Guidance Notes on Implementation of WISER Value for Money and Socio-economic Benefit Framework

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Supported by:

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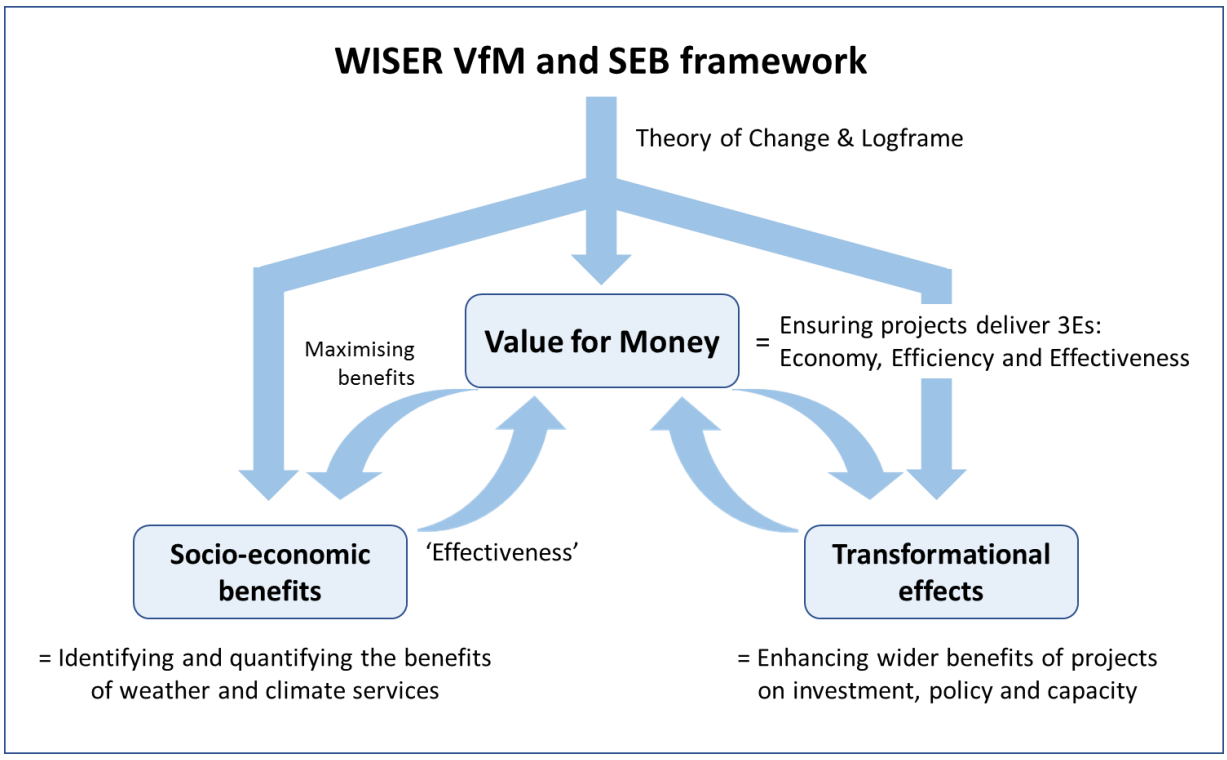
Introduction and Background

The Department for International Development (DFID) is funding the WISER programme (Weather and Climate Information SERvices for Africa) and will provide up to £35 million over four years to enhance the resilience of African people and economic development to weather and climate related shocks. The programme aims to improve the generation and use of the weather and climate information across Sub-Saharan Africa, with an initial focus on the Lake Victoria Basin region.

WISER has adopted a framework for measuring value for money, socio-economic benefits and transformational effects across the programme. The aim is to ensure a coherent and harmonised approach is adopted by the Met Office, the African Climate Policy Centre (ACPC), DFID and other project stakeholders. This framework was set out in an earlier document and is summarised below.



It was also recommended that guidance should be developed to implement the framework above: this guidance is set out in this document.

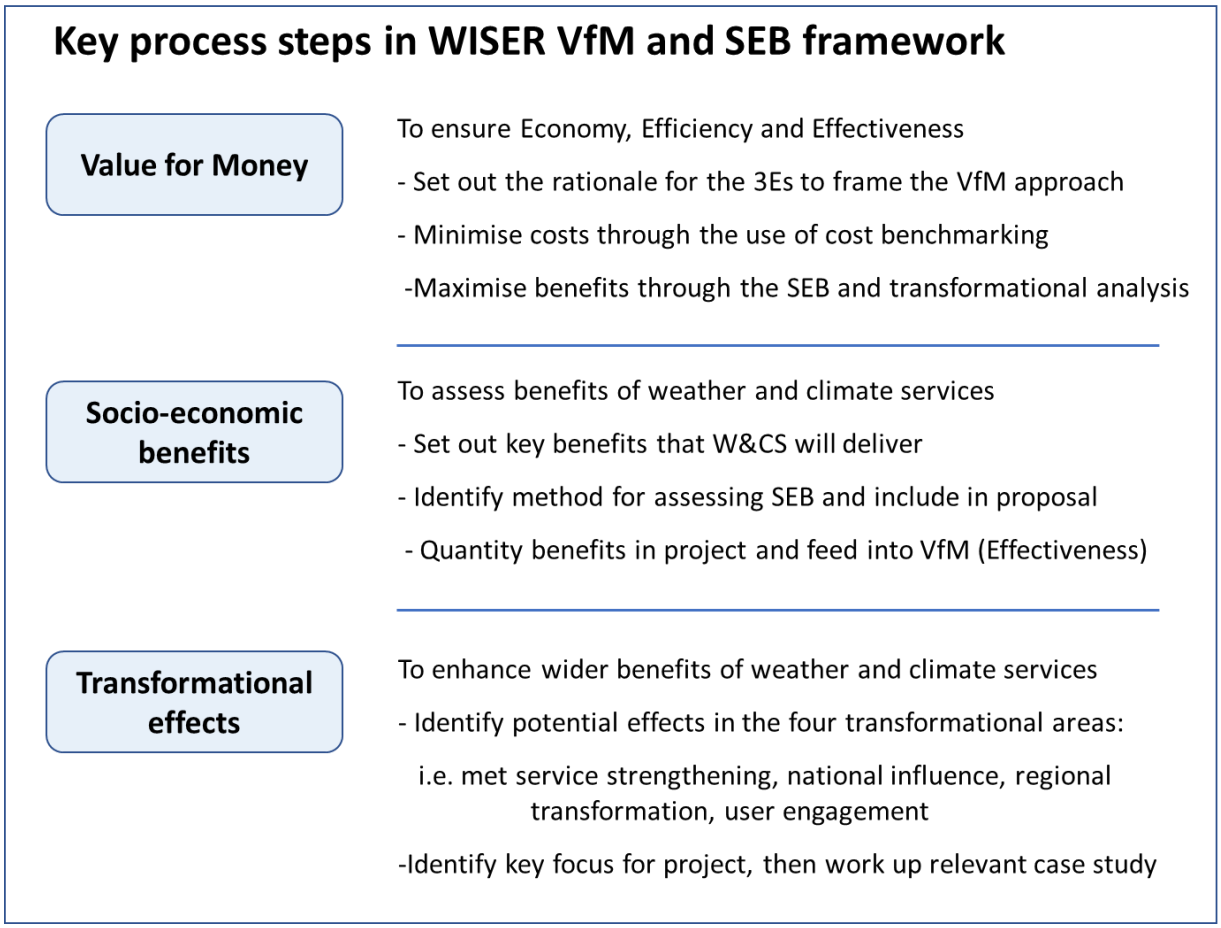
It sets out why Value for Money (VfM), Socio-Economic Benefits (SEB) and Transformational benefits are important. It includes an overview on how to consider these aspects in proposal development and subsequent implementation for Weather and Climate Services (W&CS) / Climate Information Services (CIS). While the focus is on project proposers, the information is also relevant for the overall WISER programme (and thus for fund management).

The guidance is set out in three key sections.

- Value for Money;

- Socio-Economic Benefits;
- Transformative effects.

For proposers, it is stressed that this guidance should be considered as early as possible in the process, i.e. at the concept note stage. The key steps involved in the guidance are summarised in the figure below.



