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Global Water Partnership

WASH Climate Resilient Development

Technical Brief

Appraising and prioritising options for climate resilient WASH

About UNICEF

UNICEF works in more than 100 countries around the world to improve water supplies and sanitation facilities in schools and communities, and to promote safe hygiene practices. We sponsor a wide range of activities and work with many partners, including families, communities, governments and like-minded organizations. In emergencies we provide urgent relief to communities and nations threatened by disrupted water supplies and disease. All UNICEF WASH programmes were designed to contribute to the Millennium Development Goal for water and sanitation.

About GWP

The Global Water Partnership is an intergovernmental organisation of 13 Regional Water Partnerships, 86 Country Water Partnerships and more than 3,000 Partner Organisations in 183 countries. Its vision is a water secure world. Its mission is to advance governance and management of water resources for sustainable and equitable development through integrated water resources management (IWRM). IWRM is a process that promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems and the environment.

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HR Wallingford
Working with water

ODI

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Supporting climate resilience in the WASH sector

This Technical Brief forms part of the Strategic Framework for WASH Climate Resilient Development, produced under a collaboration between GWP and UNICEF.[1] The Framework advances sector thinking around WASH and climate change, cutting across both development and emergency preparedness programmatic spheres; climate resilience is addressed as a cross-cutting issue encompassing elements of both disaster risk reduction and climate change adaptation.[2] It serves to set out the rationale and concepts for WASH climate resilient development, as well as improve understanding of how to ensure that climate resilience is considered in WASH strategies, plans and approaches.

The objective of the Strategic Framework is to support WASH service delivery that is resilient to the climate, both now and in the future. The Strategic Framework is centred around four quadrants of activity; this Technical Brief sits within the 'Identify and appraise options' quadrant, shown in the figure below.

Strategic Framework for WASH climate resilient development

Guidance Note:
- Risk assessments for WASH

Technical Briefs:
- Linking risk with response: options for climate resilient WASH
- Appraising and prioritising options for climate resilient WASH

Technical Brief:
- Monitoring and evaluation for climate resilient WASH

Technical Briefs:
- Integrating climate resilience into national WASH strategies and plans
- Local participatory water supply and climate change risk assessment: modified water safety plans

[1] GWP and UNICEF (2014)
[2] http://www.gwp.org/en/we-act/themesprogrammes/Climate-Resilience/WASH-Climate-Resilient-Development-a-GWP-UNICEF-Collaboration/

1. Introduction

1.1 Background

This Technical Brief focuses on appraising and prioritising options for climate resilience with a view to informing water, sanitation and hygiene (WASH) programme and project design. There may be a number of options to choose from so it is important appraise these to ensure the most appropriate ones are implemented and that scarce resources are used to maximum benefit. Prioritisation identifies what needs to be done now and what can be done later. Selecting and implementing the wrong type of measure might lead to wasted investments or even increase vulnerability.[3]

Different appraisal techniques are available to help prioritise options in the WASH sector. These techniques range from simple sensitivity testing and scenario analyses, to more sophisticated approaches that can be used to account for uncertainties. Each has its own strengths and weaknesses with respect to its application for increasing climate resilience.

1.2. Aim and target audience

This brief uses the climate resilient options identified in the Technical Brief, *Linking risk with response: options for climate resilient WASH*. Having identified a range of possible options covering different contexts and hazard types, the aim here is to show how these options can be appraised and evaluated against set performance criteria – for example, is the option effective, efficient and acceptable both politically and socially?

The brief sets out a simple scorecard approach for appraising and prioritising options. It is important to note that this scorecard approach only serves as an initial assessment of options. It is best carried out through consultation – for example, in a workshop with key stakeholders (see Box 1) – to help raise awareness of the key issues to consider when prioritising options. More sophisticated techniques and tools are then summarised, and users of the brief are encouraged to complete further detailed analysis of options where necessary.

Box 1: Stakeholder involvement[4]

Stakeholders can provide inputs in gathering options and data, as well as appraising the options. The types of stakeholders to involve will depend on the context. Stakeholders can be identified at different levels (national, sub-national and local) and across a variety of institutions (government, private sector and non-governmental organisations), as well as communities and private individuals, each with roles in climate resilient development. You will need to make sure that stakeholder involvement is focused, involving those with an interest in the options. This will avoid it becoming an overly expensive and/or time-consuming activity.

The target audience includes government planners, decision-makers and practitioners responsible for WASH services provision at national, sub-national and local levels, and their associated WASH development partners.

This Technical Brief:

- provides a simple scorecard/checklist approach to use as a starting point for appraising and prioritising options, and as an awareness-raising activity
- covers all aspects of WASH
- has a predominantly rural focus, to align with the rest of the Strategic Framework and Technical Briefs
- focuses on current and near future options over the next 15–20 years, which fits in with WASH programming timescales and development
- includes WASH examples to show how the approach can be applied.

[3] Ranger (2013a)
[4] GWP and UNICEF (2014)

1.3. Overview of appraisal approach

The simple scorecard approach includes a number of criteria which can be used to ensure the most appropriate options are selected and implemented. Examples of scorecards that can be used for each of the criteria are provided. These scorecards have been designed to be clear and easy to use, and are general enough to use in a wide variety of contexts. They can be adapted to suit different needs.

Options can be no- or low-regret (see Box 2), or they might have longer 'lock-in' periods – inflexible, high stakes options, where costs and benefits are high. The simple scorecard approach has been designed to be used mainly with no- or low-regret options. More sophisticated techniques should then be used to complete more complex analyses. These tools and techniques are signposted, where appropriate, with further details on their uses, and their relative strengths and weaknesses (see Section 3).

Box 2: No- and low-regret options

No-regret options are defined by the Intergovernmental Panel on Climate Change (IPCC) as those which 'generate net social and/or economic benefits irrespective of whether or not anthropogenic climate change occurs'.[5] Examples of this could include solar powered water systems or improved/sealed latrine designs. Implementation of these options will bring about benefits under the full range of climate scenarios.

