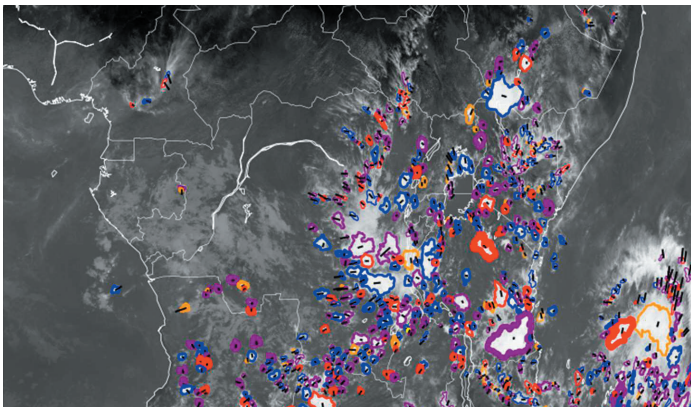
The Socio-Economic Benefits of the WISER Programme



WISER
Weather and Climate Information Services for Africa

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Weather and Climate Information Services for Africa (WISER)

The Weather and Climate Information Services for Africa (WISER) programme is enhancing the resilience of African people and economic development to weather and climate related shocks. The programme aims to improve the generation and use of weather and climate information across Sub-Saharan Africa.

WISER is funded with UK aid from the British people and will deliver maximum value for money by working in partnership and collaboration, capacity building and leveraging funds to ensure long term sustainable delivery and improvement of weather and climate services for Africa.

To find out more about the programme, please visit:

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

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Summary: Socio-Economic Benefits of WISER

Weather and climate services (W&CS) provide information, such as weather forecasts, early warning and seasonal forecasts. This information provides economic benefits to users, because it improves their knowledge and understanding of weather and climate and hence can lead to better decisions.

These benefits can include direct financial benefits, for example from improved agriculture yields or reduced losses, as well as non-market benefits, such as reduced injuries or environmental benefits such as reduced GHG emissions. It is possible to quantify both these categories and estimate the overall socio-economic benefits of W&CS.

Such an analysis has been undertaken for the Weather and Climate Information Services for Africa (WISER) Programme, funded by the UK's Foreign, Commonwealth & Development Office (FCDO) and managed by the Met Office, UK. This report summarises the findings of this analysis.

The socio-economic benefits of eight WISER East Africa projects have been assessed. These include projects that have led to new or improved weather and seasonal forecasts, as well as early warning systems, at the national and regional level. These projects were developed through a co-production approach to support more effective climate services.

The results of the analysis estimate that **the East Africa component of WISER has delivered socio-economic benefits that exceed £200 million**, as a result of the weather and climate information services supported by the programme.

It was not possible to quantify the socio-economic benefits of all projects implemented in East Africa under WISER. This was the case for five projects in Phase 2 of the programme, which undertook activities targeted towards research, training or early-stage development of services, or else did not have well defined services or user groups. However, these projects will also generate socio-economic benefits, which would be additional to the overall programme value.

The national and regional investment in W&CS from WISER will also lead to further indirect benefits, although these have not been quantified here. For example, the potential for wider users other than those directly targeted by the W&CS – such as in other sectors – to benefit from improved forecasts. Also the wider benefits of investment and training in meteorological equipment and capacity, and thus the likely improvement for other forecast products and services.

A cost-benefit analysis of WISER East Africa projects has also been undertaken. This compares the economic benefits as compared to the costs of projects, presenting these as a benefit to cost ratio (BCR).

A BCR greater than 1 demonstrates that a project has a net positive economic benefit. The analysis of WISER projects has found they have BCRs in the range from 7:1 to 26:1, demonstrating very high net benefits. For every £1 spent on these projects, there is an economic benefit of between £7 and £26. These results provide strong evidence that the WISER programme has delivered high value for money.

Finally, based on the analysis for WISER, a number of recommendations are made for future socio-economic benefits studies of W&CS.

£200 million

Total socio-economic benefits of the WISER programme

The Socio-Economic Benefits of Weather and Climate Services

Investing in weather and climate services (W&CS) leads to improved information, such as better forecasts, early warning and seasonal forecasts. In turn this information provides economic benefits to users, as they lead to positive outcomes from the actions and decisions that users subsequently take (WMO, 2015). This is known as the value of information. For example:

- Early warning systems (EWS) produce advance forecasts of extreme weather. These allow users to take action to reduce damage and losses, such as securing homes against storms, and/or reduce loss of life and injuries, by moving to safer areas.
- Seasonal forecasts provide information that allows farmers to prepare for weather trends over the coming months, i.e. for above or below rainfall. This can include planting early maturing varieties or increasing water storage, which in turn increase agricultural production through higher yields, or reduce losses from extreme events.

It is possible to quantify these socio-economic benefits (SEB). Such analysis looks at the activities and outcomes from the use of enhanced weather and climate services, and compares these to a baseline or counterfactual without such additional information. The difference is the incremental benefit directly attributable to enhanced services. This can then be compared to the costs of setting up and running the weather and climate service, to look at the overall net benefits. It should also include the costs of accessing the information and measures taken in response.

The results of SEB studies are useful in identifying and communicating the impact and value for money of programmes and projects. Recognising this, the WISER programme (Weather and Climate Information Services for Africa), has an impact indicator on 'value of avoided losses due to use of climate information'. The end of programme target for this indicator was £190 million.

This economic analysis is the focus of this synthesis. It presents a set of SEB studies for the East Africa component of WISER and evaluates the progress of its projects against the impact indicator.

The WISER Programme

Weather and Climate Information Services for Africa is funded by the UK government's Foreign, Commonwealth & Development Office (FCDO). The aim of the programme is to make a step change in the quality, accessibility and use of weather and climate information services at all levels of decision making for sustainable development in Africa.

The first phase of WISER consisted of five quick start projects delivered from 2015 by the Met Office, the UK's national meteorological service, and the International Research Institute for Climate and Society (IRI).

WISER Phase 2 began in 2017, and finished at the end of 2021, with the Met Office taking on the role of Fund Manager for the East Africa component of the programme.