VALUE FOR MONEY

WISER is funded by DFID and there is a need to ensure the programme delivers Value for Money (VfM). This is about maximising the impact of each pound spent to improve poor people's lives[1]. The purpose is to develop a better understanding (and better articulation) of costs and results to make more informed, evidence-based choices.

WISER funded projects should therefore be able to demonstrate a strong VFM rationale case and:

- Provide assurance that projects understand their costs and benefits, and ensure that resources are prioritised to where they have the greatest impact;
- Offer DFID a more detailed insight into the socio-economic returns of W&CS/CIS programmes, creating a stronger justification for investment in this area;
- Generate evidence on the most effective approaches to programme implementation, supporting transfer of this knowledge to other programmes;

WISER has therefore developed this VfM guidance for organisations preparing concept notes and proposals, though it is also relevant for overall VfM in the WISER project and thus fund management.

What is Value for Money and why do you need to include in your project?

DFID guidance frames VfM at three levels which are clearly linked to the theory of change and logframe: **Economy, Efficiency and Effectiveness (the 3Es)**. These are set out in more detail below:

- *Economy (inputs, i.e. spending less).* This refers to ensuring the lowest cost use of goods and services within a project. It focuses on making sure that input unit costs are benchmarked against market norms and thus that value is maximised through strong procurement processes;
- *Efficiency (inputs to outputs, i.e. spending well).* This refers to ensuring that the quality and quantity of inputs are appropriate to achieve the envisaged outputs and that inputs are managed in an efficient way during project delivery. The input to output ratios are the key consideration;
- *Effectiveness* (*outputs to outcomes/impacts, i.e. spending wisely*). This refers to what extent programme outputs are likely to result in the desired outcomes, whether a programme can demonstrate that the chosen outputs are the most effective way to achieve these outcomes, and how these outcomes can be measured.

[1] See DFID's Approach to Value for Money (VfM) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/67479/DFID-approach-value-money.pdf

In WISER, the approach for these three elements can be addressed in the following way:

1. **Setting out the 3 Es rationale** to frame the overall VfM approach;
2. **Minimising costs** through the use of cost benchmarking;
3. **Maximising benefits** through the use of SEB and transformational analysis.

These are each set out in more detail below:

Setting out the 3Es rationale

In the Value for Money section of the WISER proposal template, proposals should set out a high-level rationale for how they have considered the 3Es framework and consequently how VfM will be approached within the project.

Key questions that should be addressed are:

- *Economy:* How procurement will be used to ensure lowest cost inputs sufficient to ensure successful project implementation?
- *Efficiency:* How management processes will deliver outputs in an efficient manner (on time and on budget), including the use of incentives (e.g. results based finance), capacity building and appropriate governance mechanisms to overcome potential barriers?
- *Effectiveness:* Why the choice of activities represents the most effective means to achieve the envisaged outcomes envisaged in the logframe (e.g. improved productivity, risk reduction, leverage, institutional development)? What might be the typical socio-economic returns expected from such activities (expressed qualitatively or as a Benefit Cost Ratio)?

This should then be supported by a more detailed description of the project approach to cost benchmarking (minimising costs), and how the value of project outcomes might be further explored and maximised using SEB and transformational impact analysis during project implementation.

Cost Benchmarking (Minimising Costs)

Cost-benchmarking involves exploring the unit costs for a given input, output or outcome. It provides a level of transparency for your programme deliverables and allows a level of comparison between projects.

The aim is to minimise the costs required to achieve each stage of the theory of change (or logframe) and ensure that all are delivered at best value to the WISER programme.

Cost benchmarking can be done at the three levels of the VFM model, as set out below.

Economy (Cost per input)

Demonstrating economy is important to ensure that input costs are reasonable and are procured in a transparent and competitive manner. It is also important to show how a project can leverage existing 3rd party resources at low or no cost to achieve its outcomes. Projects should therefore seek to set out the main input cost drivers within the project, and how they relate to benchmarks or market norms within similar projects. Much of this data will be derived from the finance sections of the proposal (Part 14). The following aspects should be addressed:

- Set out the main input cost drivers of the project. For example:
    - Staff costs;
    - Services procured (e.g. travel, consultancy);
    - Capital/asset expenditure (unit costs);
    - Management costs.
- Indicate the cost per unit envisaged within the budget:
    - Day rate cost by grade (e.g. senior/junior), or by technical profile;
    - Cost per night accommodation, flight costs, consultancy day rates;
    - Hardware or software costs per unit;
    - Management costs as % of overall budget.
- Explain (and preferably benchmark) how these input costs relate to similar existing projects delivered by the contractor to DFID or in other similar development programme contexts (geographical, sectoral);
- Describe how procurement rules will ensure competitive pricing for any goods or services, whilst maintaining quality and performance thresholds.

3Es Example: Strengthening Climate Information Partnerships - East Africa (SCIPEA)

The purpose of the SCIPEA project is to strengthen climate partnerships on three levels. Enhancing links and data exchanges between global, regional and national climate organisations is a core part of the project, with the aim of strengthening resources and tools for seasonal forecasts. A review of SCIPEA indicated significant benefits in terms of the leverage of existing Global Producing Centres (GPC) resources and other data sets to improve the quality of national products. This has resulted in significant embedded economic value in the project for which WISER has not had to meet the costs. Project partners have also contributed significant in-kind resources during project implementation which could be better described during proposal development and project reporting.

Efficiency (Cost per output)

Efficiency ensures that the volume and quality of inputs is sufficient (but not excessive) to achieve the envisaged outputs. It also captures the quality of the management processes that will oversee programme implementation and how they will address potential barriers to the successful delivery of outputs.

Any commercial incentive structures that are likely to contribute to cost control and efficient implementation (e.g. payment by results, training, capacity building) should be set out. The aim is to ensure that outputs are delivered on time and at the envisaged cost. These outputs will normally be those set out in the programme logframe, reflecting key project deliverables.

The following aspects should be addressed:

- Set out the key outputs to be delivered (e.g. training course, forecast product) including a technical description (e.g. number of days' study and qualification achieved, technical specification of forecast product);
- Provide a consolidated cost per output that includes all envisaged input costs (design, consultation) as well as apportioned management overheads. This should include co-finance where appropriate;
    - E.g. Costs per training course delivered
    - E.g. Costs per forecast product delivered to the given standard (including all related consultation and design costs)
- Benchmark these unit costs against any existing internal or external programmes that the contractor is familiar with, explaining any potential variation in costs, and indicating sources of information used;
- Describe how management processes will ensure that these costs are monitored and reported during project implementation;

3Es Example: Kenya Training Modernisation and East Africa Forecaster Training Course

The purpose of this WISER quick start project was to build capability within the Institute of Meteorological Training and Research (IMTR) in Kenya to deliver a modernised training program that meets World Meteorological Organization (WMO) learning objectives for meteorologists. From a cost efficiency and cost effectiveness perspective, the project is able to compare its costs to delivering similar courses in the UK through the Met Office, or in other countries as part of longer term academic processes. Cost benchmarking suggests that the costs of delivery (i.e. through reduced living costs) significantly reduce the overall cost of delivery, while the train the trainers component will likely reduce the costs of teaching in the long term by building longer term capacity. The course may also be more effective in terms of outcomes due to the material being customised to the East African climatic context.

Effectiveness (Cost per outcome/impact)

Cost effectiveness benchmarking ensures that the project has selected the activities most likely to achieve envisaged outcomes at the lowest cost. It allows for the comparison between different types of interventions, recognising that outcomes (e.g. improved resilience, avoided damages, improved productivity, increased leverage) can be achieved in several different ways.

Within weather and climate services, there may be different approaches to achieve the envisaged outcome, such as by investing at different stages of the information value chain. There may also be alternatives to CIS investment which could have the same result (e.g. investment in hard infrastructure or agricultural productivity).