Low-regret options include those where the costs are low and the future benefits are high, and those that are robust or flexible and therefore address uncertainty[6] – for example, investments in early warning systems. Robust options perform satisfactorily across many different climate futures; low-regret options may, to a certain degree, be adversely impacted by climate change, but will still deliver acceptable net benefits under the full range of plausible future climatic conditions.[7]

[5] IPCC (2007)
[6] Watkiss et al. (2014)
[7] AMCOW (2012)

2. Approach in detail

The simple approach to appraising options is outlined in Figure 2.1.

The first step is to gather the options, as well as the available data needed for the appraisal process. The options are then appraised using different criteria. Once the initial appraisal process has been completed, the scores are combined and weighted to compile a list of prioritised options. The whole approach can then be used as a basis for a more detailed appraisal, using more sophisticated techniques.

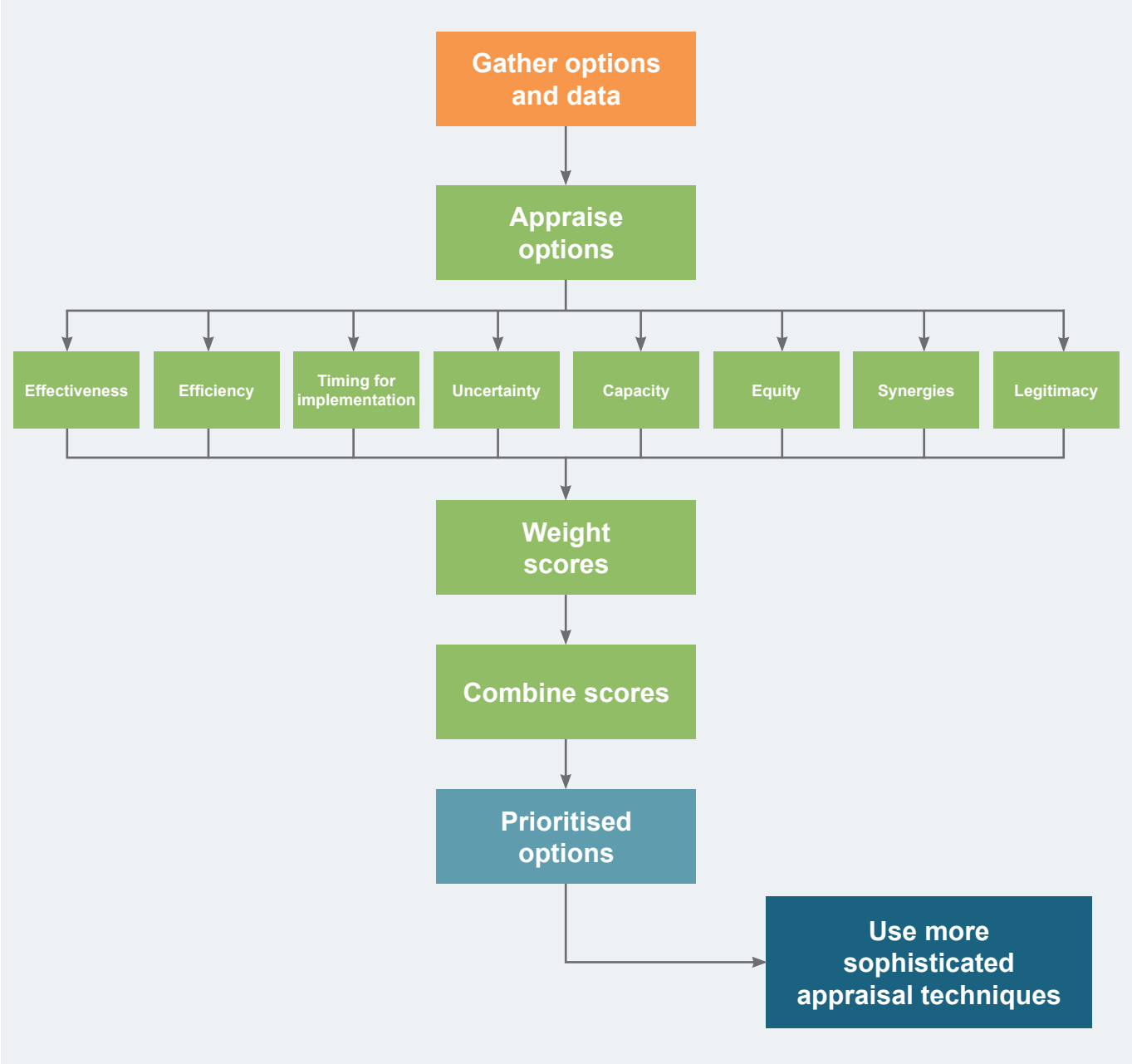

Figure 2.1: Approach for appraising and prioritising options

This approach has been designed to be used in a consultative manner, such as in a workshop setting. It uses stakeholder engagement and/or expert elicitation. This helps to create awareness of the key issues to consider when prioritising options, and may improve the uptake of solutions. Box 3 explains the differences between the two types of consultation.

2.1. Gathering the options and data

This brief follows on from the Technical Brief on *Linking risk with response: options for climate resilient WASH*, which looks at how the WASH sector could adapt to climate change. It examines the key elements of the whole 'results chain', from programme design and commissioning, to project-level systems and technologies; and identifies a number of possible options, most of which are no- or low-regret.

This first step is to gather the different options you have identified by following the guidance in the *Options for climate resilient WASH* brief. This broad list of options will be used as a starting point for the assessment. Examples of these options are given in Section 2.2, to show how the scoring can be completed for the different criteria.