Phase 2 comprised of 12 projects focused on the Lake Victoria Basin and the surrounding region (Ethiopia, Kenya, Rwanda, Tanzania and Uganda), as well as Somalia, South Sudan and the Sahel.

The East Africa component aims to improve the quality and relevance of weather and climate information and support its uptake and use by championing a co-production approach to climate services.

Co-production is a process of working together to combine the knowledge of two or more actors who think in different ways in order to create new knowledge or ways of working to address societal problems. For W&CS, this means bridging the gap between producers of weather and climate information, and the people who then use that information to inform their decisions.

There are existing methods for SEB Analysis. These aim to quantify all the elements that affect the welfare and wellbeing of a population, not just the financial benefits experienced by users as a result of using actionable W&CS.

These benefits include direct financial and market benefits to end-users, such as increased agriculture yields and incomes from improved climate services. They also include non-market benefits, such as reduced health impacts from early warning or environmental benefits. These are sometimes called tangible and intangible benefits, and together they represent the socio-economic benefit.

However, socio-economic benefits are only generated if users benefit from better decisions as a result of the information. In order to assess this, a weather and climate service value chain can be used. This looks at the stages from production of information through to its use, as shown in the blue arrow below.

The chain starts with foundational activities that underpin the services, e.g. meteorological infrastructure and observations. It then includes the generation of information, e.g. the generation of a forecast or early warning, and then the communication of this information to end-users and the numbers of users that are reached. Finally, it includes the uptake, understanding and effective use of the information by end-users in decisions.

Importantly, there is a drop off at each stage of the chain, e.g. forecasts will not be 100% accurate, only a proportion of relevant users will be reached, and not all of these will act on the information. The value chain allows analysis of these efficiency losses and can also help to identify where to strengthen action to enhance benefits.

The WISER programme produced guidance on the analysis of SEB (WISER, 2017) and this was applied to estimate benefits. This involved the following steps:

- Identify the type of benefits of the weather and climate service;
- Review and decide on the methods for analysis;
- Derive a baseline for the current situation (without the W&CS);
- Assess the change with the new or improved
- W&CS in place; assess the costs of the project;
- Compare benefits against costs, where possible in monetary terms;
- Explore how benefits from W&CS could be enhanced.

Concepts of Economic Analysis

The results of the SEB analysis presented in this report uses economic analysis and cost-benefit analysis to assess WISER projects. It estimates the economic benefits projects will have over time, and compares these to the costs, from a societal perspective. Costs and benefits that arise in different future years are adjusted to provide directly comparable values using discount rates, and expressed as present values. This is a standard approach in economic appraisal, and accounts for the fact that individuals and society prefer to receive goods and services now rather than later, and thus gives more weight to earlier costs or benefits. In the SEB analysis of WISER, a 10% social discount rate has been used. The results are expressed as the benefit to cost ratio (BCR). Note that for the WISER impact indicator on avoided losses, values are presented without the use of discount rates as this represents the total benefits of the project.

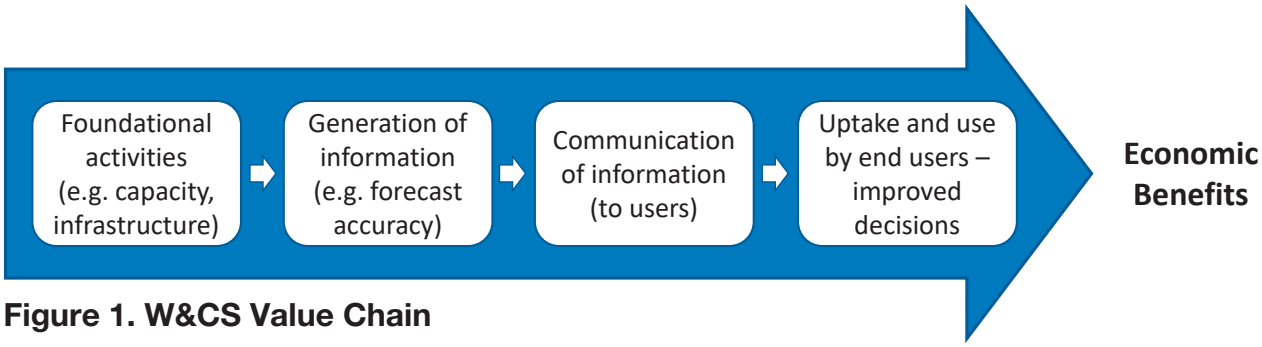


Figure 1. W&CS Value Chain

Identifying the Socio-Economic Benefits of WISER

The East Africa component of WISER funded 17 projects in total in two phases. Five quick-start projects under Phase 1 were commissioned in 2015 for one year and this SEB analysis focuses on two of these. A further 12 projects were commissioned under Phase 2, from 2017 to 2021. It was not possible to quantify socio-economic benefits for all Phase 2 projects, particularly those focused more on foundational activities in the weather and climate services value chain. This is because these projects undertook activities that were targeted towards research, training or early-stage development of services, or else did not have well defined services or user groups. The projects from Phase 1 and 2 of WISER that have been quantified and are presented in this report are shown below.

There are a number of methods in the literature that can be used for quantification. These can broadly be divided into those that assess the *potential* benefits of climate services, for example modelling the likely benefits, and those that assess the *actual* benefits after implementation, for example using surveys. The eight projects considered in the SEB analysis have used survey information to assess benefits, and these were quantified and valued using value chain analysis.

