Monitoring and evaluation in adaptation

Final Report

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1 Introduction

This report provides a review of various monitoring and evaluation (M&E) methods and steps applicable to climate adaptation decision-making. It also presents key principles of good M&E for adaptation projects and discusses two case study examples of M&E in the context of local government level adaptation to sea-level rise. The value of this report is that it identifies current practices in M&E frameworks for climate adaptation as well as identifies potential best practices that could be adopted more broadly by the local government sector across Australia. Firstly, we note that increasingly various stakeholders are demanding standardised M&E approaches for climate adaptation projects, rather than having flexible and context relevant approaches. The demand for standardisation is partly due to stakeholder experiences with climate mitigation projects in which measures used for evaluation can be standardised. For adaptation M&E however there is no 'one-size-fits-all' solution (Spearman and McGray 2011; Bours et al. 2014a,b; EEA 2015) and therefore, in this report, we only showcase potential methods and examples of M&E projects.

The report includes five sections. The first section introduces the basic concepts of monitoring and evaluation and its relevance in adaptation decision-making. Section 2 reviews steps for M&E and potential methods to assist adaptation M&E. Section 3 discusses several examples of M&E templates presented in the current literature. Section 4 discusses M&E within the adaptive management cycle of adaptation decision-making. Section 5 includes two Australian case studies that utilise the M&E templates. Finally, Section 5 provides concluding remarks for the report with recommendations for principles of good adaptation M&E for local governments.

1.1 Role of monitoring and evaluation in climate adaptation decision-making

This section examines the role of M&E in recent adaptive management approaches that have been discussed in climate adaptation research. The OECD (2002) defines monitoring and evaluation as follows:

> *'Monitoring is a continuous function that uses the systematic collection of data on specified indicators to provide management and the main stakeholders of an ongoing development intervention with indications of the extent of progress and achievement of objectives and progress in the use of allocated funds' (p. 27).*

Monitoring refers to ongoing collection of data right from planning stage to ensure adequate progress of a project or programme. It also helps to set targets and milestones to measure progress and achievement (Sweeney 2009).

> *'Evaluation is the systematic and objective assessment of an ongoing or completed project, program, or policy, including its design, implementation, and results. The aim of evaluation is to determine the relevance and fulfilment of project objectives, efficiency, effectiveness, impact, and sustainability. An evaluation should provide information that is credible and useful, enabling the incorporation of lessons learned into the decision-making process of both recipients and donors' (OECD 2002, p. 21).*

The evaluation process assesses the monitored data at various completed phases of a project or programme or at critical milestones. M&E can be voluntary or form part of a legal obligation or regulatory requirement imposed by a third party. Reporting on monitoring and evaluation conducted for adaptation projects may be required. This could also be a voluntary or legal requirement. EEA (2015) defines reporting as 'the process by which monitoring and/or evaluation information is formally communicated, often across governance scales' (EEA 2015, p. 17). Data from an M&E process can be restricted to within an organisation for its own purposes, subject to external reporting (which may or may not be accessible to the public) or provided as an open source and readily accessible form of information to the public and other organisations.

M&E forms an important part of climate adaptation decision-making. This is mainly because climate adaptation decisions are to be made amidst multiple future uncertainties (e.g. climatic uncertainties, uncertainties in technological advancements, new thresholds, new adaptive pathways). UNFCCC (2010) emphasises adaptation to be continuous, flexible and subject to periodic reviews. Similar approaches are also adopted at the Australian coastal council scale. For example, Norman et al. (2013) summarises through a number of case studies along the New South Wales coast that a 'prescriptive approach to settlement and infrastructure for coastal communities is less important than a decision-making process that is open, transparent, inclusive and adaptive, involving all levels of government and the community'(p.7).

Recent adaptation decision-making studies use approaches such as the risk management approach (Jones 2010), the adaptive pathways approach (see Haasnoot et al. 2012), the dynamic policy approach and the dynamic adaptive policy pathways approach (see Haasnoot et al. 2013) to manage uncertainty surrounding decision-making. All these processes promote continuous monitoring, evaluation and reporting of adaptation actions to manage uncertainty, ensure 'learning by doing' and review decisions in light of more information. Adaptation processes thus should be iterative and will need to combine incremental and/or transformative adaptation options depending on the adaptive landscapes of action (e.g. Are the action outcomes directed towards maladaptive landscapes? Are transformative strategies required to stay within the adaptive land scape? Are the action outcomes directed towards dead ends?) see, Wise et al. (2014). The Risk Management Framework (RMF) forms the basis of most adaptation decision cycles. It provides iterative decision cycles (Jones, 2010) with each cycle consisting of subsequent steps such as i) risk identification, ii) risk analysis and iii) risk

reduction and decision-making. Each decision cycle (steps i-iii) is subsequently followed by a monitoring period after which decisions are reviewed and evaluated.

The adaptive pathways approach (see Haasnoot et al. 2012; Wise et al. 2014; Siebentritt et al. 2014) is a step by step approach, that clearly focuses on tipping points which are points in time beyond which certain actions do not deliver the required objectives (see adaptive pathways map Figure 1). The adaptive pathways approach also includes a long term vision of the changing adaptive landscape and highlights the need to accommodate societal responses to change. This method provides insight into potential adaptive pathways, lock-ins and path dependencies. M&E of a project or programme essentially checks what aspect of a program is progressing according to the objectives and why. It also helps to provide a mechanism to refine adaptation decisions (see Figure 1). Monitoring and evaluation also occurs before implementation of the plan.

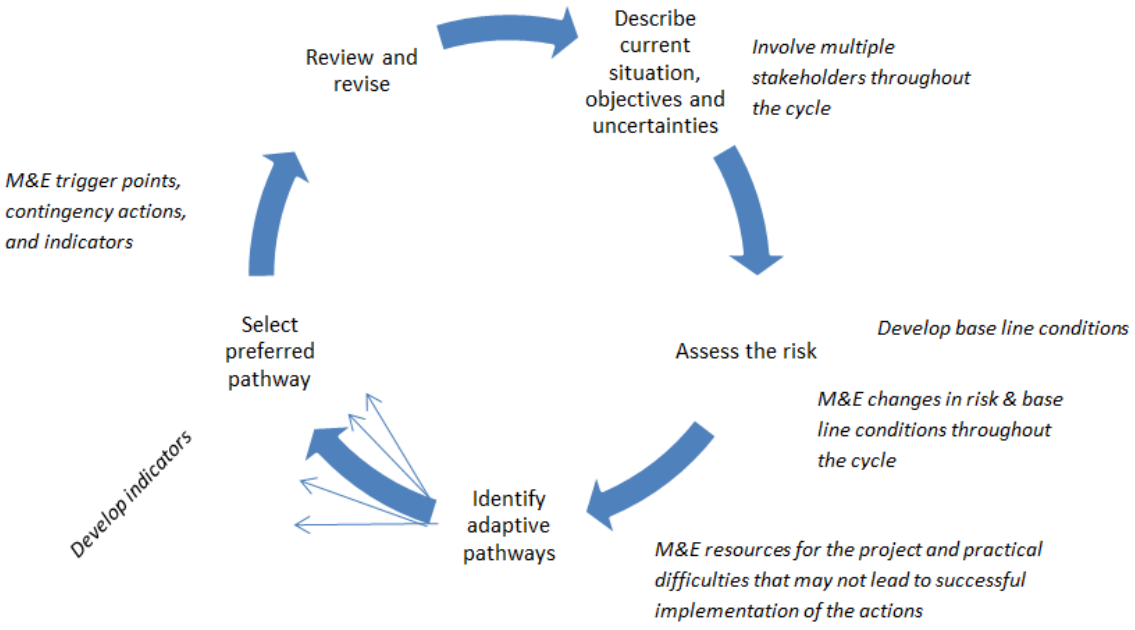


Figure 1: Adaptive pathways approach
Sources: Modified Hasnoot et al. (2013); AEA et al. (2005)

The approaches discussed above include a long term vision of the changing adaptive landscape. The changes can be caused by a number of factors such as changing demands of the community, innovation in technology resulting in low cost alternative approaches, more accurate climatic projections and presence of new vulnerabilities. Thus incorporation of M&E is important to identify the changing factors.

2 Monitoring and evaluation

This section discusses a review of the M&E climate adaptation literature; both its challenges and the steps required for monitoring and evaluation.

2.1 Challenges associated with M&E

M&E for climate adaptation presents a number of challenges. These are mainly because climate adaptation objectives across the quadruple bottom line (QBL) and cultural dimensions vary according to differing adaptation contexts (e.g. proximity to coasts, people vulnerable to multiple stressors) and effects of climatic changes (e.g. extreme events), see, e.g., Spearman and McGray (2011). One of the most important challenges associated with M&E is that a general or standard approach may not be applicable given the location and variability in policy, program and impact. By way of comparison, climate mitigation projects are mainly tracked through quantifiable units such as changes in greenhouse gas emissions or avoided emissions through the protection of carbon sinks providing common ground for monitoring, evaluation and reporting (EEA 2015). For climate adaptation however, each objective will usually have a particular appropriate adaptation strategy or combination of strategies that meet the specified objectives and a corresponding indicator that measure its effects. As well, the focus of adaptation may vary for different projects as many adaptation objectives are increasingly integrated within goals for mitigation and as part of development and disaster risk reduction planning (Sanahuja 2011 for Global Environment Facility or GEF). Uncertainty associated with climate systems, combined with uncertainties associated with the social, environmental and economic factors, influence the extent of impacts and make it often difficult to evaluate the appropriateness of adaptation policies and actions.

In addition, there are a number of other challenges associated with developing robust M&E frameworks including long timeframes, impact of multiple drivers, maladaptation and varying socio-political contexts. Impacts of climate change are usually observed over long time scales and thus success of any intervention is best measured over long time horizons. The long time frame is necessary to assess and measure damages avoided (see Morand et al. 2014). When seeking to measure avoided damages, measuring success is difficult in the absence of an event. For example, it is hard to estimate the success of an adaptive measure for an extreme storm event unless a storm event actually occurs. Compounding the challenge of a long term M&E framework is that that there are changes in societal values, biophysical conditions and socio-economic conditions. Multiple drivers (e.g. change in community attitudes, new technologies) may also contribute towards a desired outcome which makes it challenging to attribute the outcome to a particular adaptation measure during the M&E process (Oliver et al. nd). M&E needs to consider if the chosen options develop maladaptation (i.e. reduce vulnerability to climate risks but increase vulnerability to other non-climate related stressors in the long term) as the adaptive space changes. Also, objectives may need refining with changes in the

adaptive landscape (e.g. changes in community values; technological advancements, variations in assumptions made at the planning stage). There is also a need to consider potential adaptation path dependencies that can be shaped by a number of lock-in effects (Wilson 2014) which can be caused by improper planning or abrupt changes in the adaptive land scape. 'Many rational options are likely to fail, competing against political timelines and non-climate-related priorities' (see Mathew et al. 2012 p. 302), constraining the range of pragmatic adaptation pathways. This would mean M&E will need to also monitor and evaluate the socio-political contextual changes happening while adaptation options are planned and implemented. Evaluation is usually conducted against reference conditions. However, the baseline data which reflect the conditions at the time of project planning and implementation may not be stationary. A shifting baseline, where specific points of reference used to measure adaptation progress change over time will impact on the overall evaluation (EEA 2015). It is important to assess the effectiveness of adaptation by comparing what would have happened in the absence of the measure through counterfactual analysis (Oliver et al. nd). Counterfactual analysis utilises a number of assumptions to evaluate various alternative development scenario: which also makes it difficult to define a standard for comparison (Oliver et al. nd).