You will also need to gather any available data on the different options that will be helpful in completing the appraisal – such as costs and benefits, or information on the necessary capacity to implement the option. Some useful sources of information include:

- code of practice for cost-effective boreholes[8]
- developing groundwater: a guide for rural water supply[9]
- environmental assessment and risk screening for rural water supply[10]
- Rural Water Supply Network (RWSN)'s Sustainability Portal[11]
- SSWN – Sustainable Sanitation and Water Management[12]
- technologies for climate change adaptation – the water sector.[13]

Box 3: Stakeholder engagement and expert elicitation

- Stakeholder engagement is more generalist than expert elicitation, higher-level and based on consensus forming workshops.
- Expert elicitation is more selective about who is involved; can go into more detail depending on the expertise of those involved; and is based on the judgements of individuals and comparisons with fellow experts. It does not necessarily have to be done via a workshop, as experts can give their opinions independently; although it is useful to have some form of follow-up where experts can review/compare results. It is not specifically aimed at forming a consensus and is more time-consuming.

2.2. Appraising options

Once you have gathered your options and any available data, you can begin the process of appraising and prioritising them. The approach here is to assess options against a number of relevant criteria.

You will need to work through each of these criteria to appraise the available options. The results are then combined to compile a prioritised list, ranked from the highest to the lowest scores. In the scorecards:

- A value of 0–2 can be given. These scores correspond to 'high', 'medium' and 'low'. For some criteria, it may be possible to determine quantitative thresholds that define these classes – for example, for costs and benefits.
- For most criteria, 2 would be a high score, 1 a medium score, and 0 a low score.
- For costs and uncertainty, 0 would be a high score while 2 would be a low score, because low cost and low uncertainty are considered preferable.
- For the 'timing for implementation' criterion, options are assigned scores of 1 or 2.

[8] Danert et al. (2010)
[9] MacDonald et al. (2005)
[10] Ludi et al. (2015)
[11] http://www.rural-water-supply.net/en/management-and-support
[12] http://www.sswm.info/category/implementation-tools/implementation-tools-introduction
[13] De Lopez, Elliott et al. (2011)

The criteria to consider are:[14]

- Effectiveness – will the option ensure sustainable and resilient WASH service delivery or behaviours?
- Efficiency – how much will it cost to implement the option? What economic benefits will there be as a result of the option being implemented and do these benefits exceed the costs?
- Timing for implementation – how soon does action need to be taken and can the option be implemented accordingly?
- Uncertainty – is the option highly sensitive to uncertainties in future climate?
- Capacity – is there the necessary capacity to implement the option? Do people/communities have the capacity to sustain interventions after implementation?
- Equity – does the option have any adverse effects on other areas or vulnerable groups? Will it ensure access for the poorest and most marginalised?
- Synergies – would implementing the option also have benefits for other strategic objectives?
- Legitimacy – is the option acceptable both politically and socially?

You may choose to give equal significance to the criteria or assign weights to some criteria if you feel that they are of greater importance to the appraisal decision. During the workshop, you will need to decide which approach to use, and if weighting the criteria, agree which are the most important. You may also decide that a particular criterion is not relevant to your situation.

Tip

- You may decide that a greater range (from 1–5) for scoring the criteria is more suitable. This might be because you would like to have more classes so that you can more easily distinguish between different options, if they are scoring the same.
- If you would prefer to use five categories rather than three, then you can do this by including a 'medium-high' and 'medium-low' class.

Example: weighting scores

One group decided that some of the criteria were of greater importance than others in their assessment. They used a total of 12 points to assign weights to the criteria. Effectiveness, efficiency, timing for implementation, uncertainty and capacity were considered the most important; these were each assigned 2 points. Equity and legitimacy were considered less important, and these were each assigned 1 point. The group did not include the synergies criterion in their assessment.

The score for each criterion was then multiplied by the weight assigned to it. The overall score for the option was obtained by adding together all the weighted scores.

[14] Adapted from UKCIP (2010) and Venton (2010)

2.2.1. Effectiveness

For this criterion, you will consider the effectiveness of each option. How effective a measure is will depend on what it is you are trying to address. You will need to assess whether the option will meet the climate resilience objectives that you would like to achieve. For example, will:[15]

- Ensuring that adequate construction standards and materials are used when building protected springs reduce the risk of damage from increased rainfall and flooding?
- Siting dug wells away from sanitation and other sources of pollution reduce the risk of increased contamination of groundwater?
- Targeting the most productive parts of an aquifer reduce the risk of a borehole drying up during a drought?
- Designing a pit latrine to allow regular pumping or emptying reduce the risk of the pit being inundated or overflowing from increased rainfall?

You can categorise each option as high, medium or low depending on how effective you think they will be. A scorecard is given in Table 2.1. There are three categories in the scorecard but, depending on the longlist of you have selected, you may find that all the options you consider fall into either the high or medium category.

Table 2.1: Scorecard for effectiveness

Class	Response	Score
HIGH	High effectiveness at meeting the objective	2
MEDIUM	Medium effectiveness at meeting the objective	1
LOW	Low effectiveness at meeting the objective	0

Example: scoring effectiveness

A group assessed the effectiveness of three different options for addressing seasonal or drought-related reductions in water availability:

- Select the most reliable springs for development. The group assessed the effectiveness of this option as high, because higher-yielding sources are less likely to dry up during a drought.
- Site boreholes in the most productive parts of the aquifer. The group assessed the effectiveness of this option as high, as these are less likely to dry up during a drought.
- Implement catchment protection measures to enhance long-term infiltration and groundwater recharge. The group assessed the effectiveness of this option as medium, as the impacts on infiltration and recharge will be context-specific.

More sophisticated appraisal techniques

Cost-effectiveness analysis (CEA) is used to compare and rank different options in non-monetary terms, to determine which are the most cost effective. More details on CEA are given in Section 3.1.2.

[15] Examples from 'Linking risk with response: options for climate resilient WASH' Technical Brief

2.2.2. Efficiency

To assess efficiency, you need to consider the economic benefits of each measure, together with how much each measure might cost. This can be done simply by considering the questions on costs given in Table 2.2, and benefits in Table 2.3. Consider any relevant available data for each option. Data may be limited, so an estimate is sufficient.