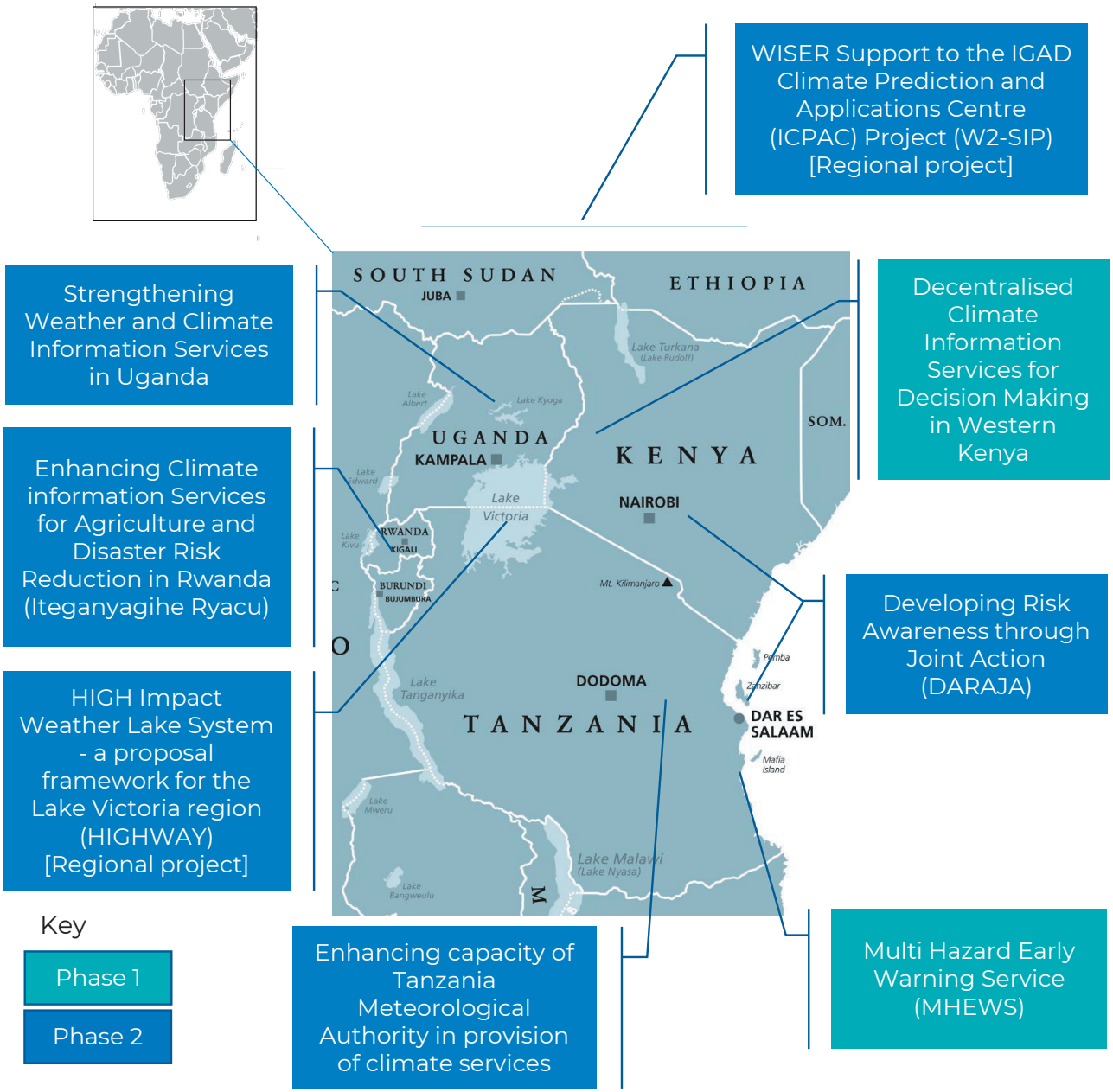
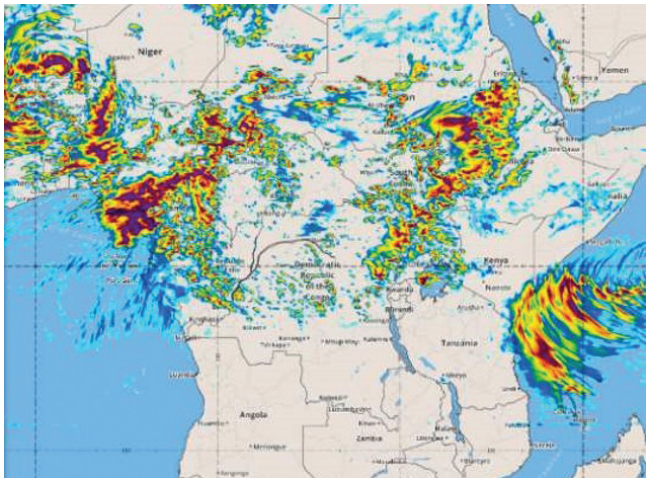


Figure 2. Location of WISER projects where benefits have been quantified

Multi Hazard Early Warning Service (MHEWS)



Extreme weather events lead to fatalities and injuries, as well as damage to property and assets. Early warning systems can reduce these impacts, leading to sizeable socio-economic benefits.

The objective of the MHEWS project was to enhance the capacity of the Tanzania Meteorological Agency (TMA) to reduce the impacts of extreme weather on coastal regions of Tanzania with delivery of an early warning system (EWS) for the marine, fishing, agriculture, public weather, and oil and gas sectors.

The Phase 1 project was initiated in 2015, and ended in March 2017. It was implemented by TMA working with Met Office, UK. While MHEWS delivered a range of benefits, the SEB analysis focused on **the production of EWS forecasts for coastal communities**, which targeted an estimated 50,000 fishermen, providing information to help to improve their decisions.

The analysis drew on the Project Completion Report and supporting analysis undertaken by another WISER Phase 2 project, TRANSFORM (Apergi et al., 2020). The analysis also drew on the results of the HIGHWAY project (presented later in this brief), transferring relevant information on the value chain and effectiveness of EWS to the coastal context.

Stakeholder surveys revealed that the service has led to reduced fatalities from extreme weather along the coast, reducing boats being lost or capsizing during bad weather. The information also allows fishermen to plan more accurately, travelling further out to sea in the knowledge that no adverse weather was predicted.

The SEB study undertook a value chain analysis, estimating the reach of the EWS, the accuracy of forecasts, and the number of people using the forecasts and taking action. This was used to estimate the avoided losses from the reduction in fatalities with the new service, as well as the economic benefits from the use of the information.

The annual reduction in fatalities and the annual increase in incomes from higher catch and cost savings for fishermen using EWS from MHEWS, has been estimated at £3 million/year.