The following aspects should be addressed:

- Identify outcomes/impacts in the theory of change or logframe that will be quantified. Examples might include:
    - # beneficiaries reached
    - # livelihoods made more resilient
    - # avoided loss of life or injury (e.g. DALYs)
    - # forecasters with improved skills
    - avoided damages to infrastructure
    - increased agricultural productivity (e.g. t/ha)
    - £ leveraged for CIS services
- Identify the costs relevant to delivering the given outcome (based on earlier input and outcome costs where these can be apportioned, otherwise taking the whole programme cost) and calculating a cost per outcome benchmark. Note that for cost effectiveness analysis, the costs should include not only WISER programme costs, but also any co-finance in relation to the overall outcomes to be achieved[2];
- Benchmark these outcomes against existing projects and programmes where similar cost effectiveness data is available, indicating sources of information as appropriate;
- Describe how the outcome will be measured, and how costs are to be apportioned;

The development of cost effectiveness benchmarks (cost/outcome) can also play an important role in informing more detailed socio-economic benefits analysis, as many of the outcomes can then be valued in monetary terms to create benefit cost ratios

[2] Note that including only WISER costs and excluding co-finance would result in a lower cost per outcome than would - in reality - be the case. Proposal developers should ensure that cost effectiveness analysis reflects the full cost of achieving an outcome.

(BCRs). This is discussed in more detail in the section on Socio-Economic Benefits later in this guidance note.

Table 1 sets out examples of how the cost benchmarking approach might be presented in the proposal as part of the VFM section in Part 10. The examples given are indicative, and proposal developers should feel free to use those input cost drivers, outputs and outcomes most appropriate to their given project. This table can be integrated into the VFM section of the proposal (Part 10).

Table 1: Overview of Cost benchmarking approach

Economy			
Main input cost drivers	**Cost per input (unit cost) (£)**	**Benchmark comparator**	**Procurement process**
Input 1 e.g. staff Input 2 e.g. capital equipment Input 3 e.g. Travel costs Input 4 Management cost	Day rate £ per station £ per flight % of budget	Other project rates Market cost Market cost % other projects	How are procurement processes being managed to ensure that costs are minimised?
Efficiency			
Main outputs	**Cost per output (£)**	**Benchmark comparator**	**Management process**
Output 1 e.g. Training course Output 2 e.g. Forecast model Output 3 e.g. Stakeholder process	£/course delivered £/model developed £/process	Comparable data from existing programmes and initiatives where appropriate	How are management processes structured to ensure that outputs can be delivered (e.g. addressing potential barriers to uptake) and that costs are appropriately apportioned to outputs?
Effectiveness			
Main outcomes	**Cost per outcome (£)**	**Benchmark comparator**	**Measurement process**
Outcome 1 e.g. # resilient beneficiaries Outcome 2 e.g. # avoided loss of life Outcome 3 e.g. # avoided infra. Damage Outcome 4 e.g. # trained forecasters Outcome 4 e.g. # increased yield Outcome 5 e.g. £ leveraged for CIS services	£/beneficiary £/avoided DALY £/avoided impact £/forecaster trained £/tonne £ per £ leveraged	Other programmes	How are outcomes to be measured during programme implementation, and how will cost per outcome will be reported during project implementation?

Table 2 provides some examples of how the framework might be relevant to different types of intervention:

Table 2: Cost benchmarking – some examples by intervention type

	Training/capacity building	**Early Warning System**	**Seasonal forecast**
Economy (Input)	Day rate for trainers Premises hire Travel and subsistence rates Management overheads	Staff costs (e.g. senior/junior) Developer costs (e.g. day rates) Stakeholder consultation costs	Staff costs Developer costs (e.g. day rates) Stakeholder consultation costs
Efficiency (output)	Cost per course delivered	Cost per EWS system developed	Cost per seasonal forecast product developed
Effectiveness (outcome)	Cost per participant qualified to the higher standard	Cost per end user reached Cost per impact avoided Cost per livelihood protected	Cost per end user reached Cost per farmer with increased resilience Cost per increase in yield (t)

WISER recognises the potential challenges of apportioning costs to a given output or outcome. Proposal developers are therefore encouraged to be transparent in their assumptions around the cost data used. WISER also recognises that benchmark comparator data may be challenging to identify or obtain. Proposals are therefore encouraged to draw on existing projects that have been (or are under) implementation, and to review the literature to identify similar activities, where input, output or outcome data are available.

SEB and Transformational Impact Analysis (Maximising Benefits)

WISER invests in Climate Information Services programmes to help governments and vulnerable communities realise the potential benefits that such information can offer. WISER classifies these benefits in the following ways:

- *Socio-economic benefits:* These are benefits that accrue directly to end beneficiaries (see next section). Improved weather and climate information services have the potential to encourage changes in behaviour and investment that can reduce risk or improve economic productivity among vulnerable stakeholder groups (e.g. farmers, marine transport, energy producers, coastal communities). Socio-economic benefits can therefore be directly attributed to changes in the improved quality and availability to end-users. These benefits are

typically those that might be appraised and valued as part of a cost benefit analysis;

- *Transformational benefits:* These are benefits that accrue indirectly due to the strengthening of the institutional and financial frameworks in which stakeholders (policy makers, met services, private sector) operate (see later section). These benefits, however, cannot usually be linked directly to end beneficiary outcomes due to the long results chains involved. They are rather enabling processes that maximise capacity to deliver sustainable socio-economic benefits over time. These are typically more difficult to value from an economic perspective and so are normally captured in more qualitative terms.

Socio-Economic Benefits (SEB) Example: Tanzania Early Warning

The Multi Hazard Early Warning Services for Tanzania (MHEWS) aims to enhance the role, capacity and reputation of the Tanzania Meteorological Agency (TMA) through the development and delivery of a pilot Early Warning Service (EWS) for the coastal regions, thus strengthening Tanzania's preparedness and reducing the impacts of extreme weather. As part of the early work in the project, a baseline desk review was on undertaken on the socio-economic damages from extreme events. This provides information on the potential current impacts, and thus the potential socio-economic benefits of the programme in reducing these damages. The potential to move to a more detailed analysis of the socio-economic benefits of the EWS, and also an analysis of the weather chain to explore how to maximise the delivery of these benefits to end-users, is being considered during potential next stages.

Transformation Example: Decentralised CIS for Decision Making in Western Kenya

The purpose of this project is to develop and deliver demand-led and decentralised services of the Kenya Meteorological Department (KMD) in the counties of Kakamega, Siaya, Kisumu and Trans Nzoia. KMD's forecasting is being streamlined to improve existing products and services and facilitate the delivery of new ones in response to demand from users in the counties. It invests in improved seasonal forecasting techniques to provide better downscaled information with a longer lead time and with updates during the season. A discussion with the project team indicated the potential for a transformation case study showing how the project had improved the funding position and strengthened the institutional arrangements for delivering weather and climate services at county level in Kenya. The programme had been successful in mobilising l funding from county budgets (e.g. from County Climate Funds), and had made progress in integrating improved CIS into county planning frameworks (Integrated Development Plans), thereby improving the resilience orientation of local policy processes. A key issue is whether the increased fragmentation and costs associated with decentralised met services is offset by the improvement in local buy in and engagement.

Each WISER project will have a different balance of the two types of benefits. For example, some projects may focus on institutional strengthening of met services and their relationships with policy makers. Others will work directly with users of W&CIS

products to improve their quality and uptake. Nonetheless, all projects are encouraged to consider how they might contribute to each benefit stream.

From a VFM perspective, WISER seeks to maximise both the socio-economic and the transformational benefits of its interventions, so that the ratio of benefits to costs is as high as possible. However, this requires that the benefits can be accurately described, measured and where possible valued in financial or economic terms.

At proposal stage, programmes should set out the high-level benefits that might be expected in both categories. These should be reflected in logframes or theories of change where appropriate. However, WISER recognises that these benefits may be difficult to appraise and quantify at programme design stage and such work can be resource intensive. Programmes will therefore be expected to incorporate activities that allow them to explore, quantify and value these benefits during programme implementation, and to integrate such activities into the knowledge management and M&E frameworks.

The approach to identifying and valuing socio-economic and transformational benefits is set out in the later sections in more detail.

Reflecting VFM in WISER proposals

As discussed earlier, the approach to VFM should be primarily set out in the VFM section the WISER proposal. However, VFM should also be reflected and aligned elsewhere. Table 3 provides a summary of where VFM is relevant within the WISER proposal and how it should be incorporated.

