2020)

The WISER support to the ICPAC project stressed the embeddedness of their capacity building activity into 'climate mandated institutions' as follows:

The Data Library platform, ENACTS approach and Map Room interface

have been implemented by more than 10 African NMHS, and by ICPAC and AGRHYMET [Centre d’Agriculture, d’Hydrologie et de Meteorologie – Centre for Agriculture, Hydrology and Meteorology], for an extended period. The general approach and basic platform seem to have reached the critical mass of acceptance and capacity needed to sustain them at some level. (Survey response, 2020)

A more detailed investigation, beyond the scope of this current study, would be required to confirm the ongoing financing of CSIS budget lines.

The sustainability of investments in Kenya’s climate services capacity, looking to recent history and to the future, will be affected by new developments in the KMD’s legal status and revenue-raising potential. A bill is currently passing through the national parliament, which could shift the way Kenya’s meteorological services are governed and benefit from external project funding (see Box 3).

5.4.2 Many projects lack sustained financing for regular assessment of dynamic user needs over time

Approximately half of the WISER projects studied did not have a financing model in place for activities beyond the life of the project geared towards understanding and meeting user needs. These projects may largely be characterised as those in which knowledge intermediaries are employed to translate, package, tailor and disseminate information in ways that make it more accessible and usable to community-level users (such as women smallholder farmers). They are the ‘last mile’ of climate services delivery. There is a need to maintain the relationships and knowledge exchange between service providers and users beyond the end of a project’s life, so as to infuse new ideas, insights and responsiveness into climate services and keep climate services providers up to date on changing user requirements.

For approximately half of the projects studied, it was stated that the responsibility for future delivery of the user interaction and

communication was embedded in the NMHS and that this activity was institutionally mandated. However, there was insufficient information available to the study team about the future budget lines for this activity within the NMHS, to be able to determine whether these functions were going to be truly sustainable beyond the project life.

The key improved functions embedded in NMHS tended to involve the highly technical work of processing and analysing data. Yet the study found that many projects relied heavily on knowledge intermediaries to play key climate services functions in the convening and consultation with information users about their needs, and the consequent communication and dissemination of forecasts. It is these knowledge intermediary activities that are particularly vulnerable and likely to be financially unsustainable beyond the life of the project.

For example, in Uganda, World Vision were engaged as part of a WISER project to translate weather forecasts into the country’s 12 vernacular languages in order to reach diverse local communities. This specific competency was not hard-wired into the NMHS mandate beyond the project’s life and so ended with the WISER project. The projects that involved intensive roles for NGOs to support and mentor journalists in community radio stations (e.g. Weatherwise in diverse Kenyan communities, DARAJA in informal settlements of Nairobi and Dar es Salaam) were also not set up to benefit from sustained public financing beyond project lifetimes.

5.4.3 Ongoing capital upgrades, data acquisition and skills training need sustained financing

The current generation of WISER projects demonstrated strong provision of skills training for in-country NMHS personnel to operate observation and monitoring equipment and produce new climate services products. However, ongoing capital upgrades, data acquisition and human resource enrichment also need sustainable business models.

To maintain adequate function after a project finishes, funding is required both for the upkeep and running of the physical infrastructure

Box 3 The future revenue-raising powers of the Kenya Meteorological Department

The Kenya Meteorological Department (KMD) has, until now, been a department of the Ministry of Environment and Forestry, dependent on budget allocations from the Government exchequer (Treasury) to carry out its functions. Although the exchequer's allocation has been gradually increasing, it has not been in the tandem with budgetary needs to meet the KMD's international, regional, national, county and community obligations. The decentralisation of meteorological services in 47 counties to support county and community planning has strained the department's financial position. The situation has been aggravated by occasional government budget cuts due to harsh economic conditions – associated with both natural disasters (floods and droughts) and regional security. In a quirk of administration which has demotivated KMD staff in national offices, the KMD may even succeed in attracting external funding for its activities, but could see the funds channelled into other Ministry spend, as funds do not necessarily remain earmarked or 'hypothecated' to meteorology (Oduour, 2020; KII, October 2019).