Key concepts and definitions used for adaptation vary with 'adaptation' often being used to mean adaptation actions, adaptation planning or adaptive capacity (EEA 2015). All of these terms may require different references for what should be measured and understood (EEA 2015). The use of indicators used for M&E are often restricted by data availability. Data for the indicators should be scalable and applicable elsewhere to allow comparison. However, data are not always available in the same format, on the same scale or over a coherent timescale. Sometimes adaptation monitoring relies on already existing data that was gathered for other purposes. This is mainly because data collection is resource intensive and often a budget may not be allotted for the purpose. All these challenges highlight the need for ongoing monitoring and evaluation.

2.2 Actors involved in the M&E process

Adaptation decision-making is a long process and involves diverse stakeholders, including staff from various organisations, consultants and community members. A number of organisations may also be involved in adaptation and monitoring, reporting and evaluation (MRE) such as the organisation co-ordinating adaptation policy, the organisation implementing adaptation, the organisation responsible for MRE and the organisation implementing MRE (see EEA 2015). Three classes of actors can be considered to be involved in a project: (i) the implementation team (which institution manages and implements the project), (ii) the boundary partners (who are in touch with the implementation team, and whose capacity is built through delivery of the project), and, (iii) the ultimate beneficiaries (the wider community), see, e.g. Crawford et al. (2004). It is important to map all key stakeholders and their roles (CARE International 2005). All involved actors need to develop a shared understanding of

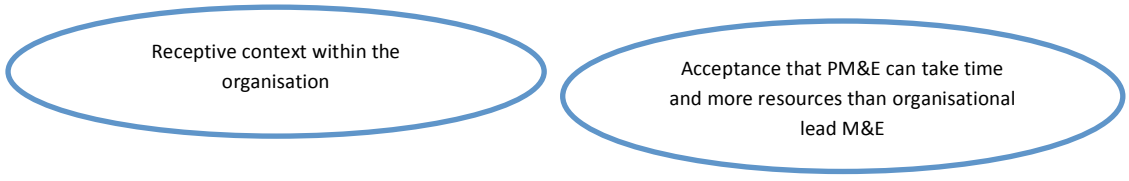
the terms of reference within the adaptation project/programme. This also means that the adaptation terminology should be transparent and clear. Each step of the adaptation process, as well as iterations of the adaptation cycle, can be conducted by different staff/consultants because of changing staff positions (e.g. promotion, employment of new staff). Terms and objectives should be made clear for monitoring and evaluation during the lifetime of the project. Monitoring could be conducted by implementation staff or boundary partners (compliance checking) or community members (coastal communities) depending on what needs to be evaluated and monitored. Training will be required at regular intervals. Staff within an organisation will need to develop a shared understanding of the M&E process (e.g. monitoring what and by whom) and storage of data to avoid dependence on specific staff. Also, adequate funding is important to perform monitoring and evaluation. Often, it needs to be assessed if it is worth investing in a costly and time consuming M&E process. The evaluation methods and choice of indicators may depend on the nature of the adaption project (e.g. high investment option, project aimed to result in positive behavioural changes) and the funding available. Note that evaluation is often conducted by an external agency although this will depend on the scale or size of an organisation and or the presence and impact of regulatory and oversight bodies.

2.3 Types of M&E systems

There are two major types of M&E systems: community based; and program, project and policy based (see Spearman and McGray 2011).

- Community based M&E initiatives

Community based M&E initiatives are usually bottom up approaches and involve highly localised vulnerabilities and immediate priorities of communities. Community based M&E ensures increased authenticity of locally relevant findings and improves the local capacity (Estralla and Gaventa 1998). Such initiatives require a participatory M&E (PM&E) framework that engages stakeholders at all (most) steps of the M&E process. PM&E may be defined as a process of 'Developing a partnership between the primary stakeholders in a program to collaboratively design and systematically implement an M&E process, develop tools, set objectives and indicators, and share concerns, experiences and learnings' (Lenine et al. 2011, p. 7). PM&E is based on trust, ownership, empowerment, inclusions and willingness for on-going learning (also, see Figure 2; Lenine et al. 2011).



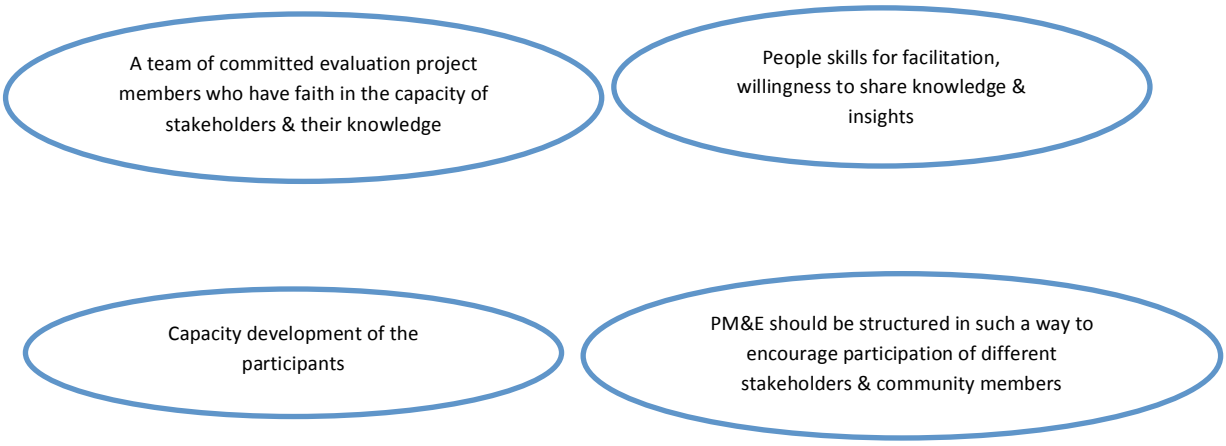


Figure 2: Key ingredients to participatory monitoring and evaluation
Source adapted from Lenine et al. (2011), p. 6.

O'Connell et al. (2016) also highlights the importance of multi-stakeholder involvement to recognise contextual issues, promote project acceptance and result in effective implementation of actions in adaptation projects. PMERL (Participatory Monitoring, Evaluation, Reflection and Learning for Community-based Adaptation) employs a participatory rural appraisal method which is used to analyse stakeholder's own situation and to develop a common perspective on particular issues.

Krause et al. (2015) present an actor oriented, context specific framework for adaptation evaluation which was applied to assess local adaptation to flood risks in the Vietnamese Mekong Delta. The study revealed that participatory approaches assist in stimulating a dialogue appreciating goals of the local authorities and the local community. These two-way dialogues do not limit adaptation decisions to technocratic 'expertocracy' consultancy (that consults specific experts and weighs views of the consultants over the local communities, see Krause et al. 2015), but assist in reflecting on the factors that influence adaptation and its value for different actions. Restricting adaptation decisions to a technical expert consultancy often fails to consider the cultural or local context and consequently such decisions are more likely to fail.

Another example of such a PM&E is that used by UNDP's community based adaptation in Guatemala (see http://www.undp-alm.org/projects/spa-community-based-adaptation-guatemala/monitoring-and-evaluation). The Vulnerability Reduction Assessment (VRA) is an example of an indicator system that could be adopted by CBA projects. The VRA helps to test whether a project is successful or not by measuring the community perceptions on the changing climate vulnerabilities of communities (see Droesch et al. 2008). A composite set of four questions which captures the context specific problems are posed during three to four community level meetings over the course of the CBA project. The basic VRA indicators include: i) vulnerability/livelihood/welfare to existing climate change and or

climate variability; ii) vulnerability/livelihood/welfare to developing climate change risks; iii) vulnerability/livelihood/welfare to magnitude of barriers to adaptation; and iv) ability and willingness of the community to sustain the project. The framework is set under the premise that 'repeated evaluation of community perceptions of project effectiveness and climate change risks permits an indication of the relative change in vulnerability' (Droesch et al. 2008, p 2).

- Program, project and policy based initiatives

Although many objectives of adaptation and development are interlinked, adaptation projects are often considered to be additional to projects that focus on overall development of a community (Spearman and McGray 2011). Such adaptation projects ensure that M&E frameworks can be implemented within the project periods and with particular focus on adaptation actions. On the other hand, some projects consider adaptation to be integrated within development requirements (e.g. UNDP's policy framework see Lim et al. 2004), but in such cases M&E frameworks are not exclusively focussed on adaptation. M&E frameworks should thus be able to monitor and evaluate both the direct and indirect outcomes of adaptation. Adaptation programs usually require multiple projects working towards the achievement of a particular goal. In such cases, uniform indicators that assist in aggregating the outcome for the program are selected across the individual projects.

Adaptation M&E at the national policy level is commonly conducted for accountability and learning purposes (OECD 2015). For example the GEF developed an approach targeting adaptation projects and programmes in the least developed countries (see GEF 2014). The GEF report describes a set of indicators specific for climate adaptation programs in developing nations (Appendix D) and a supporting tracking tool. The GEF framework is based on prescribing a series of set outcomes and indicators measured against baseline conditions (typically based on the situation before a program or activity are implemented) for each objective. Another example of national level indicators is that used by the World Resources Institute (Dixit et al nd). WRI's National Adaptive Capacity (NAC) framework assists in understanding institutional aspects of adaptive capacity at the national level, see Table 1.

Table 1: Example of indicator used within the NCA framework (Dixit et al. nd).

NAC functions	Bolivian indicators	Proposed metrics
Climate risk management	Economic incentives for risk reduction tested and rolled out through local, regional and national investments	% of funds allotted by national government to local, regional and national climate risk reduction investment projects

The EEA (2015) have developed a consolidated monitoring, reporting and evaluation (MRE) system at the national level for Europe. The EEA report highlights the importance of involving a broad range of stakeholders for MRE, with indicators mainly created through an iterative and interactive process involving experts and other stakeholders. The UK also evaluated their National Adaptation Plan (NAP) by evaluating individual NAP themes into specific and measurable factors that are the most important for managing the risks from climate change (see Committee on Climate Change 2015).

There are also M&E frameworks that aim to link both top down and bottom up approaches. The TAMD (Tracking Adaptation and Measuring Development) is one such framework that follows two tracks: track 1 to assess institutional climate risk management and track 2 to measure adaptation and development performance across scales (Brooks and Fisher 2014; Figure 3).

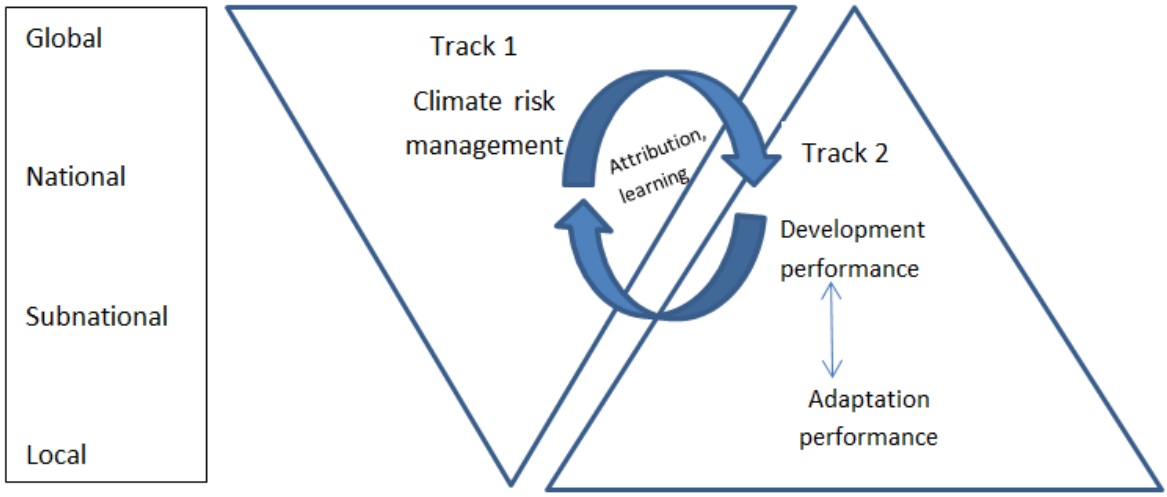


Figure 3: TAMD framework.
Source: Modified Brooks and Fisher (2014).