You may want to use categories that indicate costs as a percentage of your overall budget, or you may decide to set thresholds for the categories.

The scores for both costs and benefits can be added together to get an overall score for efficiency. A total score of 8 would mean that the option is the most cost effective, while 0 would mean that it is the least cost effective.

Table 2.2: Scorecard for costs

Question	Class	Response	Score
How much will it cost to implement the option?	LOW	Low cost	2
	MEDIUM	Medium cost	1
	HIGH	High cost	0
Will there be any operating and maintenance costs involved with implementing the option?	LOW	No costs	2
	MEDIUM	Yes – minor costs	1
	HIGH	Yes – major costs	0

Table 2.3: Scorecard for benefits

Question	Class	Response	Score
What economic benefits will there be as a result of implementing the option (or what are the costs of not adapting) and do these benefits exceed the costs?	HIGH	High benefits	2
	MEDIUM	Medium benefits	1
	LOW	Low benefits	0
Will the option reduce major damages?	HIGH	High	2
	MEDIUM	Medium	1
	LOW	Low	0

Example: scoring efficiency
A group appraised options for improving the resilience of dug wells to the increased risk of contamination of groundwater. They looked at two options, and assessed efficiency as follows:

- Site dug wells away from sanitation and other sources of pollution risk. This option scored 3 for costs. It was assessed to be a medium-cost option, but there would be no additional operating and maintenance costs involved. The option scored 4 for benefits, with a likely reduction in major damages. The total score for this option was 7.
- Improve well lining to prevent ingress of shallow groundwater flows. This option scored 2 for costs, with medium costs to implement the option and some maintenance costs involved. The option also scored 2 for benefits, which were considered less significant than those from the first option. The total score was 4.

More sophisticated appraisal techniques
Make sure that you carry out more detailed analysis, particularly for any options that have high or medium costs. Cost-benefit analysis (CBA) is a well-known decision support tool that has been widely used in economic appraisals. More details on CBA are given in Section 3.1.2.

However, it can be difficult to monetise non-economic benefits – for example, health and environmental benefits. Cost-effectiveness analysis (CEA) can be used to compare and rank different options in non-monetary terms, to determine which are the most cost-effective.

2.2.3. Timing for implementation

This criterion assesses the timeframe for implementation and how urgently you need to act. You should consider both the urgency of the risk to be avoided and the timing of the options. Some options may need to be implemented immediately, while others may be less urgent and could therefore be deferred. For example, early action is required for those options which have a long lead time[16] and where delays in implementation may result in the option becoming more costly – or even redundant if there is irreversible damage.[17] Similarly, if there are expected near-term impacts, a particular option may need to be implemented as soon as possible. For other options, it may be that there is a need to delay implementation so that more information can be collected.

Questions to consider for this criterion are:[18]

- Are there any early benefits to implementing the option?
- Does the option have a long lead time? If so, you will need to take early action.
- Is there a need to delay implementation of the option to gather more information to reduce uncertainties? Is a data gathering element required, to establish a baseline and ensure that monitoring and evaluation can be carried out?[19] If so, there may be benefits to deferring implementation.

A scorecard based on these questions is given in Table 2.4. The table assesses three examples of options to improve the resilience of pit latrines to inundation or overflowing from increased rainfall and flooding:

1. site latrines away from areas of known flood risk
2. implement land management measures to reduce flood severity
3. install robust upper foundations or other similar measures.

Options 1 and 2 score most highly with a total score of 2, while option 3 scores 0. There is a need to delay implementation of option 3 because more information is required to determine the most effect measure.

[16] Where adaptation will take many years – for example, where capacity building or research and development are required (Ranger et al., 2013b)
[17] Van Ierland et al. (2013)
[18] Ranger (2013a) and UKCIP (2010)
[19] See Technical Brief on monitoring and evaluation for climate resilient WASH for details

Table 2.4: Scorecard for timing for implementation

Question	Response	Score	Option 1	Option 2	Option 3
Are there any early benefits to implementing the option?	Yes	1			
	No	0			
Does the option have a long lead time?	Yes	1			
	No	0			
Can the option be implemented now, or is there a need to delay to gather more information?	The option can be implemented now	1			
	There is a need to delay implementation to gather more information	0			

More sophisticated appraisal techniques
The 'timing for implementation' criterion considers different questions for assessing options. Multi-criteria analysis (MCA) is used to rank available options by assessing and scoring them against different decision criteria, and both quantitative and qualitative data can be considered. More details on MCA are given in Section 3.1.2.

2.2.4. Uncertainty

There is a high level of uncertainty associated with future climate change, which means there is also high uncertainty over the future benefits of options. This uncertainty cannot be ignored and should be included in the appraisal and prioritisation of options.[20]

Inflexible options – i.e., those that are costly and difficult to adjust – should be avoided when there is uncertainty. However, many options may bring benefits regardless of changes in climate. Investments in early warning systems and building capacity, for example, are no- and low-regret options that contribute to the promotion of resilience.

This simple scorecard approach focuses mainly on no- and low-regret options. The potential sensitivity of these options to uncertainty can be addressed by looking at the following criteria:[21]

- Is the option sensitive to climate – i.e., is it affected, either adversely or positively, by climate? If so, is it robust – i.e., does it perform well across many different climate futures?
- What is the full duration of the influence of the option? How long will the intervention and its implications last?

Combining these values will give an overall score for uncertainty. Table 2.5 shows the scorecard for assessing uncertainty. Note that uncertainty is low for an option with a short-term duration of influence and high for an option with a long-term duration of influence because uncertainty becomes greater over longer periods.