Table 3: Where to reflect VFM in the WISER proposal

Section	3Es/Cost benchmarking	Socio-economic benefits	Transformation
Summary		Incorporate any SEB studies to be undertaken into project activities	Incorporate any transformation research activities or case studies into project activities
Rationale	Explain why project approach was selected as most effective way of delivering envisaged outcomes vs. other potential activities vs. other potential approaches	Provide quantification of any damage impacts or economic opportunities that could be addressed through the project Provide CBA data from similar activities to provide indicative economic returns on the project	Set out the transformational opportunity in terms of strengthening W&CIS institutions, financing and markets
Project approach	Ensure that outputs and outcomes used in VFM analysis are captured in the monitoring, valuation and learning framework	Incorporate any SEB studies to be undertaken into project activities	Incorporate any transformation research activities or case studies into project activities Ensure that key VFM and transformation indicators

Section	3Es/Cost benchmarking	Socio-economic benefits	Transformation
			(e.g. institutional capacity) are reflected in the MEL framework Explore VFM aspects of how sustainability will be achieved in terms of institutional embedding or replication.
Project interaction	Set out how the programme will incorporate co-finance and leverage 3rd party expertise to reduce costs to WISER. State how will the programme work with other complimentary initiatives		Set out how the project's institutional partnerships and relationships likely to strengthen the enabling environment and demand for W&CIS services
Project management	Indicate how management structure will focus on and influence cost control and output delivery		
MEL	Ensure that outputs and outcomes used in VFM analysis are captured in the MEL framework		Ensure that key VFM transformation indicators (e.g. institutional capacity) are reflected in the MEL framework
VFM	Set out 3Es rationale for project Insert cost benchmarking table with expected cost/input output and outcome ratios, including any existing benchmark data Describe how cost benchmarks will be monitored and reported over the project cycle	Set out in qualitative terms the benefits envisaged to end users of improved W&CIS products and delivery systems Provide any ex-ante economic estimates of benefits undertaken during project preparation Describe any existing evidence supporting positive socio-economic returns for similar types of interventions Describe how the project will incorporate new socio-economic benefit studies during implementation where appropriate	Set out in qualitative terms the expected high-level transformational benefits Provide any ex-ante quantitative estimates of to what extent the project will result in increased resource mobilisation, budget influencing, or market development Describe any existing evidence for the impact of similar interventions on transformation Describe how the project can be used to develop a case study on transformational benefits

Section	3Es/Cost benchmarking	Socio-economic benefits	Transformation
14: Project budget	Costs used here should be reflected in the cost benchmarking analysis	Use programme costs for any SEB cost benefit analysis	
Attachment 1 - Logframe	Ensure that outputs and outcomes used in VFM analysis are captured in the MEL framework		Ensure that key VFM transformation indicators (e.g. institutional capacity) are reflected in the MEL framework

SOCIO-ECONOMIC BENEFITS

This section summarises the WISER guidance on socio-economic benefits (SEB) and the linkages to Value for Money. The analysis of the socio-economic benefits of W&CS can be undertaken as a stand-alone analysis, i.e. to help in the design of the service, or to choose between options (as part of a cost-benefit analysis for appraisal). However, the analysis of SEB also forms a key part of VfM: it helps to maximise benefits, as well as providing direct evidence for the '*effectiveness'* component of the 3Es. The analysis of SEB therefore follows on from the VfM section above and also provides an additional means to demonstrate and report back on W&CS benefits.

What are socio-economic benefits and why are they relevant for W&CS?

Weather and climate services are usually seen as non-technical in nature and people find it difficult to assess their benefits in quantitative terms. However, investing in weather and climate services leads to improved information, such as better forecasts, early warning systems and seasonal forecasting. In turn, these services provide benefits to users, and lead to positive outcomes from the actions and decisions they subsequently take. As examples:

- Early warning systems can significantly reduce the damages and losses - and reduce loss of life and injuries - caused by extremes and disasters:
- Seasonal outlooks can help improve agricultural production (higher yields) or reduce losses from extreme events.

This part of the guidance aims to address this problem by outlining how to identify and quantify the benefits of weather and climate services.

There are several reasons why it is beneficial to consider socio-economic benefits.

- It can help to identify the 'impact' of the project, and what it is trying to achieve in terms of delivering benefits to users.
- It can help to understand how to maximise user-benefits, looking at how benefits are delivered from initial services down through the user chain (noting the linkage to VfM in the previous section);
- It can provide information for policy makers on the benefits of W&CIS and thus help to justify current and future investment in these services.
- It can provide quantitative information on effectiveness and help demonstrate and report on Value for Money.

How are socio-economic benefits quantified?

There are methods that allow the quantification and valuation (monetisation) of W&CS benefits. These in turn allow the analysis of the economic costs and benefits of these services.

Using such methods, previous studies[3] have shown that weather and climate services do deliver very high economic benefits. When compared to the costs of investment they produce a high benefit to cost ratio (i.e. they have large economic benefits, with benefits that far outweigh costs).

The approach used to quantify SEB looks at the activities and outcomes from the use of enhanced weather and climate services, and compares this to a baseline without this additional information: the difference is the quantified benefit. This is often known as the value of the information.

Importantly these benefits include several categories. These are reported in the box below and include direct and indirect benefits, related to both market and non-market impacts. As these are wider than just financial benefits alone, and capture the full economic benefits, they are referred to as socio-economic benefits.

More details on methods are included in the Annex.

Types of socio-economic benefits

A wide range of different benefits may arise from weather and climate services. These include areas where there is an obvious financial benefit, but other areas which provide benefits which are more difficult to value in monetary terms. While the direct losses can usually be quantified and valued using market prices, the intangibles involve non-market effects, which use economic methods to derive economic values.

	Tangible (market)	**Intangible (non-market)**
Direct	Enhanced electricity generation system management from enhanced weather information Reduced damage to buildings, infrastructure, crops from early warning Enhanced agricultural yields or avoided losses from seasonal forecasts	Reduced loss of life or injury or reduction in damage / loss of ecological goods and services from early warning Reduction in food insecurity and malnutrition from season forecast and early humanitarian response
Indirect	Reduced loss of industrial production, or traffic disruption affecting business supply, or effects on wider economy, from early warning of major disasters	Reduced impact post disaster on vulnerability

[3] Clements, J et al (2013). The Value of Climate Services Across Economic and Public Sectors. Report to the United States Agency for International Development (USAID). Available at http://www.climate-services.org/sites/default/files/CCRD-Climate-Services-Value-Report_FINAL.pdf

Why are socio-economic benefits being considered in WISER?

As highlighted earlier, WISER is funded by DFID and there is a need to ensure the programme – as well as individual projects - deliver Value for Money (VfM).

The consideration of socio-economic benefits feeds strongly into the **effectiveness** component of VfM. However, the consideration of socio-economic benefits provides other benefits for projects, so it should not be seen only as a VfM check:

- SEB analysis can help to develop a better understanding (and better articulation) of a project and help to make more informed, evidence-based choices, i.e. to improve the design.
- The focus on benefits can help in maximising the impact of weather and climate services, ensuring that the appropriate interventions along the user chain are included.
- The information from a SEB study can be used to highlight the success of the project, and how it is delivering tangible benefits. This is extremely useful in promoting the project and can be used to help provide policy briefs and summary material.

It often does not include a lot of additional work to include SEB components in a project and they can be designed so that they build on existing activities. For example, if a project is already doing survey work, then this could be extended to capture socio-economic benefits. Similarly, the information needed for a SEB assessment – such as how people understand and use information - will be of relevance for the project overall, and there is potential to extend existing activities to consider these if included at design.

What are the steps in the undertaking a SEB analysis?

As highlighted earlier, all WISER projects are expected to include some activities to quantify and value socio-benefits during programme implementation.

There are a set of steps that allow such analysis, summarised below, which draw on recent WMO analysis[4]. However, WISER recognises that assessing these benefits may be difficult at the project design stage and can be resource intensive to undertake.

The guidance has therefore broken down these steps into i) those to undertake during proposal development and ii) those to include in project implementation (noting these should be included as activities in the project proposal). These are presented in the context of the overall WISER framework as well as the VfM guidance in the previous section.

[4] WMO (2015). Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services. World Meteorological Organization, Geneva.