Karani et al. (2015) use the TAMD framework in Isiolo County, Kenya. The Isiolo County study shows that the TAMD framework can be used for both ex ante and ex post evaluation processes as it can explore links between climate risk management led at the subnational level and development performances at the local levels.

2.4 Types and foci of evaluation

Generally, evaluation types could be classified as (see Turner et al. 2014)-

i) formative evaluation (evaluation conducted to assess incremental changes and often conducted during the implementation stage)
ii) summative evaluation (assesses the overall project, once the initiative is complete).

In addition, evaluation types could also be classified into (see Turner et al. 2014; Villanueva 2011; Table 2)-

i) input-output based evaluations/outcome, impact or results evaluation
ii) process based evaluation
iii) evaluation of behavioural change
iv) economic evaluation.

Table 2: Approaches and methodologies for the evaluation of adaptation interventions.
Source: Villanueva 2011, p. 20.

M&E methodologies	Focus on	Approach	Assumption
Input-output-outcome evaluation	Effectiveness	Evaluation of adaptive capacity or risk is against a set of indicators	Increased adaptive capacity will ultimately reduce the vulnerability Risk is probabilistically determined and unknown
Process based evaluation			
Evaluation of behavioural change			
Economic evaluation	Efficiency	Evaluation is in terms of economic units	Baselines and projected benefits, costs and damage can be determined economically

2.4.1 Input output evaluation. This helps to determine if an initiative has contributed towards the targeted outcomes (Turner et al. 2014). The Tasmanian Institute of Agriculture M&E presents an 'if then' hierarchy (also based on Bennet's hierarchy (Bennet 1975) for a project designed to change social, environmental and economic condition (details cited in Wallis 2015, p. 148). The 'if/then' hierarchy provides a logical way of linking resources (human, physical, financial inputs available), activities, outputs (tangible and intangible) and outcomes (overall impact or achieved in programme or project) in a layered way (see Wallis 2015). In this approach, outcomes can be achieved through a series of steps. For example, success of a project planned to bring changes within a community may depend on how participants react to particular interventions (response as expected with good planning) leading to changes in knowledge or skills or attitudes which further leads to changes in practices, thereby assisting in achieving the long term goal.

The logical framework (also referred to as *Logic Model* or *Logframe*) is another example of the input-output based evaluation (see Table 3). A basic logic model (see Wallis 2014; Pringle 2011; GEF 2014; Oliver et al. n.d) consists of

- inputs (what resources go into a program, e.g. funding, expert knowledge, information),
- activities (what activities the program undertakes, e.g. events, research, capacity building),

- outputs (what is produced through the activities, e.g. information sessions for organisations, new skills and new knowledge),
- outcomes (intended and un-intended) short and medium term effects of initiatives and
- impacts (changes - intended and unintended) from the program over the long term.

The final impacts may be evaluated in different ways. For example, impact evaluation of a project could be conducted by measuring variables such as responses to surveys, requests for further information, or number of products taken up (e.g. incentive schemes utilised), see Sweeney (2009). Assumptions are also clearly indicated in every step of the logic model.

The disadvantage of the logic models are that they follow a linear cause and effect pattern and may need to be combined with other evaluation schemes to be applicable for climate adaptation planning. This is because adaptation pathways are more complicated involving multiple stakeholder views, steps that interlink and can be multi-directional. Krausse et al. (2015) adopts this approach and integrates the input output outcome evaluation model conducted by an organisation with multi criteria analysis to account for the diverse range of stakeholder/individual views and perceptions. O'Connell et al. (2016) present examples of outputs and outcomes (also see Appendix D for outcome indicator examples) of a project which could include project planning documents, options and pathways, learning processes to inform the next stage of the project cycle, identification of knowledge gaps, improved capacity of stakeholders to understand the dynamic system and manage adaptively.

Table 3: Illustration of Logframe.

Source: Table adapted from The United Republic of Tanzania Vice President's Office report 2012.

Project tile				
Region		FY budget	Insert start date	Insert end date
Intervention logic	Description	Indicators	Means of verification	Assumptions
Project goals	Provide information on project goals			
Objectives	State objectivise			
Outcome 1	State outcome			Provide assumptions at output level
Outcome 2	State outcome if two outcomes are mentioned in the project report			
Output 1.1	Provide information on output 1 in relation to outcome 1			
Output 1.2	Provide information on output 2 in relation to outcome 1			
Output 2.1	Continue filling the information as shown above for subsequent outcomes and outputs			
Activity 1.1.1	Provide summary of each activity for output 1 as elaborated in the Project document			
Activity 1.1.2	With more outputs continue providing summary of each activity corresponding to each output			
Activity 1.1.3				
Activity 2.1.1				
Activity 2.1.2				
Activity 2.1.3				

Bours et al. (2014b) recommend using the theory of change approach for adaptation M&E. This would help to account for the long term sustainable goals of various climate adaptation projects/programmes. In this approach, first a long term goal is visualised and then a pathway charted of clear outcomes (long, intermediate and short term) along with assumptions that would lead to the goals. The theory of change works backwards, starting from identification of long term goals and goes through a series of steps required to achieve it. Indicators, thresholds, evidence (if not an assumption) and assumptions are also presented in each step as a causal pathway is visualised and a 'change map' is developed (see Turner et al. 2014). Critically, such an approach ensures assumptions are a) identified and acknowledged, and b) monitored and evaluated. All possible causal pathways may be mapped in the change map.

The theory of change map can be used to capture the big picture of adaptation planning as it presents a map with all possible causal pathways with text to justify the change. Individual projects or even short term goals can be studied using the logic input output models or, in other words, it can be used to focus on a specific pathway in the change map. O'Connell et al. (2016) use theory of change as an important tool during the project planning and implementation phase and also as a guide to adaptation pathways post implementation in their RAPTA (Resilience Adaptation Pathways and Transformation Assessment) framework. The TAMD (Tracking Adaptation and Measuring Development) framework uses the theory of change to connect activities between two tracks – track 1 (assess institutional climate risk management), which utilises a top down approach and track 2, which utilises a bottom up approach (measure adaptation and development performance) or within a track through a set of causal mechanisms (Brooks and Fisher 2014). In the Kenyan study by Karani et al. (2015) theories of change were developed through a participatory process including experts at the subnational government scale to representatives at the community level. In track 1, a number of officers from various county/national departments were brought together to identify and prioritise climate risk management activities required to build adaptive capacity at the community level. Score cards were used for the prioritisation. In track 2, ward committees were assisted in developing theories of change for their specific adaptation/development interventions. A theory of change diagram was further developed by stakeholders involved in track 1 and 2 to explore the links.

2.4.2 Process based evaluation: This is mainly used to assess progress of a plan before implementation of adaptation interventions and thus supports formative evaluation. In other words, process indicators can be said to describe the processes that leads to a successful outcome. For example, a project's performance can be measured during the planning stage based on the number of community members interviewed to understand the nature of the issue and context of implementation. The main difference between process based evaluation and input output based models is that the former does not specify outcome indicators as it does not define what type of outcomes will emerge (Turner et al. 2014; Horrocks et al. 2005). Thus it is more flexible and can adjust to new information

as it becomes available. Outcome indicators (see Appendix D) on the other hand are mostly sector specific, easier to measure and can link adaptation objectives with other policy objectives (Horrocks et al. 2005). Process based indicators that are relevant at an early stage may no longer be valid at a later stage of a project (see French Environment and Energy Management Agency n.d).

2.4.3 Evaluation of behavioural change: Behavioural change is evaluated as an outcome in this approach (see Turner et al. 2014; Villanueva 2011). Both qualitative (e.g. pre and post project surveys) and quantitative (e.g. number of people changing behaviour) data are used to evaluate behavioural change as an outcome of a project or programme (Sweeney 2009). Self-reported surveys are commonly used to measure behavioural change. Outcome mapping developed by the International Development Research Centre (IDRC) (see Earl et al. 2001) is used to evaluate climate adaption projects funded by IDRC and the Department of International Development (DFID), see, Turner et al. (2014).

2.4.4 Economic evaluation: This is mainly used for summative evaluations and thus assesses the overall outcome from a project. It is associated with more objective and quantitative evaluation methods such as cost-benefit analysis. Economic evaluation is often driven by the requirement of organisations to ensure efficiency of projects under limited funding resources and present accountability to funding agencies. Prioritisation of adaptation options can be based on economic and qualitative evaluations. Complete economic assessments are often costly and time consuming and can be beyond the resources available to local governments. The methods used for M&E are also dependent on the available budget..

2.4.5 Process tracing: This is a methodology used for testing hypotheses. A number of process tracing tests could be used to confirm that i) a process took place ii) an outcome was achieved and iii) the outcome was achieved because of the process that occurred (Mahoney 2012). IIED (2016) uses a combination of process tracing and Bayesian updating (probability/hypothesis/expert opinion is updated as more evidence/data becomes available) to evaluate the influence of a group on a policy change that has resulted in positive outcomes among the local communities of a national park in Uganda. A similar approach can also be applied to understand the effect of adaptation interventions on various outcomes.

Evaluation approaches are not limited to the methods discussed above, but also include many other methods such as contribution analysis (evaluate contributions made by a project towards a changed outcome pattern), developmental evaluation (evaluation of programs where the outcomes cannot be predicted in advance and the program may never take a final form) etc. For an overview of additional approaches, see, for example, http://betterevaluation.org/approach.

2.4.6 Importance of M&E

Adaptive management approach which signifies the use of short time horizons and flexibility/reversibility of adaptation interventions is often used by local government stakeholders (refer to Section 1). Monitoring and evaluation is thus embedded into adaptation projects and becomes a pre-requisite to determine when to continue or change an adaptive pathway. M&E determines whether trigger points or thresholds are crossed. Evaluation of adaptation interventions can vary depending on the foci of evaluation (see Figure 4) which depends on the contexts of evaluation. While the foci of evaluation determine the methodology, it also has to be acknowledged that often not enough emphasis is placed on understanding what an organisation wants to achieve through its M&E (see EEA 2015) before designing indicators.