This could all be about to change. At the time of writing, a draft National Meteorological Bill 2020 was anticipated to be submitted to the Kenyan Parliament for debate and approval. The bill provides for the creation of a newly independent parastatal body, the Kenyan Meteorological Authority (KMA) (Government of Kenya, 2020). If established to take the place of the KMD, this body would gain the ability to generate dedicated revenue streams via a range of means, including: Treasury disbursements approved by Parliament, external donor financing, the imposition of fees upon other governmental and parastatal entities for its services, and commercialisation of services (ibid.: 19–20). Importantly, there is provision in the draft legislation for revenue generation by hypothecating monies collected under the Air Passenger Service Charge Act (ibid.: 20). Personnel working in the KMD foresee this future institutional development as beneficial in the context of the AMDAR project and, more broadly, in the authority's dealing with other sectors.

There will always be aspects in which the KMD (or subsequent KMA) is delivering public goods which are free at the point of access to drive the country's socioeconomic development – such as weather and climate products for agriculture (KII, October 2019). However, the installation of the AMDAR weather monitoring devices on Kenya Airways aircraft and 'nowcasting' of real-time weather data has the potential to create major cost savings for the airline and, as such, could be a commercialised service. Once fully functioning, the system could advise pilots and air control towers to change flight routes before they have even departed, thus making significant fuel efficiency savings.

There are other sectors and applications for weather and climate data where users may have a willingness to pay and the service could be commercialised (ibid.). For example, tourists and the tourist industry benefit heavily from the provision of detailed weather forecasts. In Kenya, a tourism levy is already charged, but this does not yet incorporate any fees for climate services. Models for monetising services may be more amply explored if the KMD's status as a parastatal body is secured. This would provide opportunities to establish steady revenues from the sectors, industries and institutions that most benefit and can afford to pay, without fear that these revenues will be lost in larger ministry coffers. Devising stable funding streams of this kind may also help cross-subsidise service provision to the rest of society, including the poorest people. However, experiences from other NMHS who already have the mandate to generate revenue, such as neighbouring Tanzania's Meteorological Authority, indicates that Authority status in itself does not guarantee an NMHS's ability to establish revenue-generating services. Organisational re-design, acquiring relevant personnel with a broader skill set (e.g. with a business function) and training are critical steps to making the most of this model. ⁱ

ⁱ Personal communication with Met Office, January 2021.

itself, and also for software and information synchronisation (i.e. there should be ongoing data exchange among the global, regional, national and subnational information systems that need to speak to each other for the effective delivery of climate services). Ongoing budget for personal salaries and skills development is needed to keep these services running after projects end. ‘Equipment procured by a project will outlast the project funds, but the operational capacity to use that equipment may not, particularly if posts have been project-funded,’ said one consultant (personal communication and follow-up interview, August 2020).

Sustainability is only ensured if the following ongoing operational budget lines continue to be funded:

- ongoing staffing costs to run all aspects of the collection, storage and processing functions of the CSIS to generate products and services
- other ongoing infrastructural costs for the operation of the CSIS, ranging from buildings operation and maintenance costs and related utility provision (including backup generators, etc.), to computer hardware, internet access and insurance costs.

Furthermore, the informational and digital components of the CSIS require frequent updating, including:

- any costs associated with the purchase/import of meteorological and/or hydrological and other data (crop, health data etc.) from other agencies that are required to generate the products and services required
- any costs associated with security and other software upgrades and any step up in computational processing capacity to support the scope of products and services required
- any costs associated with skilling-up of staff analysts to capably operate software and operation system updates to the CSIS.