During early project proposal development:

At the proposal stage, projects should set out the high-level benefits of W&CS that might be expected. These should be reflected in logframes and theories of change (where appropriate). The key steps are to:

- **Identify the potential socio-economic benefits** of the weather and climate service, including how these benefits will be delivered down the weather chain, i.e. from weather or climate information providers to users. It is also important to note the actors (e.g. the public and private service providers and users) across the chain.
    - In some cases, W&CS will provide an additional direct benefit, thus it is useful to scope out current conditions and then assess the potential benefits that will arise from the added service (e.g. the potential improvement in agricultural yield). For others, notably for early warning and seasonal forecasts, the benefits largely arise as a response to current impacts: for these types of services, a useful way to start the analysis is to look at the current impacts of current climate variability and extremes. This can include the quantified analysis of current risks, i.e. how sectors or end-users are affected. This can then be followed by an analysis of the potential benefits that W&CS will have in reducing these impacts.
    - The analysis of benefits (and where relevant impacts) should include all categories of effects, i.e. financial benefits (or avoided damage), as well as non-market effects such as health. More information is included in the SEB Annex.
- **Review and decide on the potential methods for assessing socio-economic benefits in the project**, taking account of your resources and how adequately these methods represent the local context. This should involve steps to quantify and potentially value market and non-market sectors. It could include modelling (sectoral or integrated), survey and data analysis (including statistical or econometrics) or qualitative methods. More detail is provided in the Annex.
- **Consider the information on benefits (and costs) in the proposal, and include in the VfM case**. The information from the steps above, in terms of the benefits of the project, can be used as part of the VfM case (Part 10 of the proposal form, see the earlier VfM sections). However, this information can also help to maximise the benefits of the proposal more generally, helping to explain the rationale for the project (Part 4), and can be used with an early analysis of costs to help enhance the project design.

As the project proposal develops:

As the project proposal is developed further, activities should be included to deliver the proposed SEB analysis in the main programme of work. These steps should be included in the proposal work tasks and costed in the budget. The SEB activities and

results should also be integrated into the knowledge management and M&E frameworks, including potential indicators. The activities that should be included are:

- **Derive the baseline** for the current situation without the new W&CS information provision. This should take place at the start of the project. To the extent possible, this should quantify the potential social, economic and environmental impacts, across sectors and actors (e.g. households, private and public sector) and the current provision of weather and climate services in providing benefits. Depending on the subsequent method chosen, it may also include survey work.
- **Assess the change with the new weather and climate service in place, i.e. the socio-economic benefits.** This should include analysis of all potential benefits, ideally in economic terms, building on the scoping analysis outlined above. It should also ensure that the efficiency losses along the weather chain are considered. Different approaches can be used to assess benefits of a project, including desk studies or modelling analysis, as well as with direct surveys and statistical analysis. More details are provided in the SEB Annex.
- **Assess the costs of the project**, including investment in meteorological stations, system operation and information provision (thus capturing equipment and resource (labour) costs).
- **Compare benefits against costs.** While ideally this analysis will be undertaken in quantitative and economic terms, it is recognised that assessing benefits is often challenging, thus it is critical to acknowledge any missing benefits that cannot be monetised or quantified. The use of Multi Criteria Analysis (MCA) may be considered.
- **Identify omissions, consider bias and undertake sensitivity analysis**.
- **Explore how benefits could be enhanced** through interventions along the weather chain, aligning to the learning component of WISER.

It is recognised that designing, let alone implementing, a detailed SEB study can be quite complex. Technical support is potentially available to help you during the proposal and you should contact the WISER programme manager to discuss.

Getting started

To help you think about socio-economic benefits, it is worth addressing the following set of questions:

What are the potential benefits of your programme to users? Are they likely to results in improved crop production or reduced losses from improved early warning. It is useful to identify the existing impact that you are trying to address, the list of beneficiaries and the benefits you expect.

Have you included a baseline assessment in your project proposal? It is useful to collate information on baseline conditions, e.g. on current conditions, or how large the potential current impacts of extreme events are. This could include gathering

information on the current costs of disasters (of relevance for early warning) or information on current production in the agriculture sector you are targeting. Once you have a better idea of the method for SEB, this can be used to draw up a formal step for deriving this baseline.

What are the steps in the weather chain, i.e. in the successful delivery of climate information through to end-users? It is useful to map out how your weather and climate service will flow down the chain to end users, and to identify what barriers and additional steps are needed to maximise uptake and use. It is also useful to consider the ability of users to respond and effectively use information. It may be worth including user forums or surveys to explore these issues in your project and use this to help the design.

What type of W&CS are you providing and which SEB methods might be applicable? There are a range of methods that can be used. The Annex has some look-up tables on the type of approaches that might be relevant, and the potential resource levels needed. It is useful to start with these tables to help select potential methods.

How does a SEB study feed into the VFM analysis? The results from a SEB analysis, when combined with the project cost information, generate the information for the effectiveness components of VfM. Further work can be undertaken to show how the costs and benefits of the project compare to other alternative choices. It can also be used during project implementation to assess and report on the effectiveness component of VfM.

How can you use SEB information to summarise and disseminate the benefits of your project? It is worth thinking about how to use the results of an SEB study. This could include the production of relevant policy briefs and news items, that would enhance the impact of you project. It is worth including these activities in your proposal.

A simple decision tree has been produced to help you on these issues, along with some look-up tables, provided in the Annex.

What is expected in WISER project proposals?

It is anticipated that every proposal will include at least one area of socio-economic benefits. Ideally this would involve quantitative analysis, but at the very least, it should include some qualitative assessment. Further guidance and examples are given in the Appendix.

TRANSFORMATIONAL BENEFITS

A complementary aspect of the VfM-SEB framework are the transformational benefits that WISER projects can deliver. These are the potential impacts of projects on investment mobilisation, improved resource allocation by policy makers, better climate mainstreaming into policy frameworks, more effective private sector engagement and improved institutional capacity.

Transformational benefits are primarily indirect, i.e. they cannot be linked directly to end beneficiary outcomes due to the long results chains involved. They do, however, improve the enabling environment which in turn creates capacity for increased socio-economic benefits over time. Improved W&CIS may also represent a necessary pre-condition for achieving other resilience or development aims (e.g. land zoning, agricultural planning).

Typically, an assessment of transformational effects will take a more macro-level approach than that used in the SEB analysis. The aim is to describe the economic value potentially embedded in institutional improvement and transformation process. This is combined with a more qualitative assessment of outcomes and impacts and is explored through case studies.

The types of quantitative data that might inform such an assessment include:

- The additional funds leveraged and new funding models developed by WISER projects to support enhanced CIS service provision;
- The potential reduction in the economic value at risk from CIS being used to make policy or planning approaches more resilient;
- The level of budgetary resource influenced or allocated based on improved quality and communication of CIS;
- The size of private sector markets facilitated by improved partnerships and product development;
- The level of demand for weather and climate information services among identified constituencies.

Transformational benefits framework

In WISER, the transformational framework operates at four levels: the effective functioning of national met services institutions themselves, the impact of improved CIS on the wider national development context, and the strengthening of regional institutional capacity.

Table 4 sets out key questions that WISER proposals should seek to answer to demonstrate their transformative value:

Table 4: Transformational Impact Questions

Area of Transformation	
Met services strengthening	Does the project provide opportunities for the development of new business and management models for national met services? Will the project support national met services to manage their external relationships (political/ commercial) in a more effective way? Can the project support the mobilisation of new or additional financing flows into national met services (whether from public or private sources)?
National influencing	Is the project able to improve sector-level policy making by improving the quality and communication of W&CIS data to government? Can the project influence budget processes within climate sensitive sectors to make them more resilient in terms of resource allocation? Does the project encourage engagement with the private sector, and help build products and partnerships that can reduce risk, encourage investment and build new markets?
Regional transformation	Is the project able to strengthen institutional networks and coordination structures for regional met services? Does the proposal raise the profile and credibility of met services among pan-African institutions through a clear demonstration of its value proposition and achievements? Can the project support the mobilisation of new or additional investment into regional CIS infrastructure or coordinating platforms?
User engagement	Does the project create new forms of cooperation between institutions and end users to build capacity and improve the quality and user understanding of information products over time? Does the proposal improve the propositional offer for climate and weather information

	services in a decision-making context and address potential barriers to take-up among different groups? Does the project help build demand among users for weather and climate information services, and how is this demand measured and responded to?