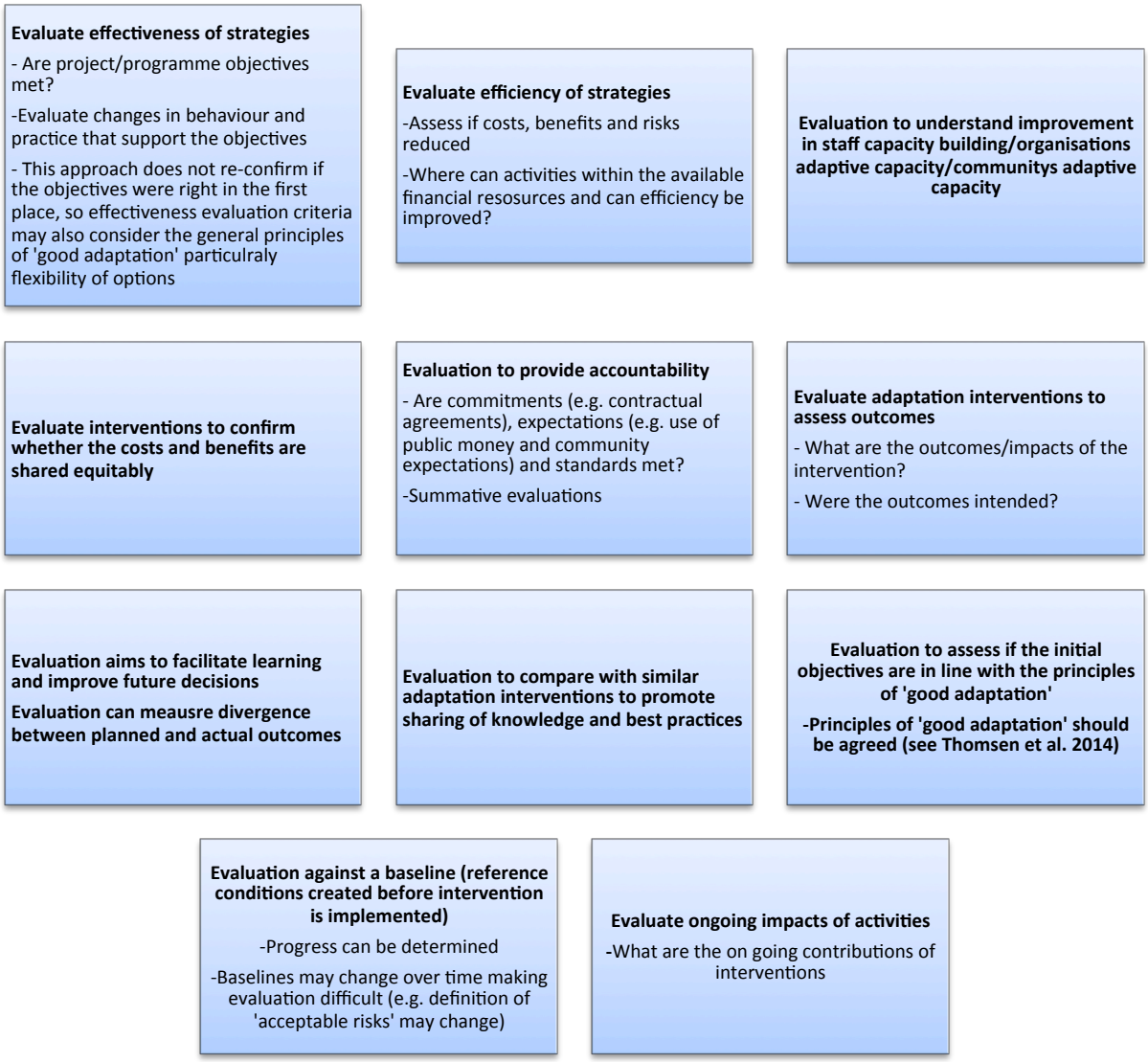


Figure 4 Different foci of evaluation synthesised from Pringle's (2011) report prepared for UKCIP.
Source: Adapted from Pringle (2011).

In summary, M&E is particularly important to:

i) support various strategies used for adaptation decision-making under uncertainty (e.g. shorter time horizons and flexible options)
ii) evaluate adaptation interventions (also see Figure 4 for different foci of evaluation)
iii) identify new thresholds/trigger points/change in adaptation circumstances that require change of options or methods/strategies used to manage future uncertainties (e.g. see Figure 1 adaptive pathways map).

2.5 Stages of M&E

Monitoring and evaluation for a project has to begin right at the start of a project or programme and thus it should be conducted across three different stages: planning; implementation (during and at the end); and post evaluation.

- Planning stage M&E

The first stage in the adaptation decision-making process is to develop a transparent and shared understanding of objectives of the project or program. Goals and objectives need to be regularly reviewed based on evaluation data that is credible, legitimate and salient (Turner et al. 2014; Wallis et al. 2015). There should be a shared understanding on the principles of 'good adaptation'. These include: i) integration that is consistent with other plans and policies and a process integrative with stakeholder interests; ii) equitability in terms of the distribution of costs and benefits ; iii) sustainability based on environmental objectives, iv) economic, social, cultural and corporate governance; v) minimising the risks posed by climate change and capitalise on potential opportunities that arise due to climate change; vi) including diverse knowledge (local, indigenous, scientific etc.), vii) collaborative and open (collective) action of individuals and organisations; viii) effectivity (practical plans, with enough flexibility to change pathways); ix) efficiency (cost effective with respect to the risks involved and timed appropriately); and x) responsiveness (flexible enough to accommodate change and uncertainties and avoid path dependencies), see Thomsen et al. (2014).

Before beginning the post implementation M&E process, it is important to describe the baseline conditions against which decisions are evaluated and reviewed. Baseline conditions refer to conditions before implementing the project such as start of the project, current vulnerability or risks, and current projects that are likely to reduce the vulnerability or risks. Baselines could be used in two ways; i) project baselines, and ii) reference scenarios (see Lim et al. 2004). Project baselines monitor change on a selection of qualitative/quantitative indicators that represent vulnerability, climate risk, adaptive capacity and adaptation baselines. Reference scenarios are different from baseline conditions and are used to describe future scenarios in the absence of any adaptation intervention. Evaluation could thus

be performed using both reference scenarios and scenarios (with various adaptation interventions) against baseline conditions. The main difference between scenarios and project baselines is that scenarios deal with longer term implications and inform policy makers on various pathways at the strategic planning level (Lim et al. 2004).

- M&E during implementation and at the end of implementation

Ongoing monitoring and evaluation is required to assess progress made towards implementing the project. Process based evaluation will be ideal during these stages. For example, evaluation at this stage could depend on the number of community members/stakeholders involved or consulted to understand the context of implementation. Terminal evaluation is required to assess efficiency and preliminary effectiveness.

- Post evaluation M&E

Post evaluation is used to assess effectiveness and overall utility of the adaptation measures. Economic evaluation may be preferred at this stage especially if high cost hard structures are implemented as part of the adaptation project.

Decision timelines for evaluation will be dependent on a number of factors such as time lines of potential risks and reporting requirements (also see Figure 5).

Figure 5: Timing of M&E
Modified from French Environment and Energy Management Agency n.d.

2.6 Major steps of the M&E process

Monitoring is an ongoing process of data collection to measure progress of actions. Plans are updated if changes are required. M&E could be considered to have three phases as described in Table 4; monitoring, evaluation, reporting and feedback (Morgan et al. 2014). Key questions to be answered in each of the phases are provided in Table 4. Monitoring is mostly conducted by the implementing organisation. Evaluation, on the other hand, is usually carried out by an external agency on completion of a project or at set time intervals for long term and high cost projects or soon after implementation of projects. The monitored data can serve as a base for the evaluation process and it can also trigger the need for evaluating a project. Unlike monitoring, the focus of evaluation is also not limited to improving the project plan (see Figure 4 for different evaluation foci).

Table 4: Different phases of M&E and key questions for consideration

Source Morgan et al. (2014).

Monitoring	Evaluation and Reporting	Feedback
What is the program monitoring? Who decides what gets monitored? How are indicators and base lines established? What data gets collected and how often? What methods are used to collect data? Who is responsible for data collection and supervision? How is data quality checked? In what form and location is the data stored? Are there clear operational procedures/protocols for those involved in the collection process?	Who evaluates the data and how often? What process is used to evaluate the data? How will the evaluation be reported? What format is the final report? How will the findings be shared and disseminated? Who is the evaluation designed for? How does the program measure i) progress, ii) effectiveness and iii) success?	How does evaluation affect change in M&E program? How does evaluation affect change in policy? Who recommends these changes/adjustments? How often does this readjustment to the program/policies take place? How long does it take to administer change?

Thomsen et al. (2014) describe four major steps for monitoring outcomes which are summarised below.

1. Development of criteria that describe assessable outcomes (e.g. dune system protection).
2. Development of indicators that reflect how that outcome will be assessed (e.g. local vegetation condition; species abundance).
3. Development of measures that reflect what will be assessed (e.g. extent and quality of vegetation).
4. Development of targets that reflect the desired level of an indicator (e.g. 50%+ of dune vegetation is intact).

These steps are described using an example from EAGA (Eastern Alliance for Greenhouse Action) councils in Victoria who have developed a monitoring programme to assess the impacts of climate change on the health of biodiversity in the EAGA council areas (see Threlfall et al. 2015). Examples of indicators used to assess the impacts in this programme include: vegetation extent, habitat connectivity, community support for biodiversity action etc. Vegetation extent may be measured by the area of mapped habitat patches (ha). Habitat connectivity may be measured by distance to the nearest patch (m), number and quality of surrounding habitat patches (a more qualitative or semi-quantitative measure) and area of habitat in buffers surrounding a patch (ha). Community support for biodiversity projects may be measured by number of people involved in biodiversity projects and the value the community places on nature. A scale will be required to measure the desired level of the values of the measured indicators. In the following sub-sections the various typologies of indicators and how they can be developed are discussed.

2.6.1 Typology of indicators

In abstract terms, indicators are often defined during M&E to measure success or achievement of objectives through interventions proposed or implemented. The UNFCCC M&E synthesis reports highlight that 'the purpose of indicators are to simplify, quantify, standardize and communicate complex and often disparate data and information' (UNFCCC 2010, p.6). The UNDP report states that 'a set of indicators is used to characterise an adaptation phenomenon, to construct a baseline, and to measure and assess changes in the priority system' (Lim et al 2004, p. 36).

Indicators can be used at various scales across the adaptation process and at the objective, output and outcome levels. Indicators can be *process based* to measure progress in implementation and *outcome based* to measure effectiveness of outcomes. Indicators could be considered to be rather on a continuum than in distinctive categories (see Figure 6 below adapted from Sanahuja 2011).

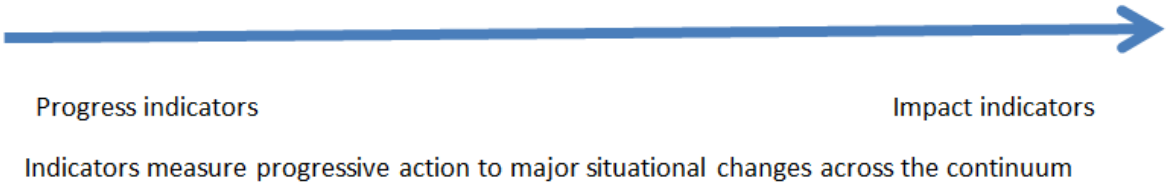


Figure 6: Continuum of indicators
Source: Modified from Sanahuja (2011).

Further to the indicator classifications over the project time periods, UNDP (2009) divides indicators as follows.

- Coverage: the extent to which projects reach vulnerable stakeholders (e.g. individuals, households, businesses, government agencies, policymakers, etc.).
- Impact: the extent to which projects/programs reduce vulnerability and/or enhance adaptive capacity (through bringing about changes in adaptation processes: policy making/planning, capacity building/awareness raising, information management, etc.) The impacts can be evaluated using a number of methods (see Sanahuja 2011).
    - Randomisation: the effectiveness of a program in this approach is measured by comparing a group of randomly selected participants into the intervention with a control group who do not receive the intervention.
    - Pipeline: this approach uses people, households, communities or businesses already chosen to participate in a project at a later stage as the comparison group. The assumption is that as they have been selected to receive the intervention in the future they are similar to the treatment group, and therefore comparable in terms of outcome variables of interest.