[20] Watkiss et al. (2014)
[21] Ranger (2013a), based on Ranger and Garbett-Shiels (2012) and the UK Green Book Guidance (HMT/Defra, 2009)

Table 2.5: Scorecard for assessing uncertainty

Question	Class	Response	Score
Is the option sensitive to climate? If so, is it robust?	**LOW**	The option is not sensitive to climate, and brings about benefits irrespective of climate change	2
	MEDIUM	The option is sensitive to climate, but robust	1
	HIGH	The option is sensitive to climate, and is not robust	0
What is the duration of the influence of the option?	**LOW**	Short term (<5 years)	2
	MEDIUM	Medium-term (5-10 years)	1
	HIGH	Long term (>10 years)	0

Example: scoring uncertainty

A group assessed uncertainty for several possible options for addressing seasonal or drought-related reductions in water availability, with respect to community-managed piped water supplies. The options assessed are:

- Develop an emergency water plan for extreme water scarcity. This option scored the maximum of 4 for uncertainty: the option was not considered to be sensitive to climate, bringing about benefits irrespective of climate change, and scoring 2. The duration of influence was assessed to be short-term, scoring 2.
- Implement catchment protection measures to enhance long-term infiltration and groundwater recharge. This option was assessed to be sensitive to climate, because the impacts on infiltration and recharge will vary according to the prevailing climate. However, the option is considered robust, scoring 1. The duration of influence was assessed as long-term, scoring 0. This option therefore scored 1 in total.
- Site wells or boreholes in the most productive parts of the aquifer. This option was assessed to be sensitive to climate, but robust as it would perform well across a range of climate futures (as the new sources would be sited in the most productive parts of the aquifer), scoring 1. The duration of influence was assessed as long-term, scoring 0. The option therefore scored 1 in total.
- Raise community awareness of the need to prioritise domestic water over other uses at times of scarcity. This option was considered to bring about benefits irrespective of climate change, i.e. not sensitive to climate, and therefore scored 2 for the first question. The duration of influence was assessed as short-term, scoring 2. The option scored a total of 4.

Optional step: considering flexibility

When you are appraising an option that involves high levels of uncertainty – i.e., one that is sensitive to future climate, is not robust, and has a duration of influence that is longer than ten years – you may want to consider whether the option is flexible and if any adjustments can be made to its implementation.[22] It may be possible, for example, to build in safety margins to WASH infrastructure design, or make options adjustable or scalable.

More sophisticated appraisal techniques
Where an option has a high or medium score for uncertainty, you may want to use more complex appraisal techniques. Real options analysis (ROA) and robust decision making (RDM) are two examples of approaches that you could try. More details on these are given in Section 3.1.3.

2.2.5. Capacity

It is important to consider capacity as part of the appraisal process. It ensures that specific options are avoided if the necessary capacity is not there to support implementation or sustain them once they are in place. A certain level of institutional capacity may be required to implement options, particularly for more complex measures or technologies. A lack of capacity will reduce effectiveness – for example, a new multiple source system for rural water supply will only provide reliable services if the capacity exists to carry out any repairs that are required.[23]

As part of the capacity assessment, it is important to consider whether any planned no- or low-regret measures include capacity building as part of the portfolio of options.

A scorecard for capacity is given in Table 2.6. When scoring the two questions, consider factors such as:

- the skills of people involved
- any necessary resources
- the availability and adequacy of data
- whether the technology exists to implement and sustain the intervention.

The scores can then be added together to get an overall score for capacity.

Table 2.6: Scorecard for capacity

Question	Class	Response	Score
Does the capacity exist to implement the option?	HIGH	Yes, there is sufficient capacity	2
	MEDIUM	There is insufficient capacity, but measures are being put in place/planned to improve capacity	1
	LOW	No, there is limited or no capacity	0
Does the capacity exist to sustain the option?	HIGH	Yes, there is sufficient capacity	2
	MEDIUM	There is insufficient capacity, but measures are being put in place/planned to improve capacity	1
	LOW	No, there is limited or no capacity	0

[22] Ranger (2013a)
[23] *Linking risk with response: options for climate resilient WASH* Technical Brief

Example: scoring capacity

A group assessed different water storage options to address the risks of water scarcity. As part of the assessment, they wanted to determine whether the capacity existed to implement and sustain each of the options:

- Install in-channel structures to enhance aquifer recharge. This option scored 1 for implementation and 1 for sustainability. There are plans to improve capacity, including training to improve the skills of those involved, as capacity is currently insufficient. The total score for this option was 2.
- Rainwater harvesting. The group considered this to be a convenient and inexpensive way to increase domestic supply. They therefore assessed the capacity to implement the option as high. While maintenance is required to ensure adequate water quality, the option includes measures to provide training to households on maintenance and addressing potential water quality issues; they therefore assessed the capacity to sustain the option as medium. The total score for this option was 3.
- Direct infiltration techniques. The capacity is not available to implement and sustain these innovative techniques. The option therefore scored 0.

2.2.6. Equity

This criterion assesses whether the option would have any negative impacts on other geographical areas or vulnerable groups. For example, if a particular type of infrastructure is built in one geographical area, would that then lead to negative consequences in an adjacent area? Or would it adversely affect or exclude certain vulnerable groups? It is important to take these potential effects into consideration when completing an appraisal of options.

A scorecard for this is given in Table 2.7, along with some examples of how this criterion can be scored. An additional question on the accessibility and affordability of the option for the poorest and most vulnerable members of society is given in Table 2.8.

Table 2.7: Scorecard for equity

Class	Does the option have any unintended negative consequences?	Score	Option 1	Option 2	Option 3
HIGH	The option would have no adverse effects on other geographical areas or users.	2			
MEDIUM	The option would have very minor adverse effects on other geographical areas or users.	1			
LOW	The option would have some or major adverse effects on other geographical areas or users.	0			
HIGH	The option would have no adverse effects on vulnerable groups.	2			
MEDIUM	The option would have very minor adverse effects on vulnerable groups.	1			
LOW	The option would have some or major adverse effects on vulnerable groups.	0			

Three examples of options to address threats to the water quality of protected springs from increased rainfall and flooding:
1. build bunds/drains to divert flow away from springs
2. use robust construction standards and materials
3. raise awareness of the risks from water quality deterioration during and after flooding.