The total benefits over time (i.e. 10 years) from the continuation of the service were then considered, taking account of a drop-off in effectiveness, enabling the total benefits to be assessed. These were compared to the costs of the project, although due to insufficent information, costs borne by individuals were not included although they should have been, because no information was available. These were evaluated in terms of the discounted benefits, and the total benefits of the project were compared to costs.

The total socio-economic (undiscounted) benefits for MHEWS were estimated at **£12.6 million**, the annualised benefits over 10 years at £1.4 million, and the benefit-to-cost ratio (BCR) at **16:1**, which is high and demonstrates good value for money.

Decentralised Climate Information Services for Decision Making in Western Kenya

Kenya has led the way in decentralisation policies and has county governments complete with elected governors and assemblies. As part of this decentralisation, Kenya Meteorological Department (KMD) is also decentralising weather and climate services to the county level. This offers the opportunity to provide disaggregated and more easily understandable localised products relative to national level equivalents.

The objective of the Decentralised Climate Information Services for Decision Making in Western Kenya project was to develop and deliver demand-led and decentralised services of KMD.

This Phase 1 project was coordinated by KMD, CARE International (CARE Kenya) and Met Office, UK. To consolidate and advance achievements, a second phase was implemented through to February 2018.

The project achieved a number of results, including the provision of **decentralised daily, weekly and seasonal forecasts to households**, which are the focus of the SEB analysis. It also delivered training and planning to county meteorological staff.

The analysis of benefits was based on the Project Completion Report, which included evidence from village focus groups that yields for farmers who used the forecasts were up to 20% higher than the yields of farmers who did not have access to the forecasts or chose to ignore them. A detailed study by Barrett et al. (2021) that used an econometric (i.e. statistical) analysis to assess the impact of KMD seasonal local forecasts on the productive income of households in Kitui County was also drawn on, as this provided analysis of benefits of decentralised services.

The SEB analysis for this project focused on the direct users of the information, which are primarily rural farmers. These were estimated at approximately 120,000 people who were reached on a regular basis by direct communication, such as from extension services.

A much larger number were however reached by radio (potentially up to 1 million people). The

analysis then developed a value chain analysis to examine the benefits of the project.

The improvement in forecasts from the downscaled forecasts was estimated, using information on improved accuracy from a study by McLeod et al. (2021), which indicated a rise from 10% to 40%. A proportion of these benefits (i.e. 80%) were attributed to WISER, recognising these improvements were strongly but not exclusively due to the project.

The improvements in forecasts for farmers were combined with baseline information on the economic benefits of decentralised services. This led to an estimate of a benefit of £33/year per household from the WISER project. The calculation did not include the costs of action taken by individuals, as no information was available on these. Further work to understand these costs is needed. At the same time, there are likely to be large indirect benefits to the wider group of users (via radio), as well as the benefits from capacity building and planning at the county level.

The total socio-economic benefits (undiscounted) of the project were estimated at **£8.2 million**, and the benefit to cost ratio was estimated at **7:1** (using a 10% discount rate).

Strengthening Weather and Climate Information Services in Uganda

The agricultural sector plays a central role in Uganda's economy, with almost 70% of the working population engaged in the sector, and it accounts for almost a quarter of Gross Domestic Product (GDP). While the country has a unique climate and high potential for agriculture, productivity is reduced by the variability of rainfall seasons as well as periodic droughts and floods.

This WISER Phase 2 project aimed to improve the availability, relevance, and use of weather and climate information by farmers in 22 targeted districts in Uganda through a range of intermediaries and communication channels. The project was implemented by World Vision, working in partnership with Met Office, UK; OPM-NECOC (Office of the Prime Minister – National Emergency Co-ordination and Operations Centre); the Uganda National Meteorological Authority (UNMA) and WIMEA-ICT (Improving East Africa's Weather Information Management through the application of suitable Information and Communications Technology) at Makerere University.

The project invested in coordination and improved data, and it improved access to co-produced weather and climate information services. The SEB analysis focused on improved access in particular, and the **production of downscaled and local language seasonal forecasts for farmers**.

The SEB analysis in this instance was based on the project's end-line evaluation, undertaken once implementation had finished (World Vision, 2020). The results of this evaluation were based on interviews, complemented with a survey of over 3,000 farmers across all districts.

The project identified approximately 200,000 farmers, 120,000 of which were women, who directly benefited from improved access to climate information services from the project. A larger group (around 3 million) were reached through radio broadcasts.

The evaluation report estimated the key outcomes before and after the project. It found a significant increase in farmers accessing information, as well as a very large increase in the percentage of farmers reporting improved accuracy and relevance of the information received. This in turn led to an increase in the number of farmers using the information.

Benefits in Focus

I used to plant my soya beans in August, due to prolonged rains for the season. After getting climate information from extension workers, I shifted and delayed planting soya beans to October. As I talk now, my soya beans on one acre of land have germinated and are now at flowering stage. The information given to me was accurate and reliable as we have had prolonged rains this year. Luluat Geofrey-member of Awida farmers group, Nyai village, Arua district. Source World Vision evaluation report.

As a result, farmers most commonly changed crops or varietal choices, or planting dates, but in some cases, they also implemented measures to address more extreme weather predictions, such as storing food before prolonged dry spells. There was also an increased uptake of sustainable agricultural practices to help address rainfall variability. The evaluation considered the benefits of these actions, and the majority of farmers reported improved yields from previous seasons (as the green box shows), although quantitative data for the improvements was not available. The SEB analysis used this information to build up a value chain, and assess the improvements along this, i.e. in reach, uptake and use of the information. This was combined with estimates of average agricultural incomes, and previous studies (Vaughan et al., 2019) demonstrating the quantified benefits of weather and climate forecasts in Africa to estimate the indicative benefits of the project.

The total estimated benefits (undiscounted) of the Uganda national project were estimated at **£25 million**. The cost-benefit analysis estimated a benefit to cost ratio of **26:1**, which is very high, though this does not account for all costs to farmers.

Developing Risk Awareness through Joint Action (DARAJA)

Heavy rains and floods are common in the major cities of East Africa, and especially impact on informal settlements, which have limited capacity to cope with these events. These floods damage property and assets, and make it difficult to travel. There are also incidences of extreme heat and settlement houses can get extremely hot during these events leading to health issues.