    - Matching: this approach involves matching programme participants to non-participants based on a number of observed criteria.
- Sustainability: the ability of stakeholders to continue the adaptation processes beyond project lifetimes, thereby sustaining development benefits
- Replicability: the extent to which projects generate and disseminate results and lessons of value in other, comparable contexts.

Indicators can also be classified based on methods used for their measurement during the monitoring and evaluation process (e.g. Wallis 2015).

- Quantitative indicators could be used to evaluate progress in implementation (e.g. area of beach protected), effectiveness (% of beach biodiversity conserved). Quantitative indicators are usually a surrogate for a larger indicator. For example, potential damage caused by flooding may be measured by the number of houses damaged in a flood instead of calculating the entire financial losses caused by a flood.
- Qualitative indicators could mainly focus on intermediate outcomes and may measure changes in knowledge, attitudes, capacities of community/organisations/business. Indicators should be defined and measured through legitimate and credible social research methodologies.

Objectives related to measuring adaptive capacity equity, learning and social impacts may require a combination of both quantitative and qualitative indicators.

Millers et al. (2012) further classify indicators as the following.

- Vulnerability indicators: these 'measure the degree to which a system is susceptible to, and unable to cope with, the adverse effects of climate change.' (Millers et al. 2012, p. A1.8) e.g. water stress could be used as an indicator that measures vulnerability of a region to water scarcity and total houses in a low lying coastal area could be used as a vulnerability indicator for floods or sea-level rise.
- Resilience indicators: these 'measure the amount of change a system can undergo without changing the functioning of the underlying systems' (Millers et al. 2012, p. A1.8) e.g. bird population numbers as a proxy for ecosystem resilience
- Adaptive capacity indicators: these 'measure the capacity or potential for adaptation' (Millers et al. 2012, p. A1.8). Nelson et al. 2010 developed a composite index to assess the adaptive capacity of Australian rural communities to climate variability using natural, human, physical, financial and social capital as main components.
- Adaptation indicators: these 'measure our adaptation i.e. how well we are equipping ourselves to deal with such impacts, and how resilient our systems are in responding to such climate-driven impacts' (Millers et al. 2012, p. A1.8). Adaptation indicators could be both

process and outcome indicators. An example could include proportion of community members trained to respond to flood disasters or bushfires in areas prone to natural disasters.

2.6.2 Development of indicators

The choice of indicators depends on the type of adaptation projects/programmes planned as well as the socio-economic, environmental and cultural contexts in which they are implemented (Spearman and McGray 2011). The main criteria for choosing indicators include; availability of data (to reduce costs and duplication of work), consistency with national indicators (especially when local government data needs to be reported to subnational or national levels for aggregation), coverage of the range of exposure (to ensure indicators are adequate for the purpose) and influence in promoting successful adaptation projects (choice of indicators that are transparent for key stakeholders) (AEA et al. 2005).

Husek and Rist (2004) caution against indicators being chosen in such a way that 'they are too indirect, too much of a proxy or so abstract that assessing performance becomes complicated and problematic' (p. 70). The dynamic processes associated with the impacts and effects of adaptation interventions are often not easily quantifiable (O'Connell 2015). Assessments may not be possible through simple indicators such as land cover or compound indicators such as GDP. Compound indicators may be irrelevant to the context of monitoring and evaluation, difficult to interpret and thus not helpful in informing decisions (O'Connell 2015). Selection of indicators should also consider the costs associated with data collection and hence already existing indicators may be used wherever possible. The only problem associated with using pre-existing indicators is that some of them may have been developed for reporting at different scales. For example, indices such as the Human Development Index showcase country level variations but not regional or local variations in human development.

Conceptually, indicators consist of two parts: the metadata and the data (NHS 2008). Metadata includes the title, rationale and information about how it is constructed; while the data is the information fed into the indicator (see Figure 7). The metadata helps to assess the relevance of the indicator and also assesses if reliable data exists or can be collected for the indicator. Indicators measure; i) who or what we expect to changed, ii) current status of the target population or current condition of what needs to be change, and iii) thresholds to cross to achieve required success (Anderson 2005).

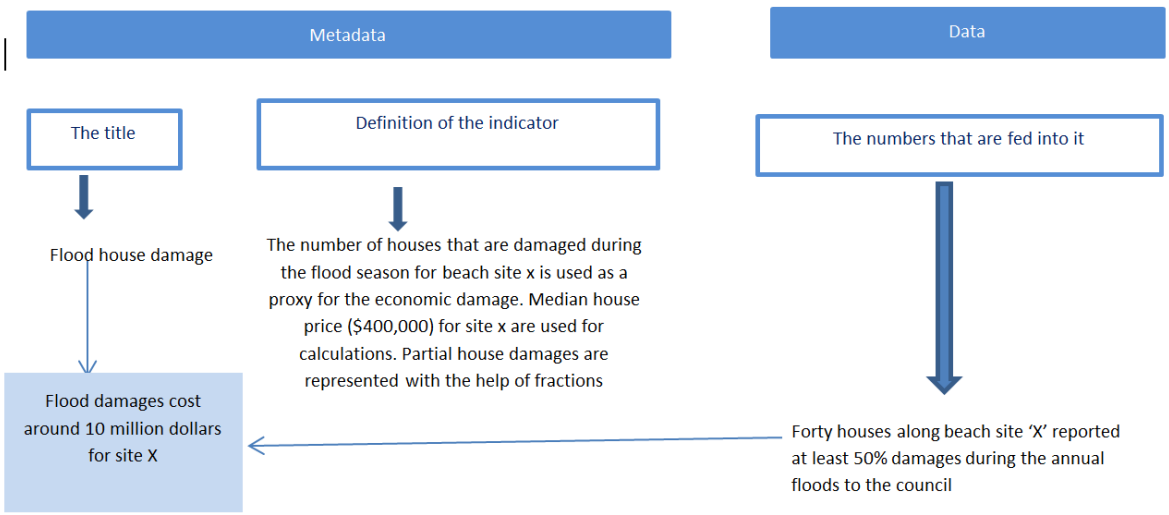


Figure 7 Indicator components

*If data collection spans a number of years, then economic data needs to be converted to net present values for comparability. Also, any changes in baseline conditions should be considered for performance rating

Source: Modified from NHS (2008).

Indicators should be SMART (see Thomsen et al. 2014; UNDP 2009; Wallis et al. 2009; LGA SA report 2015):

- **Simple & specific:** Indicators should be easily understood by users especially those who are likely to provide information for the indicators and those who are likely to collect information. For example, data collection for certain indicators can be time consuming, costly and beyond the scope/financial resources available. It should also target a specific area for improvement.
- **Measurable:** Indicators should be measurable (quantitative or qualitative) with clear cause and effect linkages.
- **Action-oriented:** Indicators used should be agreeable to all stakeholders involved in the M&E process. Councils should consider how indicators are likely to be used (who will monitor, evaluate and report them), and adjust the scope of monitoring appropriately.
- **Relevant and Realistic:** Indicators and associated measures need to be relevant to the objectives, strategies and performance criteria at hand. Indicators should also indicate what outcomes can be realistically achieved based on the available resources and time frames (also see discussion on developing 'pragmatic' indicators). They also need to adequately reflect progress towards desired long term outcomes.
- **Time sensitive:** Indicators need to be time sensitive to change. Some variables are changing very slowly in their mean values, while being highly volatile across years (e.g. climate), meaning that progress towards outcomes can be difficult to assess over the short to medium

term. In these situations, it is helpful to identify intermediate outcomes that lead towards longer-term outcomes.

In contrast to the SMART approach, Villanueva (2011) argues that indicators should be selected according to ADAPT principles: ones that are Adaptive, Dynamic, Active, Participatory, and Thorough. This aligns better with the requirements of M&E of climate adaptation projects or programmes (Bours et al. 2014a,b). Frameworks such as 'Pressure-State-Response' (PSR) can assist local government to understand the drivers behind changes in the environment. The PSR framework is perhaps the best known indicator framework, used by the OECD and in State of the Environment reporting (see Thomsen et al. 2014). It is based on the idea that human activities exert pressure on the environment and changes its state (e.g. quality/quantity of natural resources). Society then reacts to the changes through environmental, general economic and sectoral responses.

There are a number of challenges associated with the development of 'pragmatic' indicators. Some of the challenges include the:

- reversed logic which means success cannot be measured in the absence of any event
- long time scale of climate change impacts requires indicators to be insensitive to time; often indicators need to be selected in such a way that they could be compared across scales and across time
- uncertainty associated with climate change and other potential non-climate stressors in the future
- multi-sectoral nature of adaptation that involves different actors with several requirements about indicators
- diverse stakeholder involvements which can make the M&E process longer and more costly to develop
- difficulty of attributing cause and effect, particularly when different variables may contribute towards the outcome making it difficult to single out a specific cause
- costs associated with data collection for measuring the indicators can force using, and/or combining, data that are gathered for other purposes (e.g. housing policy). At times, high costs associated with data collection results in limited data availability or data suitable for measuring changes in the required indicators
- requirements of a review of existing indicators (i.e. before trying to develop new indicators, projects should identify what data is already available and whether it could be utilised and made relevant to M&E as a project progresses).

2.6.3 Limitations of indicators

Simple indicators may be able to describe key aspects of a change. For example, a coastal management project could monitor infrastructure risk by collecting information on the number of infrastructure within places that are projected to face extreme coastal erosion in the next 50 years. Composite indicators (e.g. an index for adaptive capacity see, e.g., Nelson et al. 2010) may be required for coastal ecosystem monitoring or biodiversity monitoring. Measurements for composite indicators can be costly and time consuming especially if the results depend on the scale and local contexts (O'Connell et al. 2015). Attribution of positive or negative trends or outcomes to particular projects/programmes through indicators (especially when proxy measures are used) is difficult as a number of factors can be influencing the outcome. Indicators are mainly useful to measure the status of a system or any observed trends (Miller et al. 2012) than for attribution.

Implementing adaptation projects can be costly. The costs of monitoring and evaluation should not overly burden the total cost of the adaptation project. The cost will most likely also limit the choice of indicators used to measure progress. Relying on existing data collection mechanisms and indicators can reduce the required number of personnel, cost of M&E and can ensure future sustainability in monitoring the indicators (OECD 2015).

Long-term planning required for measuring trends in indicators may not be consistent with that of the short term planning periods of local governments and political cycles. While many adaptation projects are conducted at local government scales, there may not be consistency in the indicators used for similar projects across regions. Ideally indicators should be created collaboratively to ensure consistency across various projects, geographic areas and reporting scales (Miller et al. 2012). Indicators used for climate change adaptation should be able to capture changes at local and behavioural levels (Bours et al. 2014a).

3 Sample of various climate adaptation M&E frameworks

This section outlines examples of M&E templates used by Australian local governments and international organisations to monitor climate adaptation projects and programmes.

3.1 M&E framework for adaptation programmes

In Tanzania several climate adaptation initiatives have been implemented at the local and national government level. The overall aim of the M&E framework introduced by the Tanzanian government (The United Republic of Tanzania Vice President's Office 2012) was to assist local governments and officials at national scales in monitoring and evaluating development objectives that need to consider climate change adaptation as well. The framework was developed in a participatory process involving several stakeholders. It is applicable to multi-scale projects which also focus on development.

The main components of the M&E framework include:

- development of indicators including performance indicators, process indicators, output or outcome indicators
- performance reports are prepared at different intervals of the project/programme to track project progress and update on required resources to accomplish project objectives
- performance reviews (e.g. rapid appraisal, stakeholder meetings) are conducted to strengthen capacity to effect improvements
- evaluation are conducted across the three stages: ex-ante evaluation, on-going evaluation and terminal evaluation
- information and data management systems ensure reliable and robust data for informed decision-making.