A one-off project investment in CSIS does not necessarily provide sustained value. Rather, the value of the initial capital and human resources investments essentially ‘depreciates’ over time; equipment breaks and must be replaced, and a

CSIS must be topped up as changes occur in the climate system itself and scientific understanding and interpretation evolve.

There are both ongoing operations and maintenance costs and also costs of ‘keeping current’ – with meteorological information from global and regional levels and the systems capacity needed to process it. In the countries studied, these competencies are embedded in the NMHS, the inter-governmental regional centre and government-run subnational observation and monitoring networks.

The challenge is that as a government and civil servants, we have a lot of turnover, including people taking pension and going into retirement. That’s why we have to keep doing the refresher trainings. (NGO interviewee from the Strengthening Climate Services in Uganda project)

The study team did not have sufficient access to institutional budgets to be able to evaluate the future financing of these functions. In KIIs, project leads expressed their confidence that the direct funding to the NMHS represented a form of institutionalisation and high-level ownership required for ongoing maintenance of the CSIS beyond the project lifetime. However, it would be necessary to invest in impact assessment studies – at a suggested time lapse of one and two years after the end of the donor investments – to ascertain whether all elements of the CSIS were operating at the same level of functionality as during the WISER project lifetime.

5.4.4 Climate services may have potential to be commercialised in some sectors – but not others

A study on commercialisation of climate services to a specific Kenyan farm sector was found to be over-ambitious and suggests a different approach may be more viable.

The CRISPP project had a somewhat different design from the majority of other WISER projects. It had an explicit objective, from the outset, to develop business models for the sustainable delivery of climate services to Kenya’s potato farmers. Climate Yetu (Kenya) and the

Global Climate Adaptation Partnership (UK) generated some dozen options for sustained financing of climate services to the sector (see Box 4). They did, however, note the challenges of providing long-term support to the potato sector in light of rapidly changing markets. The project is to be saluted for including this search for a business model and analysis of options in its design. The outcome of the feasibility study was to suggest that the potato sector by itself is too small and nascent to be able to generate the revenues to sustain a bespoke climate service

product. These important findings may reflect the challenge of tailoring commercial climate services to the right market segment or scale: CRISPP's experience provides lessons for future market analysis of commercial climate services products.

5.4.5 Further research is needed on radio stations' willingness to pay for forecasts

Commercial radio stations could, in theory, pay for weather forecasts but the limited experience of WISER projects suggests that the stations

Box 4 The CRISPP project: limited scope for financing specific climate services to the potato sector

The CRISPP project explored ways in which climate services might be financed for the potato sector in Kenya. Five observations emerged from the engagement with stakeholders and experts in climate resilience:

1. The market is at an early stage of development, both for potatoes as a main national crop and for export and for climate services. There are relatively few climate and weather information service providers, although there is a large number of potato growers. A considerable effort is required at early market stage in working with the leading stakeholders and investing in the landscape of climate and weather information service providers.
2. Understanding farmers' decision processes is helpful. Climate Resilient Business Process Models are an effective approach. The model template helps identify the climate risks to business processes, and what adaptation measures are needed in order to ensure different parts of the business are resilient to climate change. This approach can be used for discussions around: who are the main actors, what are their decision points, and what information, skills and technology would improve the resilience of defined outcomes.
3. Climate information products should fit the actual decision processes. There is no single service or product that benefits everyone. Nor is there a climate information product stream ready to go, as might be expected in a mature market.
4. A range of cost and revenue models could be considered. The common pay-per-user model is unlikely to be affordable in an early market context such as the potato sector. The small number of subscriptions means the delivery cost is too expensive compared to the benefits. Over a dozen possible revenue models were identified as part of the CRISPP study.
5. The most cost-effective and robust climate services are likely to be part of larger farm and manufacturing support packages. If climate services products are developed as part of a bigger support package for market growth, then the incremental cost of climate services in the potato value chain is modest.