Option 1 has a score of 0 for equity, because it was considered that diverting the flow would have major adverse effects on downstream areas and users, including vulnerable groups; and the option is not accessible or affordable to the poorest and most vulnerable members of society. Option 2 scores 4 because it has no adverse effects on other areas or vulnerable groups, but is not accessible and affordable to the poorest and most vulnerable members of society. Option 3 scores a maximum of 5 because it has no adverse effects on other areas or vulnerable groups, and is accessible to the poorest and most vulnerable members of society.

Table 2.8: Equity – accessibility and affordability

Question	Response	Score	Option 1	Option 2	Option 3
Is the option accessible and affordable to the poorest and most vulnerable members of society	Yes	1			
	No	0			

2.2.7. Synergies

The implementation of climate resilient options cannot be considered a standalone activity, because there is a great deal of overlap with other development objectives.[24] It is therefore important that options can be aligned, wherever possible, with underlying development or sectoral objectives. This criterion assesses whether options are compatible with local and national development objectives for WASH and climate resilience, and considers if the implementation of the option would result in any co-benefits for other objectives, such as environmental protection.

A scorecard for synergies is given in Table 2.9, along with some examples to show how this criterion can be scored. We examine three options to address contamination of water sources due to the inundation of pit latrines:
1. site latrines away from areas of known flood risk
2. design pits to allow regular pumping or emptying
3. implement land management measures to reduce flood severity.

Option 1 has a maximum score of 4 for synergies, because it is compatible with all development objectives and would benefit more than one other strategic objective. Options 2 and 3 both score 3 for synergies: option 2 is compatible with all development objectives and benefits one other strategic objective; option 3 is not compatible with all development objectives, but would benefit more than one other strategic objective.

2.2.8. Legitimacy

This criterion assesses whether the option is acceptable both politically and socially. A scorecard for legitimacy is given in Table 2.10, based on whether there is wide, some or limited acceptance of the option being considered.

[24] Watkiss et al. (2014)

Table 2.9: Scorecard for synergies

Question	Class	Response	Score	Option 1	Option 2	Option 3
Is the option compatible with local/ national development objectives?	**HIGH**	The option is compatible with all development objectives of local/national governments for WASH and climate resilience.	2			
	MEDIUM	The option is compatible with some development objectives of local/national governments for WASH and climate resilience.	1			
	LOW	The option is compatible with very few or no development objectives of local/national governments for WASH and climate resilience.	0			
Are there any co-benefits for other objectives?	**HIGH**	The option would benefit more than one other strategic objective.	2			
	MEDIUM	The option would benefit one other strategic objective.	1			
	LOW	The option would not benefit any other strategic objectives.	0			

Table 2.10: Scorecard for legitimacy

Question	Class	Is the option acceptable?	Score
Is the option politically acceptable?	**HIGH**	Yes, there is wide acceptance of the option	2
	MEDIUM	There is some acceptance of the option	1
	LOW	There is limited acceptance of the option	0
Is the option socially acceptable?	**HIGH**	Yes, there is wide acceptance of the option	2
	MEDIUM	There is some acceptance of the option	1
	LOW	There is limited acceptance of the option	0

Example: scoring legitimacy
A group scored the legitimacy of options to address the risk of physical damage to latrines from increased rainfall and flooding. They scored the options as follows:

- Implement drainage land management measures to reduce flood severity. There is limited acceptance of this option politically, and only some acceptance socially, because of the effects of the measures on downstream users. This option scored 1.
- Improve existing latrines by installing upper foundations, collars and footings. There is wide acceptance of the option both politically and socially. This option scored 4.
- Change the design of pit latrines. There is some acceptance of the option both politically and socially. This option scored 2.

2.3. Prioritising options

Once you have completed an assessment for each criterion, you will then need to add up the scores to compile a list of prioritised options.

Table 2.11 shows how this can be done, with option B scoring most highly. You may want to then summarise the prioritised portfolio of options to ensure that all the objectives are met.

Once you have a list of prioritised options, you will need to consider whether there are any other barriers and enablers to implementing these options, besides those already considered during the initial appraisal process. Barriers delay, divert or temporarily block the adaptation process, while enablers support it. Any barriers can reduce the uptake of potentially effective options.[25] You will need to consider which are the most significant barriers and why, as well as whether there are any enablers to exploit.

Table 2.11: Combining scores to prioritise options

Criterion	Option A	Option B	Option C
Effectiveness	2	2	1
Efficiency	5	6	4
Timing for implementation	1	0	0
Uncertainty	2	3	1
Capacity	2	3	2
Equity	2	5	3
Synergies	3	3	1
Legitimacy	3	4	2
Total score	**20**	**26**	**14**

[25] Watkiss et al. (2014)

3. Available appraisal techniques

This section sets out some of the more detailed appraisal techniques that are available. You can choose to use these methods, or other tools that are available, to carry out a more comprehensive appraisal of options. You may decide to use a combination of tools to include both quantitative and qualitative parameters in your appraisal.

3.1. Available techniques

The available techniques summarised here are:

- Conventional tools that can be used to identify the best options to meet a specific objective:
  - cost-benefit analysis
  - cost-effectiveness analysis
  - multi-criteria analysis.
- More advanced approaches that consider uncertainty. These approaches require more resources and may be unsuitable for use in smaller projects and programmes:
  - real options analysis
  - robust decision making.

3.1.1. Overview

Table 3.1 gives an overview of the techniques that are available and when it is appropriate to use them. It summarises the strengths and weaknesses of each, specifically with respect to their application in climate resilience. Both the conventional tools and the tools for decision-making under uncertainty are detailed in the table, with further information on each provided in Section 3.1.2 and Section 3.1.3, respectively.