A survey in two of the major cities in the region, undertaken as part of baseline studies for WISER, found that approximately two thirds of people in Dar es Salaam, Tanzania, and one third in Nairobi, Kenya report that they had been flooded in the past year. These climate-related impacts can be significantly reduced if people have early warning of major events, as this allows them to take preventative action.

The DARAJA project aimed to address these impacts, **by co-producing weather and climate information services for urban informal settlement communities** in Dar es Salaam and Nairobi.

The project was implemented by Resurgence, working with intermediaries in Nairobi, Kounkuey Design Initiative (KDI), and in Dar es Salaam, Centre for Community Initiatives (CCI).

The benefits of the project were captured in an end of project evaluation for the two cities, which included survey information (Resurgence, 2020), which was used for the SEB analysis.

The project is estimated to have reached 800, 000 people in Nairobi and 180, 000 people in Dar with new W&CS information, based on radio communication. There were also a number of DARAJA pilots, that provided more direct information through community groups, focusing on a smaller number of beneficiaries with more targeted actions.

The evaluation estimated the improvement in perceived forecast accuracy, the understanding and use of information, and the effectiveness of the actions taken, before and after the project. This provides the information to allow a value chain analysis.

The surveys also provided information on the benefits that residents attribute to the new weather services. Residents were asked if they felt they had saved money from the services, and how much they saved by taking action. In Nairobi, 72% reported they saved household income, and in Dar, the number was even higher, at 81%.

These estimates are of perceived benefits from users, rather than an independent, quantified analysis, and the survey did not explore the costs of actions taken, such as the costs or time involved in preparing for extreme weather. Still, they indicate sizeable household benefits among respondents.

This information was brought together in the SEB analysis, which estimated the improvements along the value chain through to the urban population, and the estimates of household benefits.

The total estimated benefits (undiscounted) of the DARAJA project were estimated at **£12.5 million**, with a benefit to cost ratio of **20:1**, indicating very high net benefits.

Wall mural from the Weather Mtaani awareness campaign showing how to use the new forecasts and take preventative action. Source DARAJA project.

High Impact Weather Lake System – a proposal framework for the Lake Victoria region (HIGHWAY)

30%

Estimated reduction in deaths on Lake Victoria due to HIGHWAY activities

Lake Victoria is one of the most convectively active regions on Earth. It generates severe thunderstorms, with intense and often heavy rainfall, high and gusty winds, high waves, lightning and hailstorms, and water spouts on the lake. High winds also create rough water and dangerous conditions for navigation. These extremes are a major source of accidents and fatalities and pose a major threat to fisherfolk, as well as passengers on small boats, and there are a large number of drownings on the lake each year.

The aim of HIGHWAY was to deliver regular weather forecasts and severe weather warnings for fishing boats and small transport vessels on Lake Victoria to address these risks, to improve resilience and reduce the loss of life and damage to property on and around the Lake in Kenya, Tanzania and Uganda. The project was implemented by the World Meteorological Organization (WMO) working with partners including the Met Office UK, the National Meteorological and Hydrological Services (NMHSs) of Kenya, Rwanda, Tanzania and Uganda, the East African Community (EAC), the Lake Victoria Basin Commission and the National Center for Atmospheric Research (NCAR).

To estimate the benefits of HIGHWAY, the potential **reduction in fatalities on Lake Victoria and the reduced loss of assets from the new marine forecasts** were assessed, as well as other benefits to fisherman and other lake users such as fuel savings, using a weather value chain analysis.

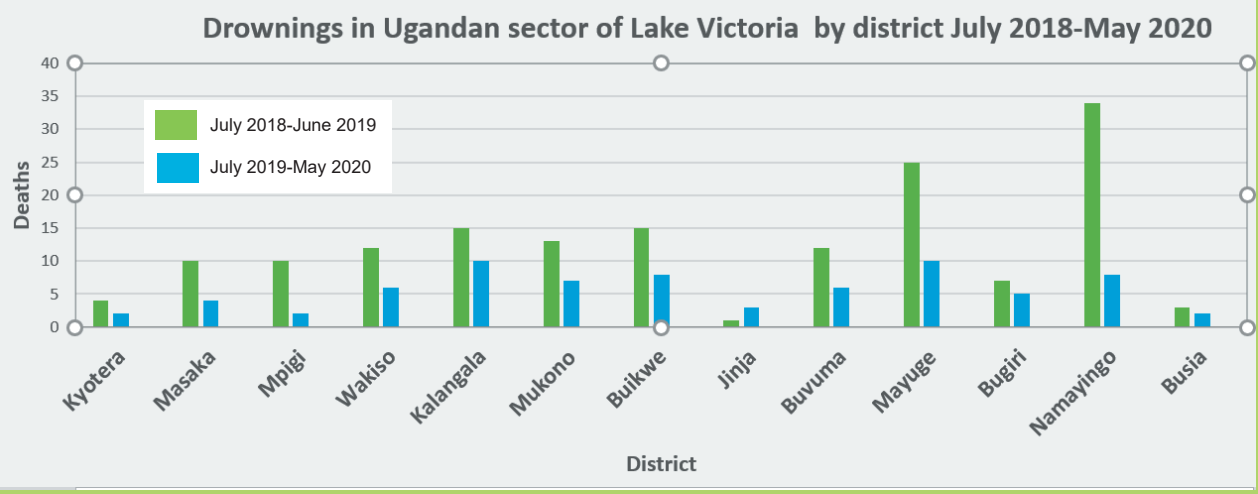
The SEB study has assessed the benefits from investment in infrastructure, training and science, and the improvement in forecasts. It also looked at the improvements made from the project in better communication and tailored weather information, as well as the activities to enhance its uptake and use.

The analysis estimated that the HIGHWAY project has led to approximately a 30% reduction in weather related deaths on Lake Victoria (estimated by the project at 1000/year). Using the current estimates of fatalities, this would mean HIGHWAY activities are preventing around 300 deaths per year.