In summary, the review by the CRISPP stakeholders and resilience experts from Climate Yetu and the Global Climate Adaptation Partnership concluded there is limited scope to generate sustainable revenue flows by charging users for specific climate services for the potato sector. Potato growers may expect to access and benefit more from climate services as part of a larger package of paid-for services to enhance market growth.

Source: Based on contributions by Climate Yetu and the Global Climate Adaptation Partnership for this study; also, Future Climate for Africa and SouthSouthNorth (2019: 98).

have little appetite to do so – and further market research is needed.

The Weatherwise project explored the potential for commercial radio stations to pay to receive weather and climate information for broadcast, as a possibility to put communications on a more financially sustainable footing. However, commercial radio stations proved uninterested in the offer. Although Weatherwise identified the demand for such information from radio-listeners, such topics do not fit commercial radio stations' preconceptions of what their listeners want: 'The media landscape is very commercially driven. I wish we had more opportunities to get into that field because commercial stations are very popular, but they have no space for climate stories. They are heavily entertainment,' said senior broadcast mentors at a media knowledge intermediary (multiple KIIs, October 2019).

On the contrary, Weatherwise project personnel found that commercial radio journalists expected to be paid by donor-funded projects to cover weather and climate stories. Journalists at commercial stations would be incentivised to cover a story if a project paid for them to travel to the field to cover a story:

[an incentive] could be, do a story and you have an opportunity to win or to go for training outside your region. Those are things that ... journalists like. There's an opportunity to go to the coast, do something [different] (KII, October 2019).

Alternatively, commercial stations sell airtime to projects, so that climate services projects could essentially generate 'infomercials' (paid-for content) – none of which is financially sustainable in the long run without donor funding.

Due to lack of interest from commercial radio stations, Weatherwise decided to work instead with community radio stations. This brought its own opportunities and challenges. Community radio stations were found to be more viable partners due to their general willingness to broadcast weather and climate information; however, their audience numbers are far smaller. In these cases, there is a heavier burden on the

knowledge intermediary to liaise with small stations to provide tailored content. These intermediaries, too, require payment as they cannot afford to work for free (multiple KIIs, October 2019).

5.5 Practicalities of carrying out the 'best-laid plans'

Finally, how can all the elements for sustained, effective delivery of climate services be achieved if they are not carefully planned for, and hard-wired into projects' early design? Feedback from all of the WISER project leads interviewed suggested that sustainability plans should form part of the thinking of a project team and its delivery partner(s) from the outset – something that should be developed as a priority, when a project is awarded (or, even earlier, required at proposal stage).

Of course, even if the best sustainability plans are laid, still sustainability may not be achieved if the project does not accomplish real progress against all of the critical elements set out here. Insights from the ASPIRE project, which was notable for the degree of sustainability planning it involved, suggest that this is the case.

ASPIRE aimed to provide strategic and technical support to social protection initiatives – such as the World Bank's Adaptive Social Protection Programme (ASPP) in Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal. As explained in the project literature, Adaptive Social Protection systems help individuals and families cope with crises and shocks [combining social protection] with climate change adaptation and disaster risk reduction, aiming to protect poor households from climate and other shocks (WISER, 2020c). In fact, the project was designed for long-term sustainability – its endeavours around seasonal forecasting in the Sahel region inform the ASPP and it is institutionally connected to the ASPP's national focal persons throughout and beyond the life of the ASPIRE project. In order to enhance connectedness to community and household levels, the consortium involved the Red Cross Red Crescent Climate Centre, with the notion that the national Red Cross chapters and extensive volunteer networks were well

placed to disseminate weather and climate information deep in communities.

The ASPIRE project planned for capacity building at the institutional level (i.e. going beyond individual-level training) to ensure that regional institutions such as the West African Science Service Centre on Climate Change and Adapted Land Use, a large research-focused climate services centre, benefited from skills development in seasonal forecasting. ASPIRE used open source data sets in order to optimise data sharing and sought ‘institutional integration’ between the World Bank’s ASPP and the National Frameworks for Climate Services being developed across Sahelian countries (WISER, 2020c).