Tool	Overview	Application in climate resilient WASH appraisals		Further information
		Strengths	Weaknesses	
Conventional tools				
Cost-benefit analysis	Identifies options that have the greatest benefits compared to costs, or assesses whether a particular criterion is met	■ Most suited to assessing options in the short term, particularly no- and low-regret options	■ Does not account for uncertainties that are unquantifiable; e.g. those associated with projections of long-term climate	Berger and Chambwera (2010) Beyond cost-benefit: developing a complete toolkit for adaptation decisions. IIED Briefing Note. Published by IIED, London.
Cost-effectiveness analysis	Compares and ranks different options in non-monetary terms	■ Near-term assessment, particularly no- and low- regret options ■ Works best with technical options	■ Less suitable for complex or cross-sectoral risks as ignores portfolios of options ■ Does not work as well with non-technical options, and can give these lower priority ■ Not suited to considering uncertainty	Watkiss, P. and Hunt, A. (2012). Cost-effectiveness analysis: Decision Support Methods for Adaptation, MEDIATION Project, Briefing Note 2. Funded by the EC's 7FWP.

Continued on next page

Tool	Overview	Application in climate resilient WASH appraisals		Further information
		Strengths	Weaknesses	
Multi-criteria analysis	Ranks available options by assessing and scoring them against decision criteria	■ Both quantitative and qualitative data can be considered and compared ■ Can be used to consider aspects of uncertainty alongside other characteristics of options	■ Tends to work with individual climate scenarios unless multiple runs completed ■ More qualitative consideration of options and uncertainty	Van Ierland, E.C., de Bruin, K. and Watkiss, P. (2013). Multi-Criteria Analysis: Decision Support Methods for Adaptation, MEDIATION Project, Briefing Note 6. Funded by the EC's 7FWP.
Tools for decision-making under uncertainty				
Real options analysis	Used in situations where there is risk and uncertainty in investments; quantifying this risk	■ Can be used to complete an economic appraisal of options under conditions of uncertainty ■ Most suitable for providing information on major investment decisions	■ High complexity, and data and resource intensive ■ Need for data, such as probabilistic climate information, a potential barrier ■ Requirement for quantitative information on costs and benefits limits its use ■ Not as useful for evaluating no-regret or soft options	Watkiss, P., Hunt, A. and Blyth, W. (2013). Real Options Analysis: Decision Support Methods for Adaptation, MEDIATION Project, Briefing Note 4. Funded by the EC's 7FWP.
Robust decision making	Developed to help make decisions on strategies which have long-term consequences	■ Is applicable under situations of high uncertainty, including wider uncertainty, e.g. socio-economic scenarios ■ Particularly useful for identifying no- and low- regret options ■ Broad applicability, including where valuation is difficult	■ Can be technically complex and data and resource intensive, especially when considering multiple sources of uncertainty ■ Requires high level of expertise	Watkiss, P. and Dynzynski, J. (2013). Robust Decision Making: Decision Support Methods for Adaptation, MEDIATION Project, Briefing Note 3. Funded by the EC's 7FWP.

Sources: Ranger (2013a), Van Ierland et al. (2013), Watkiss and Hunt (2012), Watkiss and Dynzynski,(2013), Watkiss et al. (2013), Watkiss et al. (2014)

3.1.2. Conventional tools

These tools can be used to identify the best option or options for meeting a specific objective. Three of the main tools are discussed in this section.

Cost-benefit analysis

Cost-benefit analysis (CBA) is a well-known decision support tool that has been widely used in economic appraisals. CBA can be used to identify the option that has the greatest benefits compared to costs, or it can be used to assess whether a particular criterion is met. It monetises costs and benefits, and compares these for the different options.

CBA is most suited to assessing options in the short term, particularly no- and low-regret options. It does not account for uncertainties that are unquantifiable, such as those associated with projections of long-term climate.[27] This makes it unsuitable for use in situations where the decision is sensitive to such uncertainties. Ignoring uncertainties could lead to the selection of inappropriate or less effective options, or it could even result in adverse effects. CBA is also information-intensive and therefore costly if used for small-scale projects; most community-level planners do not use quantitative CBA as part of their assessments.[28]

Box 4: The economics of climate change adaptation in Africa's water sector[26]

This ODI Working Paper summarises some of the key studies on the costs and benefits of adaptation interventions in Africa's water sector. These include:

- Kenya: climate screening and information exchange (AEA, 2008) – the project carried out a climate risk assessment in Kenya, and used basic CBA for rainwater harvesting as an adaptation intervention.
- Shaping climate resilient development: a framework for decision-making (ECA, 2009) – this framework uses CBA to evaluate possible adaptation interventions. A Tanzania case study examines drought impacts and calculates the costs and impacts of different options, including WASH infrastructure and hygiene education.
- Stakeholder-focused cost-benefit analysis in the water sector (IIED, 2013) – this guidance document for stakeholder-focused CBA in the water sector includes the costs of adaptation interventions. It is based on the findings from piloting the approach in five case studies, including one in Malawi.

Cost-effectiveness analysis[29]

Cost-effectiveness analysis (CEA) is used to compare and rank different options in non-monetary terms. It uses a cost curve to determine which options are the most cost effective. CEA can also be used to assess the order of options that would be most cost effective to implement.

CEA has the potential for use in appraising options to improve climate resilience. However, the approach uses a single metric to assess options, which can often be difficult to select. CEA is therefore less suitable for assessing more complex risks. In addition, uncertainty is often ignored in applications of CEA. The approach also tends to rank non-technical soft options as lower priorities, because it focuses more on the technical options that can be easily assessed in terms of their effectiveness.

CEA is useful for identifying near-term options, especially those that are no- or low-regret. It can also be particularly useful where it is difficult to quantify benefits. CEA can be used at both project and programme levels.