It was also found that the improved weather information from HIGHWAY is leading to substantial fuel efficiency savings – another benefit useful to fisherfolk as it reduces their operating costs. It is also being used by fish dryers and traders to reduce weather-related losses.

Adding the economic benefits from the improved weather information for various user groups together, it is estimated that the total socio-economic benefits (undiscounted) from HIGHWAY amount to **£76 million** and lead to a **benefit to cost ratio of 16:1**.

Fatalities on the Lake. In Uganda, key informant interviews and focus groups with fishing communities found that the marine forecast helped bring about a sharp fall in the number of people who had drowned in the year from May 2019 to May 2020. This indicated a 30 to 40% reduction compared to the previous 12-month period. A survey of fishermen leaders in all 13 lakeside districts of Uganda produced similar findings, as did interviews with county chairmen in Kenya.



Fishermen, transporters and fishing boat owners on Lake Victoria reported substantial savings when using the marine forecasts, from reduced outboard motor fuel, which allowed them to choose routes to avoid sailing against the wind or through large waves. These savings ranged from 15 to 30 litres of fuel per boat per week, leading to savings of approximately £550 to £1100 annually. Interviews on the Ssese archipelago with local fish traders found that many of them use the forecast to guide their activities. If severe weather is forecast, they carry extra fuel and more ice when transporting fresh fish sites to markets on the mainland.

Fish dryers. Around Lake Victoria, women buy silver fish from fishermen and dry them in the sun to preserve them before selling. If it rains while the fish is drying, the fish starts to rot, and the women have to sell at a steep discount. Silver Fish processors in Uganda reported that before the HIGHWAY forecast they suffered significant losses during the rainy seasons. Interviews found that many fish dryers are using the marine weather forecast to inform their fish buying activities and estimate the forecasts allow them to save up to £75/month.

Enhancing Climate information Services for Agriculture and Disaster Risk Reduction in Rwanda (Iteganyagihe Ryacu)

Rwanda is a small, landlocked and hilly country in East Africa. The economy is dominated by agriculture, which contributes 30% of GDP and accounts for around 70% of employment. It has a more temperate climate than most of the region, due to its generally high elevation, but the hilly terrain is vulnerable to heavy rains, soil erosion, floods and landslides. There are also periodic droughts in the lower eastern region.

The objective of Iteganyagihe Ryacu was to increase the use of improved weather and climate services that have been co-produced and are more accessible to inform the decisions of different users.

The project was implemented by CIAT (The International Center for Tropical Agriculture) working with Meteo Rwanda (the Rwanda Meteorological Agency); Met Office, UK; and the International Research Institute for Climate and Society (IRI).

The project had several objectives, which included improved information for farmers, as well as a new impact based early warning (IBEW) of extreme rainfall events for disaster risk reduction professionals and the wider public.

Using information in the Project Completion Report (CIAT, 2021), which included surveys with farmers on the use and benefits of weather and climate information, **the SEB analysis in this case focused on benefits to farmers,** notably their increase in income due to the use of information.

Benefits will also have been generated from the IBEW funded by the project, but there was insufficient information on this to allow quantification at the time of this analysis.

The surveys provide information for various aspects along the value chain, with information on reach, accuracy, uptake and use. This found improvements in all of these elements, with higher values reported in the end of project survey, as compared to the baseline. The surveys also sampled farmers on the benefits of using such information, who reported better crop yields and increases in income due to accessing and using weather and seasonal forecasts from the project. This survey information was used to produce a value chain analysis and estimated benefits. The benefits were adjusted to take account of the role of WISER funding as compared to other improvements and so attribute a proportion of benefits to the project.

The total estimated benefits (undiscounted) of the Rwanda national project were estimated at **£19.2 million**, with annualised benefits of £3.4 million/year. The cost-benefit analysis estimated a benefit to cost ratio of **23:1,** which is very high.

Enhancing the capacity of Tanzania Meteorological Authority (TMA) in provision of climate services in Agriculture, Energy, Marine transport, Disaster and Water Sectors

Tanzania's economy is very dependent on the climate, because a large proportion of GDP is associated with climate sensitive activities. The weather of the country is affected by high levels of variability between years, and it is frequently impacted by extreme events.

The aim of this project was to increase the availability and quality of weather and climate data, through enhanced skills, improved communication and new co-produced products in target sectors.

Implemented by TMA, the project worked in partnership with Met Office, UK and the Tanzania Meteorological Society (TMS). It facilitated 14 co-production meetings to improve climate information and its access for decision making.

The SEB analysis is based on the Project Completion Report (TMA, 2020) and focuses on a sub-set of benefits of the project, from increased access to tailored-made information by farmers through the Farm SMS. This service aimed to help farmers improve their decision-making, such as in selecting crops, and with livestock and pasture management in light of climate forecasts. Registered subscriptions show that the project is estimated to have increased the service from a baseline of 5,000 to 11,600 farmers.

The analysis focused on the **increased income of farmers due to improved management of weather-related risks**. This took account of the value chain for the service, meaning the number of users and the uptake and use of information.

The level of benefits for farmers that used the service were also estimated. This was based on a Farm SMS pilot, which reports increased crop yields in Tanzania and indicated positive high yield increases (of between 50% to 100%). The lower end of this range was used for the SEB analysis for TMA, taking into account the lower values likely from moving to large-scale uptake of the service, and assuming these benefits arose for most but not all farmers. These benefits are combined with data on wages in agricultural services to estimate possible benefits.

It is highlighted that this calculation does not include the costs of action taken by individuals, but at the same time, the project generated services for other sectors (in energy, marine transport, water and disaster risks) which were not quantified in this study.

The annual incremental benefits were estimated at £0.6 million, and for the project overall, the socio-economic (undiscounted, over 10 years) were **£4.2 million**. Taking account of project costs, the economic analysis estimated the benefit to cost ratio at **16:1.**

WISER Support to the IGAD Climate Prediction and Applications Centre (ICPAC) Project (W2-SIP)

East Africa experiences high levels of climate variability, driven by the regional and global climate, including the El Niño – Southern Oscillation (ENSO) cycle. As a result, it has very large annual variations in rainfall from one year to the next, including regular droughts and floods. These events have high economic costs. Recent analysis of Ethiopia, Kenya, Tanzania and Uganda estimates these could lead to annual equivalent losses of USD$200 million for agriculture alone (CIMA, UNISDR 2018: 2019).