Even when WISER projects built in most of these elements of sustainability, like ASPIRE, personnel found that project timelines (e.g. two years) were too short to make satisfying progress on all of them. Longer paid project time would have allowed for more effective relationship building and collaborative working,

thus consolidating a stronger base for future, sustained activity. For example, in ASPIRE, core project staff from international institutions found that it was a ‘work in progress’ to convince ASPP managers to work closely with NMHS and regional climate centres. Furthermore, endeavours to engage NMHS were hampered by the latter’s extremely stretched resources: the project completion report concluded, ‘engagement of in-country partners needs funding; NMHS in the focal countries are limited by resource capacity and funding constraints’ (WISER, 2020c: 23).

The reality is that the various elements of sustainable capacity are difficult to achieve, even with the best planning and intentions. They take time, particularly for developing professional relationships and trust, and, even more so, if key actors in the climate services landscape (such as NMHS and domestic NGOs or international partners) do not have established relationships of trust already in place at the outset.

6 Conclusion and recommendations

In summary, the experience of the WISER projects significantly reinforces the findings documented by other case studies and suggested by the WMO's implementation guidelines for climate services (WMO, 2014a). Namely, projects must achieve the following elements if they are to lay the groundwork for sustainable capacity in climate services:

- **Invest in human skills and capacity**, both individual and organisational, in addition to hard infrastructure investments, and secure a commitment to continue these dual-track investments over time.
- **Establish high-level buy-in and accountability** for providing sustainable, effective weather and climate information services into the future. This buy-in and accountability should not only be in NMHS themselves, which are the foremost delivery agencies for climate services, but also in broader government. The effective cross-sectoral functioning of climate services is essential to enable countries to cope with climate change. This depends on the robust performance of a publicly accountable NMHS, respected by and integrated with other agencies.
- **Secure the partnerships and protocols necessary** for reviewing and responding to dynamic user needs over time (recognising that user needs for weather and climate information are not static).
- **Develop and execute sustainable business models** to finance climate services for the long term, which may include a blend of domestic public funding and private finance.
- **Start developing a sustainability plan** from the beginning; this can be an iterative process, undertaken in the context of how a project is

contributing to a region's or country's climate services capability.

It is recommended that future climate services programmes hard-wire all of the above elements necessary for sustainable capacity into their budgets and plans. Specific recommendations on how to do this, based on WISER learning and best practice from other parts of the world, are as follows.

6.1 Invest in human skills and capacity

Many national meteorological and climate agencies are focusing their efforts on strengthening observation networks, research and development, and information management systems – all the heavy technical aspects of climate services. But the user interface aspects and actual delivery of services in a co-designed and co-produced manner tend to receive the least financial and institutional support. It is vital to foster collaborations and multi-disciplinary work between the climate information providers with disaster risk reduction, climate change adaptation, sector specialists, sociologists, political economists and other communities of development practice such as NGOs. This will facilitate effectiveness, including the ability to produce impact forecasts and vulnerability and risk assessments to understand how people and sectors will be affected by weather and climate. However, Carter et al. (2019) rightly point out that, in practice, co-production of climate services does not necessarily lead to greater sustainability. It can contribute to the conditions for sustainable delivery – by creating a form of human capital to drive it – but other conditions,

such as sustainable financing, are needed to provide continued momentum (Carter et al., 2019). Co-production can even make it harder to be sustainable as it means finding more resources for a greater range of partners.²¹