Multi-criteria analysis[30]

Multi-criteria analysis (MCA) is used to rank available options by assessing and scoring them against decision criteria. Both quantitative and qualitative data can be considered in MCA through the use of different criteria. Weights are then assigned to each criterion and the sum is used to rank options. Analysis, stakeholder engagement and expert elicitation can be used in MCA to identify options, relevant criteria and their weightings, and scoring.

MCA has been widely used in the environmental sector to rank different options and is particularly relevant for adaptation to climate change. The use of qualitative information in the analysis is especially useful given

[26] Doczi and Ross (2014)
[27] Ranger (2013a)
[28] Berger and Chambwera (2010)
[29] Watkiss and Hunt (2012)
[30] Van Ierland et al. (2013)

the frequent gaps in data, as well as the need to assess aspects that are difficult to quantify.

MCA can also be used as a tool to complement CBA, because it can include consideration of qualitative data – for example, for those options that may be difficult to value, such as synergies and legitimacy. It can be used at both project and programme levels.

Box 5: CEA and MCA case studies[31]

- As part of the Capacity Building to Enable the Development of Adaptation Measures in Pacific Island Countries project (CBDAMPIC),[32] CEA was used to assess adaptation options for freshwater resources on four islands in the Pacific (Cook Islands, Fiji, Samoa and Vanuatu). The aim of the project was to find options that would ensure sustainable water quality and quantity for vulnerable communities. The costs and effectiveness of a number of identified options were considered, with rainwater harvesting selected as the most cost-effective option by all communities.
- A study in Yemen aimed to evaluate the options to best manage scarce water resources, while also taking into account the country's other development priorities.[33] Using a method developed under UNEP's MCA4 climate initiative[34] different options were assessed, including basin-wide adaptation policies, urban water adaptation policies, and rural water adaptation. A criteria tree for policy evaluation was used and each option was scored according to its performance against each criterion, with weights assigned. It was found that some policy options performed better if implemented with other options, so further work was completed to evaluate portfolios of policy options.

3.1.3. Tools for decision-making under uncertainty

One of the disadvantages of using conventional tools such as CBA and CEA is that they do not formally deal with uncertainty.[35] This could lead to the selection of an option that is inappropriate; it might, for example, be less effective than other options, or it could even result in adverse effects. Selecting and implementing the wrong type of measure could mean that societies are locked into development that could actually increase their vulnerability – for example, building WASH infrastructure that is not resilient to potential climate change.

Two more advanced tools that consider uncertainty are Real Options Analysis and Robust Decision Making.

Real options analysis[36]

Real options analysis (ROA) is used to assess the valuation of options and risk transfer in financial markets, but can also be used in other situations where there is risk and uncertainty in investments, such as the investment in physical assets to improve climate resilience. ROA quantifies this risk.

ROA is especially useful for assessing the value of the flexibility of investments. This might include flexibility in timing and the ability to adjust investments if necessary.

There is potential to use ROA to assess investments for climate resilience, because it can be used to conduct an economic appraisal of options under conditions of uncertainty. Options that would not normally be selected for implementation using conventional economic analysis could therefore be considered viable using this approach. ROA aligns with iterative risk management approaches and is most useful for projects which involve large investments.

Robust decision making[37]

Robust decision making (RDM) is a decision support tool that was developed to help make decisions on strategies which have long-term consequences. RDM can be used where there is deep uncertainty involved – i.e., where there is little or no probabilistic information available about the future potential states of the world, such as whether a particular location will be wetter or drier, warmer or cooler in future.

[31] UNFCCC (2011)
[32] Kouwenhoven and Cheatham (2006)
[33] Miller and Belton (2011)
[34] http://www.mca4climate.info/
[35] Ranger (2013a)
[36] Watkiss et al. (2013)
[37] Lempert et al. (2006), Watkiss and Dynzynski (2013)

The approach tests near-term strategies across a range of different future scenarios. It can be used to identify any potential weaknesses of options, helping decision-makers to anticipate or mitigate possible negative impacts that arise in different scenarios.

RDM is useful for climate resilience because it can help inform decisions about which options are robust to a range of future scenarios – i.e., they perform satisfactorily regardless of the climatic conditions. It explicitly considers uncertainty, such as climate uncertainty, and can also be used to consider wider uncertainties such as those associated with socio-economic scenarios. RDM is especially useful for identifying no- and low-regret options – i.e., those which are also likely to increase resilience in the long term as well as the short term.

Box 6: Multi-criteria search and trade-off analysis

- Another approach that can be used is multi-criteria search and trade-off analysis. This can help decision-makers understand the trade-offs inherent to a system when considering engineering or policy interventions, and involves developing a simulation model. The model has the trust and support of stakeholders because it represents their understanding of the system and the benefits it provides. In relation to WASH this could be a river[38] or groundwater system, and the modelling could be performed with any one of a range of tools from a spreadsheet to a piece of open source or proprietary software.
- Understanding trade-offs can help make more transparent and equitable decisions about the allocation of resources between stakeholders and how different intervention options might impact on the choices available. This type of approach lends itself particularly well to river basin or sub-basin scale analysis and should be based around an interactive stakeholder process of defining the problem, identifying options and debating the best course of action based on the information provided.[39]

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[38] Hurford et al. (2014)
[39] Huskova et al. (2016)

4. Next steps

By following the approach given in this Technical Brief, you will have completed an initial appraisal of options and be aware of the more complex tools and techniques that are available to help prioritise options in the WASH sector.

The next steps are to move to the next quadrant of the Strategic Framework, 'Deliver solutions', which covers the integration of options into existing planning processes for implementation. There are two Technical Briefs. *Integrating climate resilience into national WASH strategies and plans* describes a stepwise approach to applying a 'climate lens' to national WASH sector strategies and plans, and includes guidance on the application of the approach in the form of questions, potential responses and suggested actions. *Local participatory water supply and climate change risk assessment: modified water safety plans* outlines a participatory approach to ensuring more resilient community-based rural water supplies, which builds on an existing Water Safety Plan (WSP) framework.

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