The objective of W2-SIP was to increase the use of co-produced reliable weather and climate products and services to inform regional and national level policy planning and decision making.

It was implemented by the Intergovernmental Authority on Development (IGAD) Climate Prediction and Applications Centre (ICPAC) in Nairobi. This is a specialised institution which aims to build resilience in the region through provision of quality climate services. The geographical focus of the project was the Greater Horn of Africa, which includes Ethiopia, Djibouti, Kenya, Sudan, South Sudan, Somalia, Uganda, Rwanda and Tanzania.

The project built on previous interventions in the region, including WISER's Strengthening Climate Information Partnerships – East Africa (SCIPEA), a Phase 1 project. This helped improve forecasting, interpreting and use of dynamical seasonal forecasts.

Building on the results of SCIPEA, one of the key objectives of W2-SIP was to support ICPAC move from consensus-based to objective seasonal forecasting. Historically, seasonal forecasts in East Africa were prepared using statistical approaches and included a significant subjective component. These forecasts were generated through consensus, but had a number of limitations. These can be addressed by moving to objective, traceable and reproducible seasonal forecasts, in line with World Meteorological Organization (WMO) recommendations.

With this in mind, ICPAC, with support from W2-SIP, produced the first objective consolidated forecast for the June-September 2019 rainfall season.

This used predictions from seven global dynamical models. The move to objective forecasting, along with a digital rather than a map-based format, improved the quality and usefulness of the forecasts, and increased forecast accuracy – defined in terms of the relative operating characteristic (ROC) skills.

The **SEB analysis investigated the benefits of these objective seasonal forecasts**. This used information from the Project Completion Report (ICPAC, 2021). This analysis was a little different to the other WISER projects, because the project was focused on foundational activities. The socio-economic benefits are generated by upstream activities (forecasting), as opposed from changes to the uptake and use of services.

The analysis of potential benefits was estimated by developing a baseline of current economic impacts from climate variability and extreme events in the region, drawing on recent UN disaster risk profiles for the major countries in the region. This focused on the flood and drought related impacts to the agriculture sector.

The potential benefits of seasonal forecasts in reducing these impacts were then estimated, for a baseline (i.e. consensus-based forecasts) and with the WISER project (i.e. objective based forecasts), the difference being the benefits attributed to W2-SIP. Baseline estimates were based on the literature (Vaughan et al., 2019), while the improvements in forecast accuracy from the project were based on Coleman et al. (2018), which undertook a specific analysis of the improvements for the Greater Horn of Africa region. This found an increase in skill due to the use of indirect forecast modelling and calibration, as compared to the consensus-based approach.

The total estimated benefits (undiscounted) of the W2-SIP project were estimated at **£40.9 million**, with a benefit to cost ratio of **14:1**.

Phase 2 Projects Not Quantified

It was not possible to quantify the socio-economic benefits for all Phase 2 projects. This was the case for five Phase 2 WISER projects, where activities were targeted towards research, training or early-stage development of services, or else did not have well defined services or user groups.

However, these projects – summarised below – will also generate socio-economic benefits, which would be additional to the values for the quantified Phase 2 projects.

The WISER **Adaptive Social Protection – Information for Enhanced Resilience (ASPIRE)** project was implemented by a consortium of the Met Office, UK, the Walker Institute (University of Reading) and the Norwegian Refugee Council. It provided strategic and technical support to social protection initiatives, notably the World Bank's Adaptive Social Protection Programme in the Sahel. This aims to reduce poverty by helping countries move away from expensive post-disaster emergency aid towards anticipatory action. ASPIRE demonstrated how climate information could inform and strengthen adaptive social protection decisions and has built foundational activities such as training on use of seasonal forecasts. Currently, however, a new service has not been implemented and socio-economic benefits have not been estimated.

Coastal Resilience and Improved Services for Potato Production (CRISPP) was implemented by the Kenya Meteorological Department (KMD), Met Office, UK and the Global Climate Adaptation Partnership (GPAC) Kenya. The coastal component of the project aimed to provide access to downscaled and targeted decision-relevant weather and climate information for households in Kenya's coastal region, including marine forecasts. The potato farming component sought to improve the use of climate information in business decisions in Kenya's potato sector. While the project led to important improvements in both areas, there was not sufficient data to perform a meaningful socio-economic benefit analysis.

Weather Wise: Joining Forces to Communicate Weather and Climate was implemented by BBC Media Action in partnership with the Network of Climate Journalists in the Greater Horn of Africa. The aim was to strengthen the capacity of media professionals and technical experts for climate and weather information needs of audiences living in Kenya and Tanzania. The project undertook extensive activities to improve the generation and communication of weather and climate information. This will generate benefits, from the subsequent use of this information in people's decision-making, but it was difficult to quantify these effects, as there was not a focus on specific forecasts or users.

The WISER **Aircraft Meteorological Data Relay ("AMDAR") Programme for Kenya** was implemented by the World Meteorological Organization (WMO), Kenya Meteorological Department (KMD) and Kenya Airways (KQ). It established a meteorological observing programme based on the automated reporting of atmospheric information from a fleet of aircraft, using existing aircraft onboard sensors and communications systems to collect, process, and transmit data to ground stations. The improved observations have benefits for the aviation industry – for safety aspects and the costs of operations – and more broadly in terms of improved forecasting. Due to challenges, the operational delivery of the project was delayed, and so its benefits were not estimated.

Somalia and South Sudan (SSS) – **WISER Support for Priority Sectors** was implemented by IGAD Climate Prediction and Applications Centre (ICPAC), working with a number of project partners. The aim was to identify priority users of climate information services and engage them to understand their needs. The project also trained meteorological service employees. The project invested in key foundational activities, which will allow the subsequent uptake and use of weather and climate services in Somalia and South Sudan. A significant result for SSS is that the project set up two new National Climate Outlook Forums (NCOFs) for Somalia and South Sudan. However, the focus on consultation and training activities, rather than new services, means it has not been possible to estimate benefits.