Experience from other countries and regions suggests that it is critical to dedicate individual experts or working groups (commensurate with the scope or scale of the climate service) to bring social science competencies and techniques for inclusion of women, different age groups and people of differing abilities to the design, delivery and monitoring of climate services. For instance, Weather and Society Integrated Studies (WAS*IS) was an international movement to ‘build an interdisciplinary community of practitioners, researchers and decision-makers collaborating to effectively understand how to improve weather warnings, incorporate societal impacts into weather forecasts, and use social science tools and methods’²² and had members from North America, Europe and Caribbean nations. Experiences from that initiative generated foundational guidance, tools and concepts for integrating social science within meteorological and climatological research and services,²³ elements of which have been taken up into the concepts of what makes for ‘good’ climate services. Without such clearly designated and well-integrated expertise at the institutional level or in a country or region’s climate services knowledge landscape, meteorologists and climate scientists alone may find that they lack the skill sets and are too stretched to manage such integrative work alone.

6.2 Establish high-level accountability and leadership

A project sustainability plan should consider whether the domestic host institution is going to continue in the climate services role beyond the project/programme life and what their enduring

role is going to be. Projects and programmes should ensure high-level buy-in on the part of the host government: this may sit at institutional director level or – with respect to authority for budget allocation – at ministerial level. An important aspect of generating high-level buy-in is the clearly demonstratable alignment of climate services investments with a country’s broader climate services and development strategies. Such ownership increases the likelihood that adequate human resources are budgeted beyond the life of the project; and, furthermore, that there is not only ongoing investment in staff numbers but also in staff skills to fulfil the roles needed.

6.3 Secure necessary partnerships and protocols

It is not necessary for a single institution to span the complete spectrum of competencies required to deliver effective climate and weather information services: understanding user needs, meeting user needs, observation and monitoring, collecting and processing data, and researching, modelling and predicting weather and climate.

These competencies can be fulfilled by two or more institutions and partners with complementary mandates that operate in synchronisation at regional, national and subnational levels. However, the delineation of complementing roles and responsibilities and commitment to cooperation should be defined in Memoranda of Agreement with high-level approval. Formalisation of institutional commitments (both political and financial) is very important, especially in the African context. An associated plan between organisations for concrete collaboration is also necessary.²⁴

Knowledge intermediaries such as NGOs, journalists and media houses, and civil society organisations such as farmers’ groups and women’s unions can be instrumental in

21 Personal communication, WISER consultant, August 2020.

22 See www.sip.ucar.edu/wasis/.

23 See www.wiley.com/en-us/Weather+and+Society%3A+Toward+Integrated+Approaches-p-9780470669846.

24 Research validation workshop, November 2020.

helping meteorologists and climate scientists to understand the needs of end users. They can also be vital players in communicating weather and climate information effectively to their members and broader communities.

However, the ongoing contribution of such knowledge intermediaries is not assured when they do not have formalised roles and sustained financing or essentially free access to information services through existing channels (e.g. access via WhatsApp) with their members and audiences. Furthermore, if knowledge intermediaries propagate weather and climate information that is inaccurate, they are a liability and undermine trust on the part of scientists and end users. Therefore, it is in the interests of governments and other investors in climate services to build and sustain the capacity of such actors for accurate reporting.

Because skill in communicating weather and climate information is an area for continual attention and targeted investment, capacity-building should be an ongoing focus of donor investment, whether public or private donors, or international or domestic. Sustainable financing is urgently needed, for the ongoing provision of climate services by NMHS and particularly for training and engagement of under-valued knowledge intermediaries (e.g. NGOs, journalists and media houses, civil society organisations).

6.4 Develop and execute sustainable business models

National climate services need to develop sustainable business models to underpin their ongoing viability. In reality, national circumstances will vary widely, and so the prognosis for each country will depend on their own particular circumstances. Sustainable business models are likely to include some combination of:

- **Capacity to access external donor funding on a longer-term basis** and including mutual dialogue with donors/investors on performance standards – although for the very long term (beyond ten years), it is arguably not sustainable to rely on one external government grant after another.

A phased approach may be considered whereby donor funding is phased out when the sustainable capacity models developed by the project are well established and become embedded in host-country institutions and networks. Those donor models could include subsidising start-up costs until other forms of domestic finance take over.