A number of tools have been suggested to support effective monitoring and evaluation. The tools include the logical framework (Logframe- see sections on input output evaluation); the Monitoring and Evaluation Plan; Indicator Tracking Matrix; Activity Tracking Matrix and budget and expenditure tracking (see Tables provided in Appendix A).

3.2 Template for monitoring outcomes due to various strategies against the quadruple bottom line

Thomsen et al. (2014), in their report for the Sydney coastal council group, describe three worked examples. The examples focus on protection as well as accommodate and retreat measures for coastal councils. Thomsen et al. (2014) use a monitoring outcomes template (see Appendix B) which is designed to assess the performance of adaptation activities by local councils (see Appendix B for the case study examples using the monitoring outcomes template). In the template, evaluation is carried against performance indicators across four dimensions of the QBL; environmental, social, economic and governance. Performance could also be monitored over time which can assist users to determine whether adaptation strategies are appropriate for realising council's objectives, or whether the council needs to consider changing strategies.

3.3 Template for monitoring and evaluation; foci on roles and responsibilities for M&E and their timing

The Local government Association of South Australia,LGSA (nd) describes a climate impact profile for their climate adaptation plans with three different types of indicators:

- output indicators that measure the tools and resources delivered by the project
- outcome indicators that measure the immediate, short-term results of project implementation

- impact indicators that monitors and evaluates the longer term results of the project.

The table provided in Appendix C shows the M&E template used by the Local Government Association of South Australia (see LGA SA n.d. report p. 61).

4 Monitoring and evaluation within the adaptive management cycle

M&E has to be included into all stages of an adaptation project from planning to post implementation of the project. In this section we discuss M&E within the main steps of the adaptive management cycle which include:

1. Identifying risks and project objectives
2. Assessing risks
3. Identifying actors (e.g. those implementing/co-ordinating/organising the project activities including M&E, those who benefit from the project) to be involved and map their roles in the adaptation project.

You need to develop a theory of change diagram, mapping all possible causal pathways with text to justify the change and assumptions for each pathway in a participatory way. This also helps to retrace past decisions made and also records the logical reasoning behind each pathway (see Figure 8 as an example). Active involvement of stakeholders ensures better clarity to the people who are meant to implement the plan. Individual projects or even short term goals could be described using the logic input output models or in other words it could be used to focus on a specific pathway in the change map.

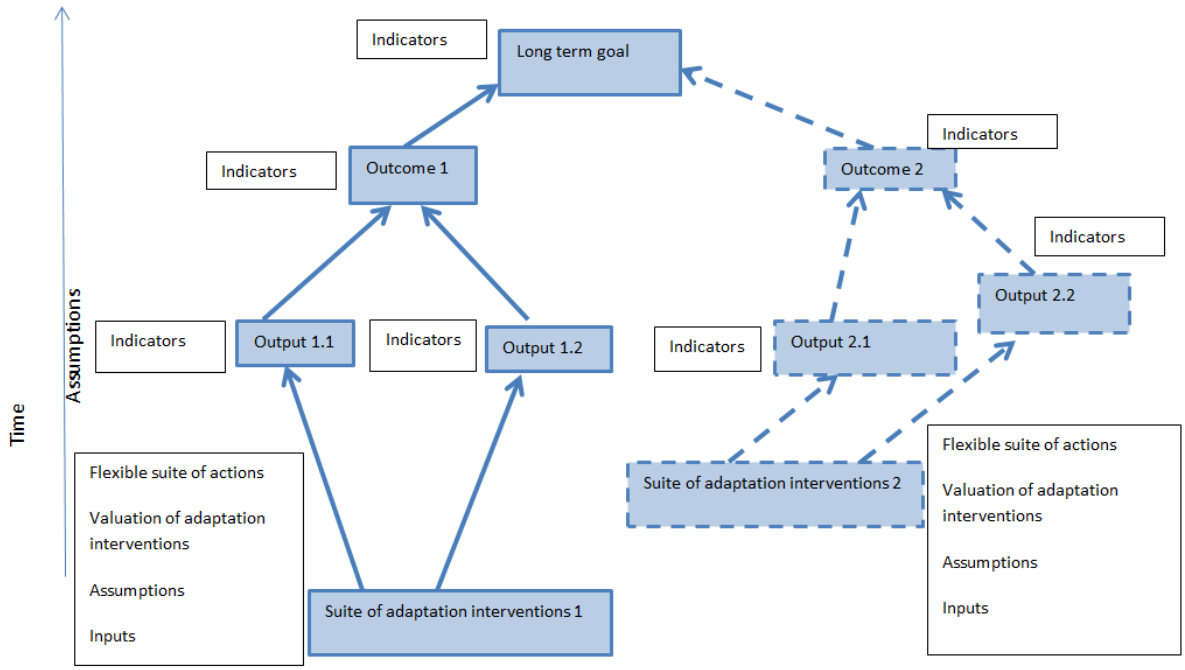


Figure 8 Theory of change diagram contextualised for adaptation decision-making. Different pathways have been represented with solid and broken line arrows

Source: Modified from Anderson (2005)

4. Finalise potential adaptation options

Pre-implementation M&E: A few examples of pre-implementation M&E requirements include identification of risks, financial sources for the project including finance for conducting M&E, or identifying the availability of dedicated staff, allocation of duties and responsibilities between organisations and within organisations. Monitoring and evaluating the changing risks and resources required for the project ensures the sustainable and successful completion of the project. M&E during implementation of options: M&E during implementation is mainly to assess progress of work (e.g. work progress against financial targets and time commitments).

5. Project implemented

M&E post implementation of a project/action: Ongoing monitoring to measure progress of the project/activities towards achieving theproject goals is required after the implementation process. This also requires monitoring of changes in risks or reference conditions against which evaluation is being conducted. In addition to that, the evaluation could be conducted to suit stakeholder, organisational or funding agency requirements (e.g. evaluation to check for accountability, efficiency of options and effectiveness of options, also see Figure 4).

6. Revisit decisions

Feedback is provided to the implementing organisation through M&E. Decisions will have to be revisited depending on the outcomes of the evaluation process. Revisions of decisions may be required due to a number of factors such as:

- overall goal of the project is not achieved
- unanticipated changes occur over the planning period (e.g. more data, new technology)
- assumption errors made in steps 1 to 4 (e.g. strategy used for uncertainty management and choice of strategies in steps 2 and 3; improper definitions of sub-outcomes or sub-actions delivered to achieve overall project objective)
- change of project objectives as planning is made in a highly dynamic decision space
- changes in baseline conditions
- test and adjust assumptions as the adaptation context changes over time.

5 Case study examples using various context specific M&E frameworks

Two case study examples are presented in this report to showcase the use of the monitoring and evaluation templates in varying contexts. The data used within the template has mostly been sourced from council reports, discussions with council personnel; additional hypothetical data are used to demonstrate the context of M&E. The first case study, utilises post implementation M&E, while the second case study utilises planning stage M&E.

5.1 Single strategy monitored against the triple bottom line

The City of Mandurah is a local government area of Western Australia. It covers an area of 173.5km^2 and is located south of Perth. It has a resident population of over 82,000 people. An average annual increase in population of 3.7% is forecasted for this location till 2025 (for a complete profile of the area see http://www.mandurah.wa.gov.au/en/City-and-Council/City-Profiles/Profile-of-Mandurah). The coast of Mandurah predominantly includes sandy beaches atop a limestone ridge. The sandy beaches are highly valued by the local community and the region is also renowned for its water based activity facilities.

The Council's climate change risk assessment study reports the following projected changes to climatic conditions under the A1F1 (high emission) scenario – increase in mean annual maximum temperature (2.7ºC increase), increase in sea-level rise (0.47m increase), decrease in rainfall (decline by 19%) and seasonal changes to wind speed by 2070 (Harrison and Perry 2010). The coastal zone of the City of Mandurah is susceptible to increased rates of erosion and loss of sand dunes due to sea-level rise and modification of sediment transport.

The coastal management strategy of beach nourishment is usually implemented to both preserve the value of the beach amenity and to serve as a buffer between the sea and any adjacent infrastructure. In Mandurah, council personnel explained that currently beach nourishment is conducted to maintain the beach value as a public amenity/asset/liability rather than to safeguard the properties behind the beach. One of the council's strategies to maintain beach width is to redistribute the sand (e.g. transport sand accreted up stream, reduce berm heights that block natural down drifts) along the coast wherever possible. Council personnel currently use a combination of monitoring processes which include; taking photographs, conducting cross sectional surveys by a coastal survey team (daily to weekly basis) and using LiDAR and hydrographic survey as inputs for numerical models.

Monitoring and evaluation conducted by the City of Mandurah is not restricted to a post storm event or just informed by research consultants and thus may be referred to as active and continuous management. The council has staff specifically responsible for the monitoring process required to

inform the beach nourishment programme and these staff aim to increase the intellectual uptake within the council for such projects. External coastal engineering consultants are used only when the required knowledge capacity exceeds that of council's staff. Consultants are often utilised to inform the Council, but implementation of decisions in Mandurah are based mostly on the frequently monitored data. An example of such an external consultancy is that conducted by M P Rogers & Associates (MRA). The study was commissioned by the City of Mandurah in 2010 to re-evaluate the coastal management options at Falcon Bay, with an emphasis on the protection of Rakoa Street, and to provide any further long term management options for the area. Initially, council's management was ad hoc at Falcon Bay and Rakoa Street and was carried out in response to stormier years; now it has shifted to a proactive management approach with an active monitoring process. Examples of potential interventions have also been provided in the report prepared by M P Roger & Associates Pty Ltd (2010).

5.1.1 Example of how a decision is revisited and reviewed

The decision to adopt beach nourishment as a strategy was mainly to protect the value of the beach as an environmental asset of particular significance to the local community. The advantage of this strategy is that it does not require any high cost structural constructions that obstruct the natural view, although there might be trucks and pumping equipment on various beach sites on a regular basis. Beach nourishment aims to preserve the beach value rather than protect private buildings close to the coastal area. The ongoing cost of beach nourishment is uncertain and depends on the level of erosion that is also linked to the uncertainties attached to sea-level rise projections and occurrences of extreme storm events. Thus protection structures, such as sea walls or groynes, may need to be considered for various sites along the Mandurah coast. Any structure should be designed in a staged approach to reduce the impact of the structure on the surrounding areas and would require ongoing monitoring given the dynamic nature of the beach. Ongoing monitoring of the impacts of the structure will allow for further assessment against climate projections. This also provides an example of the importance of M&E during the implementation phase. As part of a staged process, a rubble mound groyne, complemented with some initial sand nourishment, could increase the amenity of the area by providing a wider beach width and by also providing an additional buffer to any existing structures.

A decision to continue with beach nourishment may depend on the economic returns, environmental and social benefits (i.e. net benefits) from the adaptation measure or performance rating as seen in Table 5. Consider *Scenario 1*, in which performance rating of beach nourishment (as in Table5), starts to decline in one or more of the evaluation aspects of the triple bottom line (TBL) over the years, prompting the need to consider other strategies. Consider *Scenario 2*, in which performance rating of beach nourishment continues to be above expectation, but there is an extreme event, then there will be a need to consider hard structures that can protect the coast against such events. Consider *Scenario 3*, in which the objectives set for the TBL change due to changes in community values, council's

priorities or legal responsibilities, and so require consideration of other options. City of Mandurah does not use a structured monitoring and evaluation template for reviewing its decisions as outlined in Table 5. Depending on the situation, each of the objectives across the TBL/QBL may gain prominence. For example, if a high cost protection structure fails, the council may focus on the economic efficiency: or, if a nourished beach fails to protect against a storm event, then the focus may be on high cost infrastructure. Also, the decision to make the beach as wide as possible along the coast varies with sites. Certain sites may be accessed by groups with special needs such as the elderly and disabled requiring additional infrastructure (special access, toilet facilities, etc.). This may require wider beaches with infrastructure to support its visitors. On the other hand, there may be beaches used for walking dogs, where some users may prefer the beach's remoteness with minimal infrastructure. In summary, decisions are reviewed based on regular monitoring across various sites, community consultations, use of sites, community priorities, legal liabilities and government funding. All of these also determine the objectives of evaluation for rating the performance of a strategy.