Total Socio-Economic Benefits of WISER

The results from individual WISER projects are brought together in the table below. It shows that the East Africa component of WISER has exceeded its anticipated target of £190 million of avoided losses**, delivering significant economic benefits that exceed £200 million** from the use of W&CS supported by the programme.

There would also be additional benefits from the other WISER projects for which quantification was not possible. Furthermore, the national and regional investment in weather and climate services from the WISER programme would lead to additional indirect benefits, such as the potential for other users to use improved seasonal forecasts, or the wider benefits of training for other forecast products.

Estimated Socio-Economic Benefits of the WISER Programme

WISER Programme	Benefits (£Million)*
Phase 1 Projects	
Multi Hazard Early Warning Service (MHEWS)	12.6
Decentralised Climate Information Services for Decision Making in Western Kenya	8.2
Phase 2 Projects (quantified)	
Strengthening Weather and Climate Information Services in Uganda	24.9
Developing Risk Awareness through Joint Action (DARAJA)	21.7
High impact weather lake system (HIGHWAY)	75.8
Enhancing Climate information Services for Agriculture and Disaster Risk Reduction in Rwanda (Iteganyagihe Ryacu)	19.3
Enhancing capacity of Tanzania Meteorological Authority in provision of climate services in Agriculture, Energy, Marine transport, Disaster and Water Sectors	4.1
WISER Support to the IGAD Climate Prediction and Applications Centre Project (W2-SIP)	40.9
Phase 2 projects (unquantified)	
Adaptive Social Protection – Information for Enhanced Resilience (ASPIRE)	NQ
Coastal Resilience and Improved Services for Potato Production (CRISPP)	NQ
Weather Wise: Joining Forces to Communicate Weather and Climate	NQ
WISER Aircraft Meteorological Data Relay ("AMDAR") Programme for Kenya	NQ
Somalia and South Sudan – WISER Support for Priority Sectors (SSS)	NQ
TOTAL	207.5

NQ = not quantified.

*Note benefits are presented as the undiscounted benefits, as this represents the total benefits of the project. This correlates with the WISER programme's first impact indicator in its logframe.

£200 million

Estimated total socio-economic benefits of the WISER programme

Total Benefit to Cost Ratios of WISER

The results of a cost-benefit analysis undertaken as part of the SEB analysis are also presented, for those projects where quantitative estimates were possible. This compares the benefits and costs of projects, analysing and presenting these as a benefit to cost ratio (BCR), shown in the table below.

A BCR greater than 1 demonstrates that a project has a net positive economic benefit.

The table shows that the BCRs of WISER East Africa projects are in the range of 7:1 to 26:1, and thus have large net benefits. **For every £1 spent on these projects, there is an economic benefit of between £7 and £26.** Overall, the average across the projects is 17:1. These results provide strong evidence that the East Africa component of the WISER programme has delivered high value for money.

Economic Benefit to Cost Ratios (BCRs) for East Africa Projects in WISER

WISER Programme	Benefit to Cost Ratio*
Phase 1 Projects	
Multi Hazard Early Warning Service (MHEWS)	16:1
Decentralised Climate Information Services for Decision Making in Western Kenya	7:1
Phase 2 Projects (quantified)	
Strengthening Weather and Climate Information Services in Uganda	26:1
DARAJA (Developing Risk Awareness through Joint Action)	20:1
High impact weather lake system (HIGHWAY)	16:1
Enhancing Climate information Services for Agriculture and Disaster Risk Reduction in Rwanda (Iteganyagihe Ryacu)	23:1
Enhancing the capacity of Tanzania Meteorological Authority (TMA) in provision of climate services in Agriculture, Energy, Marine transport, Disaster and Water Sectors	16:1
W2 WISER Support to the IGAD Climate Prediction and Applications Centre (ICPAC) Project (W2-SIP)	14:1

*Note, BCRs are presented using a 10% discount rate.

The BCR calculations do not include the costs of action taken by individuals, and their inclusion would reduce net benefits and the BCR ratio. At the same time, these projects will also generate indirect benefits, i.e. the spill over effects of improved seasonal forecasts for other users, that are not captured, which would increase benefits and increase the BCRs. Further work to understand these additional elements is needed.

17:1

Average Benefit to Cost Ratio of WISER projects

Recommendations

Based on the analysis presented in this report, a number of recommendations are made for future socio-economic benefits studies:

1. There has been positive feedback on the SEB values, and many project teams have subsequently used the SEB information to communicate the benefits of their projects. The SEB results also provide key information on the value for money of projects and the programme overall. A general recommendation is to encourage the analysis of SEB in weather and climate service programmes.

2. The use of a programme level impact indicator on economic benefits has been useful in WISER, and a recommendation is to use a similar indicator in future programmes. Following from this, it would be useful to ensure that projects include socio-economic benefit as an outcome or impact indicator in their logframes as well, to demonstrate and report on improved yields or incomes. Again, this action should be taken forward when commissioning studies, and will support a way to link project to programme performance.

3. WISER SEB guidance was developed during Phase 1 of the WISER programme. However, many Phase 2 teams did not undertake a detailed SEB analysis. A recommendation is that SEB analysis needs to be planned from the start of projects, and should be included in project costing.

4. To improve SEB analysis, a clearer set of baseline studies are needed which establish baseline forecast accuracy, reach, use, and effectiveness of uptake along the weather and climate service value chain for projects. This action should be taken forward when commissioning studies, and it may be useful to provide technical support to projects to ensure this happens early on.

5. It would be useful for future SEB studies to undertake more rigorous analysis of potential benefits, seeking to assess and report on these in baseline and end of project surveys, and as part of project evaluations. Projects should also consider the potential indirect benefits, including for different end-users in other sectors, or from wider benefits of improved forecasting capability. Likewise, SEB studies should include analysis of the costs of action, including the costs of actions taken by individuals.

6. Finally, one area that has not yet been explored are the socio-economic benefits and benefit-to-cost ratios of co-production. The WISER programme promoted the use of co-production as integral to delivering user led W&CS. It would be useful to commission some SEB analysis to investigate the economic and vaue for money case for this in a potential future phase of the programme.

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