- **Long-term grant-giving partnerships** between domestic government departments and the community organisations and structures best placed to deliver widely accessible climate services (delegation of service delivery and concomitant domestic financing).
- **Commercialisation of services and fee-based models of service delivery.** This approach has grave limits in low-income community situations, although there is the possibility that an NMHS could develop commercial climate services products, the revenues from which (if hypothecated) could cross-subsidise the provision of climate services as public goods.
- **Organisational modernisation**, including the identification of operational efficiencies that may save money in one area (such as capital expenditure or hard infrastructure upkeep) to drive greater financial sustainability in other essential areas (such as personnel training and staffing of vital processes such as ongoing user needs assessment).

The most sustainable long-term solution is for ongoing, specific budget allocations for climate services within national budgets. This is likely to remain the most significant funding source. However, it requires ongoing monitoring and high-level engagement to demonstrate the value of services and convince national governments to earmark the expenditures specifically for climate services and including user engagement.

Monitoring and evaluation as well as longer-term impact assessment appears to be lacking across the board. For example, a study found that the MHEWS project closed in early 2018 with the formal launch of the service, but without sufficient time or budget to carry out any monitoring, evaluation or learning activities post-launch (Apergi et al., 2020). As noted in the MHEWS project completion report, it would

still be beneficial to determine user confidence in – and understanding and interpretation of – the warnings received (WISER, 2020d). When projects and programmes strengthen monitoring and evaluation systems and national stakeholders' commitment to them, they bolster the likelihood of ongoing national buy-in and funding of climate services.

6.5 Have an adaptive sustainability plan early on

The elements of sustainability described here are mutually reinforcing. The WISER experience suggests that achieving one of these sustainability elements alone without the others is not sufficient. In fact, progress against any one or two elements of the sustainability plan can be undermined if other elements are not advanced. They all need attention at the design phase and throughout implementation, with clear success metrics defined from the outset against which to measure progress.

Sustainability planning can be an iterative process, which project teams can consider in the broader context of how a project is contributing to a region's or country's climate services capability. For projects aiming to drive innovation and experimentation in climate services, having a sustainability plan in place from the very outset may not be practical. Innovation in the sector is very much needed and sustainability plans should not stifle innovation. However, a sustainability plan can be established as a strategic mechanism to support innovation and adaptive management, while aligning resources and institutional arrangements for sustainability of services in the long term. At their best, sustainability plans are a lever for strategic thinking and scaling-up of successful pilot initiatives.

6.6 Further practical recommendations

The WISER programme raises further pragmatic lessons, which could inform the design and implementation of other climate services programmes and projects.

Longer timeframes. Among these lessons is the observation that each of the sustainability elements is difficult to achieve in practice and takes time, patience and dedication. A two-year project lifespan is unlikely to be long enough to achieve all elements of the sustainability plan sufficiently to ensure enduring outcomes. The study of WISER projects suggests that longer timeframes and higher investments by external partners may be required to set African climate services on a sustainable footing. This should not be the work of one donor but the result of dedicated coordination efforts among multiple donors (who are already investing in a multitude of projects, with WISER representing only one part). The burden of coordinating financial flows to climate services should not rest solely on host-country institutions but should be shared willingly by multiple donor agencies and international partners themselves, to extend the most helpful and respectful support possible to their host-country counterparts.

Political attention and leadership. At the same time, certain foundational elements of sustainable capacity cannot be the responsibility of external actors; domestic political leaders must take charge. In particular, WISER experience has highlighted that vital aspects of domestic interagency coordination and partnership, working with domestic actors who can deliver the 'last mile' of climate services to end users in communities, can be difficult to achieve without reforming institutional mandates. Often, it requires establishing Memoranda of Agreement and/or standard operating procedures among agencies and partner institutions. But frequently the people and institutions who are championing this agenda for sustainable climate services are low-ranking in government and do not have the leverage to progress institutional reform. It is for political leaders to recognise the importance of achieving excellence in climate services delivery and champion the cause. Few political leaders have yet grasped the potential of climate services to permeate and strengthen almost all facets of national development on today's changing climate. Well-delivered climate services can avert or reduce losses and damage from

rapid-onset weather and slow-onset climate events and climate change, and can enable countries to make the best of opportunities for green economic growth. It is the work of national leaders to recognise and act on this integrated agenda. Donors can support national leadership of this type, which aligns climate services investments with wider national development priorities (beyond resilience and adaptation).