In summary, this case study example demonstrates several aspects of active M&E. Firstly, to a great extend the Council aims to build the M&E capacity of their own staff. Secondly, monitoring is not restricted to post storm events, but is conducted from a daily to weekly basis. Thirdly, high cost options are introduced in a staged process ensuring continuous learning through M&E. Finally, adaptation responses are not focussed on stormier years, but the Council follows a proactive management approach which is based on an active monitoring process.

Table 5: M&E for beach nourishment Mandurah City Council

Title of project Beach nourishment by Mandurah City Council					
Context: Mandurah City Council has a sandy shoreline that is subject to erosion. One of the council's strategies is to put back (redistribute) the eroded sand from further upstream sites where the sand has accreted. Beach nourishment is conducted as part of maintaining the beach value as a public amenity/asset/liability rather than to safeguard the properties behind the beach. Assumptions: One of the assumptions is that the lateral longshore transport across the beach continues to be the same and as projected Objective of the M&E project: Use of this template aims to assess the effectiveness of beach nourishment against the economic, environmental and social objectives set by the council (as informed by the local community's priorities). The purpose of this template is to monitor progress of the strategy- beach nourishment towards achieving the council's objectives. Monitoring is conducted on an ongoing basis. Performance rating is conducted annually in this case					
Objectives across the TBL	Baseline condition	Indicators	Monitoring requirements, type of data collected and how is the monitoring frequency determined (i.e. T1, T2, …)	Performance rating (assessment of beach nourishment against the TBL objectives) across the monitoring periods (T1, T2, T3, T4 and T5) *Use the key to rate the strategy, also mention any assumptions made during assessment Performance rating key ● Exceeding or meeting desired outcome ● Moving towards a desired outcome ● No change towards desired outcome ● Not meeting desired trend and showing signs of decline ● No data available in that particular reporting period	
				T1=year 1	T2=year 2
Economic objective Sub criteria 1: Ensure affordability & efficiency of the strategy	Economic conditions before the intervention (reduced use of beach &associated income due to receding shoreline) Economic projections before the intervention (required for performance rating against T1, T2, …).	Change in cost/benefit ratio due to the strategy Benefit can be measured using proxy measures such as residential property values attributable to beach amenity, Expenditure by beach visitors etc. Cost/benefit ratio projection due to the intervention	Net benefit of beach nourishment (Benefit due to nourishment minus ongoing cost of beach replenishment) is compared against baseline economic conditions Data needs to be collected to quantity the benefits of having a wider beach. The economic returns associated with more local community members, tourists and businesses utilising the spot could be used as a proxy indicator for the economic benefits for that particular year.		
Sub criteria 2 (also part of sub criteria 1): Maintain or improve economy associated with the beach (e.g. tourist activities, local activities)	Current number of businesses linked to the beach area	Change in the number of businesses associated with the beach area	Quantify the economic returns due to business expansions/new businesses linked to the beach		

Environmental objective Protection of beach from erosion associated with storm surge and sea-level rise	Beach width before the intervention Projection of beach width in the absence of beach nourishment	Change in beach width	Measure beach width Ongoing data collection will be required		
Ensure quality of water is not damaged due to organic sediments Maintain the natural habitat and resources for it	Current water quality Current species diversity	Water quality measurement Change in number of species abundance and concentration	Measure species diversity Measure water quality Ongoing data collection will be required		
Social objective Maintain and enhance recreational amenity	Current social uses of the beach and projected use of the beach in the absence of beach nourishment	Change in number of tourist visits (use of recreational facilities, number of surfers)	Data needs to be recorded regularly (daily basis)		

5.2 Framework for planning phase M&E

The City of Shoalhaven is a local government area in the south-eastern coastal region of New South Wales, Australia. It is famous for its beaches and waterways. Many of the Shoalhaven beaches, such as Mollymook, are threatened by coastal erosion and a significant proportion of public and private assets at various sites are already at risk to various coastal hazards (see Lawless et al. 2014). The city already has a development control plan that has information and development controls needed to prepare and assess development applications on flood prone land.

In addition to coastal erosion, Shoalhaven beach areas are also at risk from sea-level rise. The following sea-level rise projections have been adopted by the Shoalhaven council: 100mm for 2030; 230mm for 2050 and 350mm for 2100 (sea-level rise projections associated with RCP6.0 (mid-range greenhouse gas emissions scenario) (see https://www.shoalhaven.nsw.gov.au/Environment/Coastal-Landscape/Council-and-climate-change). In the following M&E template (which is a simplified version of the Tanzanian M&E template), the focus is on a simple example of a project that aims to create awareness among developers, planners and community members regarding potential sea-level risks to new and expanding developments in risk prone areas. The M&E template is used to check for resource availability for implementing a plan (through a number of soft adaptation options) to control development in sea-level prone area. This could be the first step towards developing a development control plan for areas at risk to sea-level rise by 2030, 2050 and 2100. The data entered in Table 6 includes both hypothetical information as well as information derived from council reports and through council personnel consultation. This is an example of planning stage M&E for an adaptation project.

Table 6: Conceptual monitoring and evaluating resources for M&E of an adaptation project

Title of project: Minimise future coastal risk from sea-level rise				
Purpose of M&E: Resource availability check for M&E (financial and personnel) for a project that aims to minimise future coastal risk from sea-level rise in the Shoalhaven area This template is completed to ensure that dedicated staff will be available for i) monitoring the actions/outcomes and evaluating the actions during/after a storm event Monitoring frequency Monitoring frequency of resources could be compatible with actual monitoring frequency of project actions/outcomes In this case it may include • Annual monitoring and evaluation for council reports; • Regular monitoring that aligns with monitoring requirements for specific actions/outcomes • Monitoring during and after an event Evaluation frequency • After a storm event				
Adaptation actions	Outcomes	Indicators *Indicators should reflect the purpose of monitoring and evaluation	Roles & responsibilities of organisations Who monitors? Who evaluates?	M&E requirements for financial and resource personnel (e.g. what data needs to be collected?)
Action 1.1 Consider development application in view of future sea-level rise impacts on coastal erosion	Outcome 1 Vulnerability of development to future coastal risk decreased	Personnel: Number of staff dedicated to M&E # - how many staff are required Financial: Amount dedicated for M&E (not for the project actions, but $ for M&E) -how much amount is required for M&E over the project life time -what are the potential sources for the funds	Staff for regular monitoring (council staff +any other partner staff): Staff dedicated to evaluation of action's success after a storm event: Development assessment staff and private certifiers	Monitoring: Personnel: Number of staff required to perform duties and responsibilities (M&E) for action 1.1. (e.g. If there are any changes such as new staff replacing old staff, project training may be required) Financial: Are Financial resources allocated for staff (to conduct M&E to perform M&E after actions of the project have been implemented, resources for new/additional staff training; M&E is a long term process and hence may require financial resources that electronically record every decision/event relevant for the project for future revisiting Evaluation During/after storm event • Did the number of staff available match the required number of staff (M&E allotment evaluation) • Were the number of staff dedicated for the project enough (measure success of planning used for personnel allocation) • Were the resources allocated sufficient? • Was monitoring conducted appropriately?
Action 1.2 Request developments to have setbacks or be on piered foundations	Outcome 1	Personnel: Number of staff allotted to record development in coastal risk areas with relevant development controls	Development assessment staff	

or relocatable buildings		Number of staff with required level of training Financial: Amount dedicated for council staff training, council staff conducting the		
Action 1.3 On-going beach transects monitoring to assess impact of sea-level rise		Personnel: Trained staff for monitoring Financial: Annual budget for beach transects monitoring-	Council surveyors to conduct monitoring. Coastal officer to analyse data for local sea-level rise impacts	Evaluation Evaluation could be conducted through structured interviews or reflection workshops Have the surveys been done correctly? Was there adequate training for Council staff? Were Council surveyors available to do surveys when required? Were there sufficient of staff allocated for M&E? This data could be collected through a Council staff survey.
Action 2.1	Outcome 2			
Action 2.2	Outcome 2			

6 Conclusions

The M&E literature suggests that there is no one size fits all solution that could be adopted across regions and scales for adaptation M&E. The report thus does not conclude with a single M&E framework that could be replicable across local governments in Australia. The tools for M&E and indicators are context relevant. The following recommendations are made to inform local governments on how good M&E can be conducted for adaptation projects.

1) Monitoring and evaluation should not be limited to post implementation of adaptation projects. M&E is a continuous process that should be conducted during the planning stage, implementation stage and post implementation stage of an adaptation project.
2) Resources and personnel required for M&E should be accounted for while preparing the budget for an adaptation project/programme to ensure sustainability and adaptability of the project.
3) The case studies indicate that local governments conduct M&E for adaptation projects, but do not report it in a structured format. This makes it difficult to retrace the logic behind chosen adaptation pathways. The theory of change map could be used to capture the big picture of adaptation planning as it presents a map with all possible causal pathways with text to justify the change and assumptions for each pathway. This is also in line with the adaptive management approach adopted for adaptation decision-making under uncertainty. Individual projects or even short term goals could be described using the logic input output models or in other words it could be used to focus on a specific pathway in the change map. The theory of change diagram could be updated as more information becomes available.
4) The review and discussions with council personnel point towards the relevance of 'active M&E' which encourages participation of a diverse range of stakeholders and ensures some degree of capacity building is achieved for Council staff and community members. Active M&E also supports a participatory approach (within the budgetary constraints) to ensure a shared agreement of the objectives of successful adaptation, development of indicators and sharing of duties and responsibilities between all involved actors.
5) While a standard set of indicators cannot be recommended for local government adaptation to sea-level rise, a combination of the SMART (Simple & Specific, Measureable, Realistic & Relevant, Time sensitive) and ADAPT (ADAPT principles: ones that are Adaptive, Dynamic, Active, Participatory, and Thorough) approach could be used for developing appropriate indicators.