WISER recognises that not all proposals will focus equally on all aspects of the transformational agenda. All projects however will be expected to find at least one aspect where their project can play an enabling role. More detail on each is provided below.

National Met Services Strengthening

- *Development of new business models for met services provision:* Met services are evolving from technical units into demand-driven service bodies with the potential to develop more tailored products for both public and private clients. Proposals are encouraged to examine the extent to which they can support the development of new business and management models and address barriers to institutional transformation;
- *Establishing new forms of institutional cooperation:* To become more credible and effective, met services need to create better institutional linkages and cooperation modalities with a range of boundary organisations. Proposals should consider how they are improving met service capacity and skills to engage with external stakeholders, and how this might support improved product development and service quality over time;
- *Mobilisation of new financing flows into national met services:* The funding of national met services is dependent on a strong value proposition being developed and communicated. Proposals should consider their capacity to help mobilise finance from both national budgets, private sector partners and external donors (e.g. donor/Green Climate Fund);

National Influence

- *Policy influencing through enhanced quality and communication of data:* Enhanced weather and climate services can underpin more effective policy making and strategic planning (e.g. through national development and sector strategies). Proposals should consider whether they can engage with and influence policy processes, and how information should be best presented to ensure buy-in and uptake;
- *Influencing of budget processes and resource allocation within climate sensitive sectors:* Enhanced W&CIS can support more robust decision making in relation to the allocation of budgetary and other resources in sectors such as agriculture, infrastructure and DRR. Better resource allocation can improve resilience,

enhance early response and reduce waste. Proposals should consider to what extent they can improve the allocation of resources, and how information should be best presented to influence outcomes (e.g. in terms of economic costs and benefits);

- *Promoting private sector engagement:* The private sector is playing an increasing role as both a developer and consumer of met service products. Closer partnerships can facilitate the development of an ecosystem of W&CIS markets such as insurance, transport and logistics and agriculture. Proposals should examine the opportunity to support the emergence of more dynamic markets in weather and climate services through commercial partnerships;

Regional Transformation

- *Strengthening of regional met services networks and coordination structures:* Key to ensuring the coherence and quality of pan-African met services is the strengthening of regional networks, coordination structures and capacity. Proposals should examine how they might support this process by supporting the development of regional products and standards, and strengthening the regional networks;

- *Raising profile and credibility of met services among pan-African institutions:* It is important that wider pan-African political and economic institutions recognise the value of strengthened met services and the role that they can place in building economic and social resilience. This requires the development of a clear value proposition and its effective communication to key constituencies. Proposals should explore how they can support this process through direct engagement and the development of targeted knowledge products (including SEB information);

- *Mobilising investment in regional infrastructure and met services capacity:* Strong pan-African met service capacity requires dedicated investment in regional infrastructure. Proposals should consider whether they can contribute to mobilising new and additional funds for regional platforms and met service institutions;

User Engagement

- *Establishing new forms of institutional cooperation:* to better understand weather and climate information in their decision-making users need to create better institutional linkages and cooperation modalities with a range of information producers and boundary organisations. Proposals should consider how they work with user groups as well and producers to support improved product development and service quality over time including demonstrating the value of approaches to co-production of weather and climate products and services;

- *Embedding weather and climate information in decision making in sectors, institutions and organisations:* Any efforts to support strengthened and enhanced use of climate information to support specific decision making processes need to be informed by a clear understanding of what benefits this can bring for users

and the processes through which this can occur. It is also essential to understand any constraints, be they climate or non-climate related, which currently prevent climate information from supporting this decision-making process;

- *Increased demand for weather and climate services:* A measure of the usefulness and credibility of weather and climate information is the increased demand for services. Proposals should set out how they aim to address building demand for new services, and how demand is responded to and how this is measured.

Integrating transformational benefits into the proposal

The approach to measuring transformational benefits is primarily set out in of the VFM section of the proposal, but should also reflected elsewhere in the relevant sections (see Table 3 in the earlier section for more details).

Activities that support transformation process

Proposals should consider including specific research activities where these are likely to support the transformation process. This might include stakeholder engagement, business case development or the development of influencing knowledge products. An example taken from the recent WMO Highway proposal is set out below.

Example: WMO Early Warning Systems Proposal (Highway)

WMO has developed the HIGHWAY proposal looking at the development of regional Early Warning Systems for Lake Victoria. The proposal takes its starting point as the strengthening of national systems, but is looking to integrate and scale these up into a regional systems approach to be adopted by countries bordering the lake. Regional integration has the potential to result in a more effective and better standardised product, lower costs and better institutional coordination. However, the proposal recognises the political economy challenges in moving from national to regional approach. As part of the project activities, the proposal therefore includes a research component to build the VFM business case for the transformative benefits. This will include an analysis of costs, potential synergies and efficiency savings, and an assessment of potential gains in outcomes for lake users and policy makers alike. The development of this business case is central to the ability of the HIGHWAY programme to engage with stakeholders and to bring about the envisaged institutional transformation.

Transformational benefit case studies

Transformational benefits are assessed within WISER primarily using **case studies**. It is anticipated that every proposal will suggest at least one case study (but potentially more) that could be developed as a knowledge product based on the envisaged project activities and achievements. This could be drawn from any one or

a combination of the four areas of focus (national met services strengthening, national influencing, regional transformation, user engagement).

Case studies will be prepared primarily to target **external audiences** (national and regional bodies) to showcase WISER achievements, to influence how met services are supported and to build the business case for ongoing investment. Each case study would be prepared with a specific audience in mind. For example:

- *Policy makers:* How can climate information services add value to policy and resource allocation processes and how can government engage with met services to maximise the benefits of better W&CIS products?
- *Donors and budget organisations:* What is the investment case for supporting investment in met services infrastructure and where how can this funding be used to ensure greatest value for money by targeting the relevant stage in the W&CIS information value chain?
- *Met services:* How can met services become more relevant to policy makers and other stakeholders and what are the opportunities to develop new products and business models that allow for sustainable funding?

Case studies would be developed during and after project implementation on the basis of project experience and achievements.

ANNEX: FURTHER INFORMATION ON SOCIO-ECONOMIC BENEFIT ASSESSMENT

This section provides some additional material for socio-economic benefit assessment.

Identifying benefits

There have been a relatively large number of socio-economic benefit studies for weather and climate services. These provide examples of the types of benefits from W&CS and are summarised below (from Clements et al, 2013).

Sector/industry	Studies reviewed[a]	Examples of specific applications
Agriculture	64	• Crop management (e.g., timing of planting/harvest, selection of crops) • Irrigation decisions • Product marketing • Input use (e.g., fertilizer application) • Herd management (e.g., when and how many animals to sell) • Changes in commodity prices • Implications for global trade market
Energy	10	• Planning purchases of gas and electric power • Managing responses in emergency situations • Managing capacity and resources (e.g., grid/distribution management, electricity production/pricing) • Optimizing reservoir/hydropower operations • Commercial/residential consumption decisions
Fisheries	6	• Responding to threat of harmful algal blooms (HAB) • Harvest management
Transportation	5	• Reducing wait times on runways • Fuel purchasing • Accident reduction • Snow preparation/removal • Canal management
Water resources management	7	• Storage/release decisions by reservoir managers • Water pricing/allocation • Adoption of conservation measures
Tourism/ recreation	3	• Marine forecasts/warnings • Event management
Disaster management	3	• Hurricane preparedness • Early warning systems
Cross-sector	17	• Weather impacts on national economy • Willingness to pay by consumers for weather information • Multi-sector studies including value of forecasts for transportation, water, construction, energy, fisheries, forestry, and other sectors
Other[b]	30	• Pricing of weather derivatives/other financial products • Pricing of insurance products • Forecasting extreme weather events

a. Total number of studies adds to greater than 139 due to studies that included the evaluation of climate services in more than one sector.
b. Studies in this category are not necessarily relevant to a specific study (e.g., theoretical models of forecast value).

For WISER, there are several common areas of focus. A short summary of these is provided below

Early warning systems

There are several studies (see ECONADAPT, 2015[5]) that have assessed the benefits of meteorological or hydro-meteorological information and early warning systems (EWS) related to the evacuation or preparation in advance of tropical storms or floods. The benefits arise from the anticipation and preparation for extreme events and the reduction in damage costs to assets and fatalities and injuries avoided. A set of potential benefits is included in Look-up Table 1.