Gender- and socially inclusive performance objectives. Future climate services programmes must have performance objectives for gender responsiveness and social inclusion, particularly as climate risk and resilience programmes begin to more rigorously address differentiated risks and decision contexts. This should include collecting disaggregated data on performance of services (by gender and other key characteristics affecting the access to and use of climate services, such as disability). Payment milestones could be linked to attainment of these objectives. Strengthening these aspects would contribute greatly to the operational effectiveness of climate services and their prospects for long-term societal benefit.

Experience from other types of climate programme, e.g. climate change adaptation and resilience programmes, could inform the inclusivity of climate services, as many of the key principles are transferable:²⁵

- **Affirmative action in the selection and training of scientific personnel.** Women and minority social or ethnic groups should be intentionally targeted and up-skilled in all aspects of climate services development and delivery, from NMHS scientists through knowledge intermediaries including journalists. This will strengthen understanding among climate service delivery institutions of the diversity of people they are meant to serve.
- **Partnership with women's groups and minority social or ethnic groups** which represent the target population from the early design stages of a project through to its implementation and monitoring and evaluation process. Depending on the scope and scale of the initiative, this may range from NMHS partnering with a women's ministry and/or other ministries with the promotion of young people and marginalised populations in their mandates to strengthen a National Framework for Climate Services, to partnership with women's unions, federations of women workers, and community-based women's organisations in specific districts and sub-national target areas.
- **Design of user needs assessments to provide women the opportunity to meet and be consulted separately from men** in community contexts, if women otherwise lack confidence or feel disempowered to speak out in mixed groups. Depending on power dynamics and the social constitution of the target population, it may also be desirable or necessary to separate women and men into further social groups, so that everyone is empowered and has the confidence to speak up. This also may apply along dis/ability lines and for specific age groups.
- **Mainstreaming gender and social inclusion training into kick-off meetings** for programmes and projects. Projects should require multiple personnel to attend gender and social inclusion training that is mandatory, not an add-on.
- **Implementing special measures in project delivery to overcome barriers to women's or disabled groups' participation.** For example, measures can be taken to establish a culture of non-discrimination and zero tolerance of sexual or gender-based harassment. Furthermore, explicit support can be extended to breastfeeding mothers or to parents with childcare responsibilities for young children to enable their participation in project activities (CDKN, 2020).
- Likewise, taking deliberate measures to boost inclusivity for other diverse user groups. Climate services need to be accessible and relevant to different age groups and people of differing abilities and education and literacy

25 Experiences of the authors and interview with LeMasson (May 2020). See also Dupar and LeMasson (2020) and LeMasson and Kratzer (2016).

levels. This includes people with physical disabilities (such as deafness or visual impairments) and their carers. These needs must be well understood and met to ensure the ongoing effectiveness of climate services.

Although the Paris Agreement calls for climate change adaptation action to ‘follow a country-driven, gender-responsive, participatory and fully transparent approach, taking into consideration vulnerable groups, communities

and ecosystems’ (UNFCCC, 2015: Art. 7), measures to integrate gender-responsive and socially inclusive climate services are still being left largely to chance. Partnerships and protocols for ensuring women, people with disabilities and other socially disadvantaged people are served effectively and equitably with weather and climate information must become part of ‘business as usual’. Doing so is a critical element of delivering excellence in – and sustainability of – climate services.

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