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Appendix A

Table A.1 Monitoring and evaluation plan

Project tile						
Region		FY budget	Insert start date		Insert end date	
Intervention logic	Indicator	Indicator definition	Data source	Data collection methodology	Frequency of data collection	Who is responsible?
Project goal						
Objectives						
Outcome 1						
Outcome 2						
Output 1.1						
Output 1.2						
Output 2.1						

Table A.2 Indicator tracking matrix

Project tile							
Region							
Intervention logic	Indicator	Baseline	2 month target(set target as appropriate)	Target achieved in 2 months	FY budget	Start date	End date
Project goal							
Objectives							
Outcome 1							

Outcome 2							
Output 1.1							
Output 1.2							
Output 2.1							

Table A.3 Activity tracking matrix

Project tile														
Region		FY budget	Insert start date						Insert end date					
S/N	Activities	Staff responsible	FY	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	…..
Activity 1.1.1	Provide summary of each activity for output 1as elaborated in the project document	Indicate the												
Activity 1.1.2	Do the same as above													
Activity 1.1.3														
Activity														

2.1.1														
Activity 2.1.2														
Activity 2.1.3														
Activity 1.1.1														

Table A.4 Budget monitoring and expenditure tracking system

Activity	Description	Budget		Expenditure	Remarks
		Unit cost	Total cost		
Activity 1.1.1					
Activity1.1.2					
Activity 1.1.3					
Activity 1.1.4					
Total cost					

Appendix B Hypothetical examples of monitoring and evaluation in the Sydney coastal councils

Source: Thomsen et al. (2014)

Case Study 1 - Erodeville: An example of monitoring and evaluating the performance of a protective adaptation strategy

Adaptation Objectives	Strategies	Indicators	Performance Rating		
			Time 1	Time 2	Time 3
ENVIRONMENTAL					
Protection of beach and dunes from erosion associated with sea level rise and storm surge	Construction of a submerged reef to reduce wave velocity and retain sand by reducing longshore drift	Measure of wave velocity and longshore drift	●	●	●
	Beach nourishment	Volume of sand on beach and in dunes	●	●	●
Create and maintain habitat and food sources for marine fauna	Placement of geotextile containers on reef to encourage habitat development	Change in species abundance and composition	●	●	●
	Forbid anchoring along the reef zone to avoid damage to habitat and the structure	Extent of reef zone damage caused by anchoring	●	●	●
Limit negative impacts of adaptation strategies on associated sites	Periodic monitoring of impacts on adjacent sites	Adjacent beach width	●	●	●
		Change in species abundance and composition in adjacent sites	●	●	●
SOCIAL					
Maintain or enhance recreational amenity	Enhance beach access	Change in number of overall visits	●	●	●
	Enhance beach usability/utility	Change in number of recreational uses	●	●	●
	Design reef to enhance surfing conditions	Change in number of surfers using the site	●	●	●
ECONOMIC					
Ensure affordability of adaptive measures	Ensure benefits of construction and on-going maintenance outweigh costs	Change in cost/benefit ratio (benefit may be measured by reduced expenditure on emergency response and repairs following extreme weather events)	●	●	●
Maintain or enhance local economy associated with the coastal zone	Incorporate landscape design principles that increase visitation through the provision of enhanced amenity	Change in number of businesses associated with the coastal zone	●	●	●
GOVERNANCE					
Development and maintenance of responsive governance processes	Adaptation strategies are widely communicated across council	Change in number of council divisions incorporating adaptation in decision-making processes	●	●	●
Council staff learn from challenges and opportunities of adaptation	Ensure all relevant staff use a systematic process for reflecting on activities	Extent of lessons learned incorporated into future plans	●	●	●

● *Meeting or exceeding desired outcome/trend*
● *Moving towards a desired outcome/trend*
● *Limited to no changes towards a desired outcome*
● *Not meeting desired trend and showing signs of decline*
● *Data unavailable in reporting period*

Case Study 2 - Splashville: An example of monitoring and evaluating the performance of an accommodate adaptation strategy

Adaptation Objectives	Strategies	Indicators	Performance Rating		
			Time 1	Time 2	Time 3
ENVIRONMENTAL					
Protection of biodiversity	Update Council's biodiversity strategy to take into account climate change impacts (e.g. potential ecosystem fragmentation)	Change in species abundance and composition	🔴	🟠	🟠
SOCIAL					
Maintain communities	Provide advice on retrofitting existing buildings to cope with increasing exposure to climate change events	Change in number of buildings retrofitted to cope with increasing exposure to climate change events	🔴	🟠	🟢
Reduce vulnerability of new residents	Introduce sustainable building design requirements for new developments (in accordance with State policy provisions)	Change in number of new buildings complying with sustainable building design requirements	🟢	🟩	🟩
	Ensure new developments in 'at-risk' areas are constructed to withstand potential climate change impacts (in accordance with State policy provisions) e.g. develop a sea level rise factor to determine floor levels for habitable areas of dwellings	Change in number of new buildings in 'at-risk' areas that are constructed to withstand climate change impacts	🟢	🟩	🟩
Raise awareness of climate change issues among residents	Develop communication and education campaigns to raise awareness of climate change issues in the coastal zone and survey community awareness levels	Change in number of residents who understand climate change impacts	🟠	🟢	🟩
ECONOMIC					
Maintain economic structure and activity	Provide advice on retrofitting existing businesses to cope with increasing exposure to climate change events	Change in number of businesses retrofitted to cope with increasing exposure to climate change events	🔴	🟠	🟢
GOVERNANCE					
Development and maintenance of responsive governance processes	Adaptation strategies are widely communicated across Council	Change in number of council divisions incorporating adaptation in decision-making processes	🟢	🟩	🟩
Council staff learn from challenges and opportunities of adaptation	Ensure all relevant staff use a systematic process for reflecting on activities	Extent of lessons learned incorporated into future plans	🟢	🟩	🟩

🟩 *Meeting or exceeding desired outcome/trend*
🟢 *Moving towards a desired outcome/trend*
🟠 *Limited to no changes towards a desired outcome*
🔴 *Not meeting desired trend and showing signs of decline*
⚪ *Data unavailable in reporting period*

Case Study 3 – Tide Town: An example of monitoring and evaluating the performance of a retreat adaptation strategy

Adaptation Objectives	Strategies	Indicators	Performance Rating		
			Time 1	Time 2	Time 3
ENVIRONMENTAL					
Allow ecosystems to adapt autonomously to climate change impacts	Re-zone highly exposed coastal residential land to conservation areas	Change in area of coastal land zoned as conservation areas	🟠	🟢	🟢
SOCIAL					
Relocate buildings in highly exposed coastal areas	Condemn buildings in highly exposed coastal areas	Change in number of buildings in highly exposed coastal areas	🟠	🟢	🟢
Ensure equitable long-term distribution of costs and benefits to all residents in the Local Government Area (LGA)	Ensure appropriate Council expenditure across coastal and non-coastal residential areas in the LGA	Ratio of Council expenditure across coastal and non-coastal residential areas in the LGA	🟢	🟢	🟢
	Ensure expenditure on risk reduction is distributed equitably to benefit the broader community (i.e. not just acutely affected areas)	Change in risk exposure of the broader community	🟠	🟢	🟢
	Ensure the costs and benefits for the LGA as a whole are considered when determining allocation of funding for climate-related initiatives	Allocations of funding for climate-related initiatives are based on an assessment of the costs and benefits across the LGA	⚪	🔴	🟠
Raise awareness of climate change issues among residents	Develop communication and education campaigns to raise awareness of climate change issues in the coastal zone and survey community awareness levels	Change in number of residents who understand climate change impacts	🟠	🟢	🟢
ECONOMIC					
Ensure affordability of adaptive measures	Ensure benefits of land re-zoning outweigh costs of on-going protective measures	Change in cost/benefit ratio (benefit may be measured by reduced expenditure on emergency response and repairs following extreme weather events)	🔴	🔴	🟠
GOVERNANCE					
Development and maintenance of responsive governance processes	Adaptation strategies are widely communicated across council	Change in number of Council divisions incorporating adaptation in decision-making processes	🟢	🟢	🟢
Council staff learn from challenges and opportunities of adaptation	Ensure all relevant staff use a systematic process for reflecting on activities	Extent of lessons learned incorporated into future plans	🟢	🟢	🟢

🟢 *Meeting or exceeding desired outcome/trend*
🟢 *Moving towards a desired outcome/trend*
🟠 *Limited to no changes towards a desired outcome*
🔴 *Not meeting desired trend and showing signs of decline*
⚪ *Data unavailable in reporting period*

Appendix C M&E template used by LGA South Australia

Table C.1 M&E template used by LGA SA

Source LGA SA nd pp 61

Key issue/adaptation action	Indicators	Lead organisation	Support organisation	Monitoring frequency	Monitoring requirements	Evaluation frequency	Evaluation requirements
Reduction in amount of potable water/build a dam	Domestic water shortages	SA water	DEWNR	March, June, September, December every year for 7 years	Production (M), evaporation (mm), rainfall (mm), current storage(%)	December every year for 7 years to correspond with December monitoring frequency	Usable storage (%), Active bores (ML), Treated water (L/p/d), Bulk water (ML/d)
Develop information package with vulnerable groups	Level community uptake Post implementation review of understanding and implementation	Council	LGA	End of each summer	Assessment of numbers in target group Hits on website Number of requests for direct mail out	After three years	Trend in uptake and usage of information
Provide transport for elderly to go to refuges	Proportion of target group using service (%) Cost of service ($)	Council	School bus contractor	Each month during implementation period	Proportion of target group using service (%) Cost of service ($)	Every two years	Trends in usage of the service Cost benefit of service
Subsidise insulation and energy efficiency programs for vulnerable groups	Proportion of target group using service (%) Cost of service ($)	Housing agency	Health agency	Every six months when implemented	Number of target dwellings Proportion of target group using service (%) Energy use data before and after the program	After five years	Cost benefit assessment of program Level of penetration into target dwellings

Appendix D Results framework of the GEF adaptaiton program

Table D.1 Examples of outcome based indicators used by GEF

Source: GEF 2014 pp 6

Goal	Increase resilience to the adverse impacts of climate change in vulnerable developing countries, through both near- and long-term adaptation measures in affected sectors, areas and communities; leading to a reduction of expected socio-economic losses associated with climate change and variability.
Objective 1	**Reduce the vulnerability of people, livelihoods, physical assets and natural systems to the adverse effects of climate change**
Indicator 1	Number of direct beneficiaries
Outcome 1.1	*Vulnerability of physical assets and natural systems reduced*
Indicator 2	Type and extent of assets strengthened and/or better managed to withstand the effects of climate change
Outcome 1.2	*Livelihoods and sources of income of vulnerable populations diversified and strengthened*
Indicator 3	Population benefiting from the adoption of diversified, climate-resilient livelihood options
Outcome 1.3	*Climate-resilient technologies and practices adopted and scaled up*
Indicator 4	Extent of adoption of climate-resilient technologies/ practices
Objective 2	**Strengthen institutional and technical capacities for effective climate change adaptation**
Outcome 2.1	*Increased awareness of climate change impacts, vulnerability and adaptation*
Indicator 5	Public awareness activities carried out and population reached
Outcome 2.2	*Access to improved climate information and early-warning systems enhanced at regional, national, sub-national and local levels*
Indicator 6	Risk and vulnerability assessments, and other relevant scientific and technical assessments carried out and updated
Indicator 7	Number of people/ geographical area with access to improved climate information services
Indicator 8	Number of people/ geographical area with access to improved, climate-related early-warning information
Outcome 2.3	*Institutional and technical capacities and human skills strengthened to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures*
Indicator 9	Number of people trained to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures
Indicator 10	Capacities of regional, national and sub-national institutions to identify, prioritize, implement, monitor and evaluate adaptation strategies and measures
Objective 3	**Integrate climate change adaptation into relevant policies, plans and associated processes**
Outcome 3.1	*Institutional arrangements to lead, coordinate and support the integration of climate change adaptation into relevant policies, plans and associated processes established and strengthened*
Indicator 11	Institutional arrangements to lead, coordinate and support the integration of climate change adaptation into relevant policies, plans and associated processes
Outcome 3.2	*Policies, plans and associated processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures*
Indicator 12	Regional, national and sector-wide policies, plans and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures
Indicator 13	Sub-national plans and processes developed and strengthened to identify, prioritize and integrate adaptation strategies and measures
Outcome 3.3	*Systems and frameworks for the continuous monitoring, reporting and review of adaptation established and strengthened*
Indicator 14	Countries with systems and frameworks for the continuous monitoring, reporting and review of adaptation