Seasonal outlooks

There are several studies focus on the provision of weather forecasting and climate services (seasonal outlooks) services, especially to the agricultural sector. Benefits arise from the use of information to enhance agricultural production or avoid losses (e.g. crop selection and the timing of planting and harvesting, as well as water management). A full set of potential benefits is included in Look-up Table 1.

Climate projections

The analysis of the benefits of future climate change information – i.e. for longer time-scale - is more challenging. The same conceptual approaches can be used, with the value of information, but the chain from information provision to final user is much more complex. There are also two other factors that are unique to the climate change context (as compared to W&CS) which complicate the analysis. First, there is a difference in the timing, as the benefits that arise from climate change information primarily occur in the future: this reduces their benefit when compared to costs in present value terms. Second, there is very high uncertainty with future CC projections, thus the effectiveness over the use of information is not simple. Indeed, it is quite possible that the use of future projections could lead to maladaptation, i.e. under or over-investing to address future risks. The analysis of the benefits of forecast information therefore has to be considered in parallel to the use of the information and the decision-making approach adopted (for further information, see ECONADAPT[6]).

Weather (Value) Chain Analysis

Estimates of the benefits of weather and climate services vary according to the assumptions about the uptake and use of information.

For example, it is vital to know whether potential users of climate data services have the resources to act effectively on the information they receive (i.e. do they have

[5] ECONADAPT (2015). “The Costs and Benefits of Adaptation”, results from the ECONADAPT Project, ECONADAPT consortium, http://econadapt.eu/.

[6] Further information is available from http://econadapt.eu/.

access to financial resources, or the ability to change behaviour or respond to risks) and what their incentives to act are.

This is itself determined by the nature and form of information provision and its perceived reliability. These issues are important to capture in determining benefits and it is possible to undertake a weather chain (or value chain) analysis.

Recent analysis has identified the key steps in the chain as

- forecast accuracy,
- tailoring of information to user groups,
- access to information,
- comprehension of information by users,
- ability to respond,
- effectiveness of response, and
- redistribution (leaks) of initial benefit.

Considering these steps highlights the issues of service use and information decay along the chain (Perrels et al, 2013[7]): understanding this requires 'cost-loss' (CL) analysis, which identifies the effects of changes in forecast accuracy in an otherwise fully informed world, combined with weather service chain analysis (WSCA).

There are also other issues around the socio-institutional and governance landscape, societal norms, which have to be understood to ensure benefits.

Socio-Economic Benefit Methods

There are a range of different types of benefits from weather and climate services. These include some benefits that can be valued using market prices, but others that involve broader social, economic or environmental effects. The latter can be valued using a range of economic techniques, but this often requires additional analysis (or the use of benefit transfer that is likely to significantly reduce the robustness of the findings). It is possible to also assess benefits using qualitative approaches, though this does not provide the same level of inputs (noting that the use of quantitative economic approaches feeds directly into VfM effectiveness and efficiency).

It is therefore important to identify the types of benefits that a particular weather or climate service will provide (see earlier), before then assessing which potential methods should be used to assess these benefits. This normally starts with an analysis of the impacts (of current climate variability and extremes) that the W&CS is seeking to address – and then the benefits that the W&CS will provide (in reducing these impacts, or in leading to new opportunities or benefits).

[7] Perrels, A., Harjanne, A., Nurmi, V., Pilli-Sihvola, K.,, Heyndricx, C., and Stahel, A. (2013). TopDAD. D2.2–Sector specific and generic impacts of enhanced weather and climate services in a changing climate. Available from http://www.topdad.eu/

There are a number of distinct but complementary methods for identifying the impacts and benefits, and the overall economic measure of weather and climate services[8]:

- It is possible to model the potential benefits from the use of information. This is a common approach for looking at the value of climate services for agriculture, with the use of crop models to assess the potential benefits of receiving better information (or different types of information). In this case, benefits are realised through the enhanced yields and thus market prices. These are often known as ex ante studies, as they rely on forecast and modelled information rather than observations. These studies have advantages in terms of providing detailed technical analysis, but the information is estimated not observed, and relies critically on the assumption of the forecast accuracy as well as the uptake of information and the cost-loss analysis in the chain. In many cases, these ex ante studies assume that management decisions are based on perfect knowledge of historical climate data or on the forecast available at the time, and often assume forecast accuracy is also perfect (though some use probabilities). A range of models exist, with either crop models that provide changes in output (that are then converted using market prices to an economic value) or more integrated economic approaches such as input-output, trade or computable general equilibrium models.
- Benefits can also be estimated using hydrological and disaster risk models (also known as cost loss models, etc.) that use historical events as their basis. This is particularly relevant for early warning systems, to assess the losses associated with previous disasters or events of defined return periods (i.e. probabilistic events) and then how EWS will avoid or reduce these. This has the advantage of using some observed (ex post) data on losses but still involves many assumptions regarding the modelling approach. There are also examples where ex post data has been used to look at the failure of forecasts (i.e. where a seasonal forecast has missed a major extreme weather event). Note that in cases where the benefits of early warning systems are assessed, the benefits are estimated from avoided losses, but this includes the avoided costs of damage, but also the reduction in fatalities and injuries. The latter can be monetised using non-market valuation techniques, but this involves additional assessment.
    - A simpler form of this approach is to use analogues of previous events to scope out the potential benefits. This could include looking at information on damages recorded (e.g. in national or international databases on events) or looking at humanitarian spending.
- It is also possible to look at observed improvements following the implementation of better weather and climate services and assess the benefits. This can be done using different levels of detail, from econometric analysis (regression) to simple

[8] IIED (2014) Assessing the effectiveness of investments in climate information services. Briefing note for Clim-Dev Africa.

assessment of avoided losses and costs. A recent example has been undertaken in Kenya[9]: this used spatial variation in household income (2014–2015) to assess the association between using local level weather and climate products and services and income appreciation, finding households receiving decentralised products and services had higher income levels when in receipt of local advisories and seasonal forecasts. These studies have the advantage of using direct observations and thus address many of the efficiency and cost-loss assumptions. However, they are complex and time consuming to undertake, and in many cases it is difficult to separate out (attribute) the role of weather and climate information from other factors such as the role of micro-climates.

- A further approach is to directly survey users to explore potential benefits through their willingness to pay for weather and climate services. This can use measures of *revealed preference*, i.e. recorded observations of how people change their behaviour, including their decision-making, in instances where new climate information has been introduced. An alternative (or a further complementary validation) is for *stated preference* methods, which use interviews with identified user communities to estimate their willingness to pay for weather and climate services directly.

- Finally, it is possible to use cross-sectoral causal descriptive models that can incorporate several of the methods mentioned above, from historical observations to simulation of future scenarios. These models, based on the Systems Thinking and System Dynamics methodology, have been traditionally used to support planning exercises at various levels (e.g. from national to landscape) with the analysis of "what if" scenarios. The key features include horizontal integration (i.e. a variety of sectors interconnected with one another) and a fairly aggregated level of detail for each sector. The former allows to include social, economic and environmental indicators; the latter indicates that this approach does not substitute others, instead it complements existing –and more detailed- sectoral modelling efforts with a more comprehensive framework of analysis. As a result, these models can be used to simulate alternative scenarios of action and inaction, using several weather indicators as input and providing insights on both the identification and anticipation of vulnerabilities and the identification and evaluation of interventions (e.g. based on forecasts of SEB).

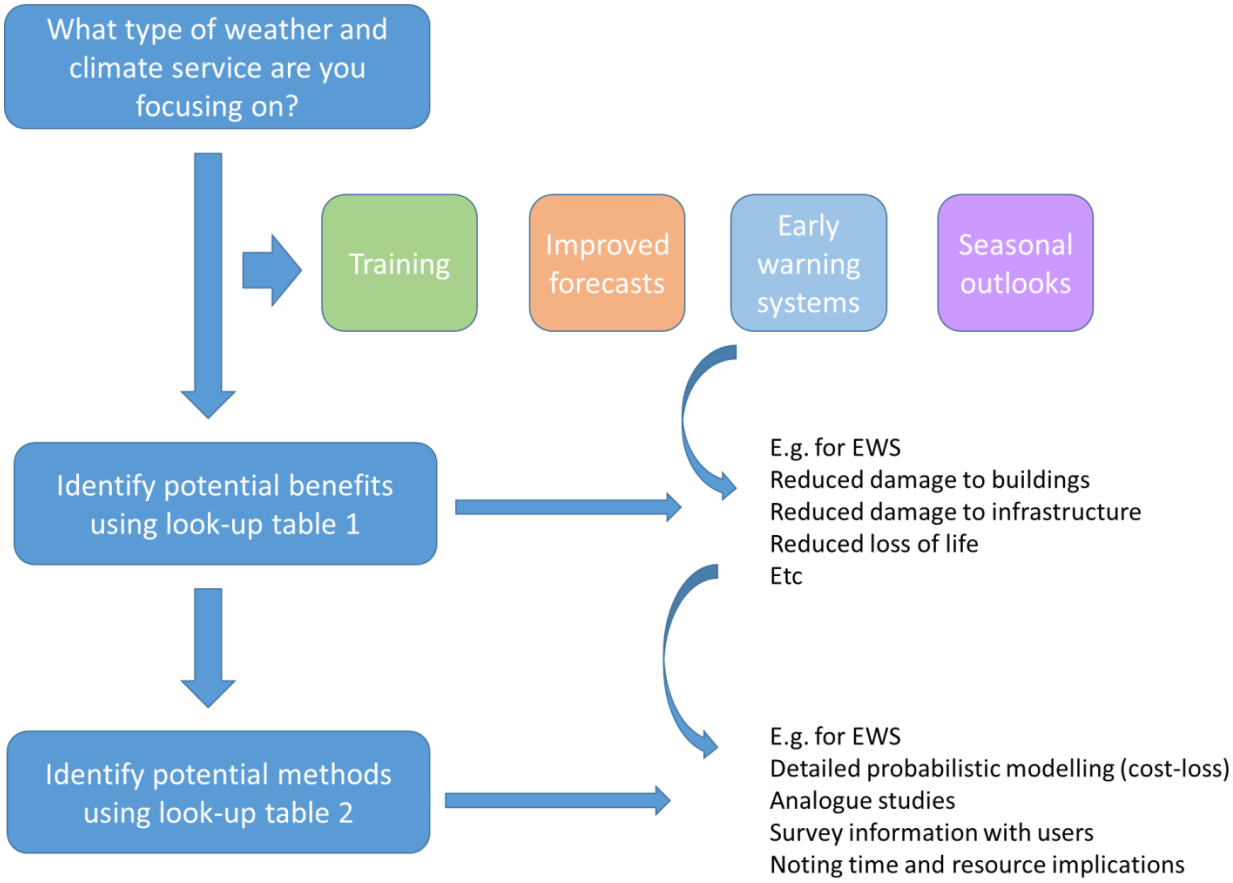
These different methods have varying levels of relevance according to the type of services and the sector, as well as the availability of data. The risk preferences of the decision makers and potential users also have an influence on the choice of method (including whether information is used to maximised gains or minimise losses).

Their application also involves very different amounts of time and resources. A consideration is therefore to think about the type of method and the resource implications for your project.

[9] Sam Barrett and William Ndegwa (2016). An Economic Valuation of the Kenya Meteorological Department's Decentralised Provision

To help this, some simple look-up tables and decision trees have been produced to give examples.

Example decision trees and look up tables



Look up Table 1: List of possible benefits

Type of Meteorological Service	Example of Benefits of Service	
Capacity building and training	Better understanding and interpretation of weather data (observed and forecast) results in improved weather service provision. Enhanced ability to develop better weather services.	Investment in computing hardware needed to do additional data modelling in order to provide more sophisticated weather forecast service. Investment in weather observation stations. Forecaster training
Enhanced weather forecasts e.g. 2 day → 3 day forecasts	Improved anticipation and planning in: • agriculture management activities resulting in higher yields and general productivity, • hydro-power operations resulting in improved electricity supply provision • transport logistics leads to better traffic flow management	Harvesting can be better timed to avoid wet periods. Water flow rates can be better predicted, allowing more accurate scheduling with other energy supplies. Traffic hazards such as accident risks can be reduced through awareness of e.g. rain-storms.
Extreme weather event forecasting, e.g. floods, windstorms	Reduced damage (economic benefits from avoided losses), e.g. infrastructure, housing damage. Prevented disruption (e.g. to transport) Reduced loss of life and injuries.	Improved awareness of intense rainfall events allows households to move their possessions out of areas vulnerable to flooding. Could include e.g. cattle or transport. Knowledge of approaching windstorm allows e.g. fishermen and boat cargo operators to plan trips around the event. Awareness of possible flash-flooding in river channels allows individuals to move out of these areas
Seasonal forecasts	Using agriculture as an example: reduced agricultural yield losses, resulting in maintenance of farm incomes, avoided asset loss, and food security	E.g. for agriculture: improved forecasting e.g. of extended dry season allows farmers to plan crop planting around more drought-resistant varieties or to consider investing in artificial water provision, e.g. irrigation, bore hole, etc.

Look up Table 2: List of possible methods

Type of Weather / Climate Service	Methods	Example application	Resource implications
Capacity building and training	Ex post evaluation of benefits of equivalent investments in weather service training elsewhere	Up-grading of computer hardware to enable 3-day forecasts, and accompanying training in interpretation and management of associated resulting data-streams in S. Africa	Time spent on identifying and interpreting previous studies ($500-$3000)
	Questionnaire/survey of likely beneficiaries of improved weather services.	Survey of farmer/farmer representatives, freight and household transport representatives, etc. of what their most important needs are regarding better weather forecasting.	Cost of undertaking survey and processing/interpreting results ($800-$10,000). Likely to be more accurate than results transferred from elsewhere.
Enhanced weather forecasts e.g. 2 day → 3 day forecasts	Ex post evaluation of benefits of equivalent improvements in weather services elsewhere	Either: simple transfer of existing study results Or, quantification of income benefits of improved weather forecasting on basis of regression analysis of data from similar site where forecasting has been introduced.	Time spent on identifying and interpreting previous studies ($500-$3000) Cost of data collection and analysis. ($5000-$10,000)
	Questionnaire/survey of likely beneficiaries of improved weather services.	Survey of farmer/farmer representatives, freight and household transport representatives, etc. of what specific operational improvements they would be able to make, given improved services.	Cost of undertaking survey and processing/interpreting results ($800-$10,000). Likely to be more accurate than results transferred from elsewhere, as long as survey well-designed.
Extreme weather event forecasting, e.g. floods, windstorms	Bio-physical modelling of weather event impacts, using simulations or historical analogues of events to calibrate impact costs	Either: simple transfer of existing study results of e.g. flood events from similar area.	Time spent on identifying and interpreting previous studies ($500-$3000) Cost of data collection and analysis. ($500-$5,000)

	Questionnaire/survey of likely beneficiaries of improved weather services.	Or: repair/replacement costs associated with similar previous events in study area Survey of farmer/farmer representatives, freight and household transport representatives, etc. of what specific operational improvements they would be able to make, given improved services.	Cost of undertaking survey and processing/interpreting results ($800-$10,000).
Seasonal forecasts	E.g. for agriculture. Bio-physical modelling of impacts resulting from seasonal variations in key weather variables. Questionnaire/survey of likely beneficiaries of improved weather services.	E.g. for agriculture. Either: Simulations of effects on agricultural yields as a result of alternative seasonal conditions, and resulting changes in farmer income/revenue *Or:* simple transfer of existing study results from similar area. Or, quantification of income benefits of improved weather forecasting on basis of regression analysis of data from similar site where forecasting has been introduced. Survey of farmer/farmer representatives, freight and household transport representatives, etc. of what specific operational improvements they would be able to make, given improved services.	E.g. for agriculture. Time spent on developing model and data analysis of results ($5000-$50,000). Appropriate for large-scale change. Time spent on identifying and interpreting previous studies ($500-$3000) Cost of data collection and analysis. ($5000-$10,000) Cost of undertaking survey and processing/interpreting results ($800-$10,000).