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Report No. 263

Reflecting on Adaptation to Climate Change: International Best Practice Review and National MRE and Indicator Development Requirements

Authors: Kathrin Kopke, Evanna Lyons, Ellen MacMahon, Barry O'Dwyer and Jeremy Gault

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Government of Ireland

ENVIRONMENTAL PROTECTION AGENCY

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EPA RESEARCH PROGRAMME 2014–2020

Reflecting on Adaptation to Climate Change: International Best Practice Review and National MRE and Indicator Development Requirements

(2014-CCRP-DS-7)

EPA Research Report

Prepared for the Environmental Protection Agency

by

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ACKNOWLEDGEMENTS

This report is published as part of the EPA Research Programme 2014–2020. The EPA Research Programme is a Government of Ireland initiative funded by the Department of Communications, Climate Action and Environment. It is administered by the Environmental Protection Agency, which has the statutory function of co-ordinating and promoting environmental research.

The authors would like to acknowledge the members of the project steering committee, namely Patrick Pringle (Senior Research Associate at Climate Analytics, UK) and Dr Margaret Desmond (Environmental Protection Agency, Ireland).

DISCLAIMER

The EPA Research Programme addresses the need for research in Ireland to inform policymakers and other stakeholders on a range of questions in relation to environmental protection. These reports are intended as contributions to the necessary debate on the protection of the environment.

EPA RESEARCH PROGRAMME 2014–2020
Published by the Environmental Protection Agency, Ireland

ISBN: 978-1-84095-803-4 November 2018

Price: Free Online version

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Executive Summary

Ireland's climate is changing, with the scale and rate of change broadly consistent with regional and global trends. Ireland must be prepared to respond to such processes in a timely and efficient manner. This requires not only a clear understanding of the processes themselves but also an understanding of the monitoring, reporting and evaluation (MRE) frameworks and relevant indicators that need to be in place. In the wake of the publication of the European Union (EU) Adaptation Strategy, Member States are at various stages of bringing their adaptation processes and reporting procedures into line with those adopted at EU level. Accordingly, adaptation policy in Ireland is moving towards alignment with that advocated at EU level. A key next phase of this process will be the development of indicators supporting EU and United Nations Framework Convention on Climate Change (UNFCCC) requirements for monitoring, evaluation and reporting.

This report represents the output of desktop-based research, undertaken under the Environmental Protection Agency (EPA) Climate Change Research Call 2014 and predates significant Irish legislation of relevance to the research area. It aims to provide an introduction to the use of MRE frameworks and indicator development for climate change adaptation and draws on best practice and guidance from relevant international and EU Member States to identify a set of criteria to develop nationally relevant indicators.

Based on best practice, the study proposes a draft MRE framework for Ireland to assess local and sectoral preparedness for climate change in Ireland. Within this framework, support of MRE activities takes place through national-level guidance, policy and legislation. A suite of draft adaptation indicators was developed and is nested within the proposed framework, incorporating recommendations of the literature review within the remit of the study.

Draft adaptation indicator development concentrated on local authorities and the sectors of agriculture and marine and fisheries, which resulted in the identification of 70 draft adaptation indicators. An additional 197 indicators are proposed for additional sectors of interest, namely coastal areas, biodiversity, capacity building, water management, tourism, landscape and heritage, health, business, critical infrastructure and forestry. The draft adaptation indicators are housed within a comprehensive Microsoft Excel document, the "Draft Adaptation Indicators" table. Draft indicator factsheets for local authorities and the agriculture and marine and fisheries sectors are included within this report, presenting individual draft indicators and essential associated information, to introduce and illustrate the process of draft adaptation indicator development.

Based on the literature review and the desktop-based research, the authors would recommend the following:

- development of a specific MRE framework as relevant legislation, policy and guidance becomes available that includes dedicated support for adaptation indicator development and implementation;
- engagement with relevant stakeholders at all levels of indicator development and implementation;
- testing and refinement of the adaptation indicator development process outlined;
- regular evaluation of data and information used to populate identified adaptation indicators;
- development of new adaptation indicators and collation of relevant data and information as they become available;
- prioritise the implementation of adaptation indicators that can support the establishment of a baseline for local authorities and sectors.

1 Introduction

To avoid the worst effects and take advantage of any opportunities presented by climate change, climate action is now an international [e.g. Conference of the Parties – COP 21, Paris Agreement 2015 (UNFCCC, 2015)] and national [e.g. Climate Action and Low Carbon Development Act 2015 (Government of Ireland, 2015)] imperative. Until recently, international efforts have focused on decreasing atmospheric greenhouse gas (GHG) concentrations through mitigation actions by addressing the causes of climate change. International efforts are now under way to address the inevitable impacts of climate change through adaptation actions, which aim to anticipate the adverse impacts and take action to reduce or avoid the damage they cause, or take advantage of any opportunities that may arise.

1.1 Climate Change Adaptation

Climate change has long been a topic of international conversation, for example the Intergovernmental Panel on Climate Change (IPCC) was established in 1988 and the United Nations Framework Convention on Climate Change (UNFCCC) entered into force in 1994. Compared with climate change mitigation, adaptation to the impacts of climate change and associated policy is a more recent area of focus (Klein *et al*., 2007). However, adaptation in itself has always been a natural human response to environmental changes and appropriately planned adaptation has become a core element of climate policy (Ford and King, 2013). The need for such planned adaptation is now widely recognised and has been incorporated in European Union (EU) policy and in Irish legislation (EC, 2013a; Government of Ireland, 2015).

The IPCC defines adaptation as "adjustment or preparation of natural or human systems to a new or changing environment, with the aim of moderating harm or exploiting beneficial opportunities in natural or human systems in response to actual or climate change stimuli or their effects, which moderates harm or exploits beneficial opportunities" (IPCC, 2007). In other words, adaptation refers to our actions to prevent or reduce the worst impacts of climate change while taking advantage of any opportunities.

The IPCC's most recent assessment report (AR5) focuses on the potential risks of climate change and assesses opportunities for adapting to those risks. It suggests that "taking a longer-term perspective, in the context of sustainable development, increases the likelihood that more immediate adaptation actions will also enhance future options and preparedness" (IPCC, 2013).

Climate change adaptation is an ongoing and long-term process, which spans multiple scales (spatial and temporal). Adaptation decision making is an iterative process that facilitates planning through learning by doing (Tschakert and Dietrich, 2010). Although climate actions are now being undertaken, because of the long timescales involved in some more costly adaptive interventions, monitoring successful outcomes of adaptation is challenging and international focus has turned to the need to review and evaluate progress towards adaptation in climate change research and policy (UNFCCC, 2010; Hinkel, 2011; Spearman and McGray, 2011; Ford *et al*., 2013; OECD, 2013; Bours *et al*., 2014a).

To avoid maladaptation, effective and robust monitoring, reporting and evaluation (MRE) frameworks are required. These allow for assessing the suitability of an adaptation process, monitoring progress towards adaptation objectives and aims, and evaluating whether appropriate outcomes have been reached (Ford and King, 2013). Importantly, MRE frameworks allow us to develop an understanding of what good adaptation might look like and assess the efficacy of our potential future actions. MRE of adaptation actions aims to ensure that actions are fit for purpose and facilitates learning from adaptation processes to substantiate successful future adaptation (Bours *et al*., 2013; UNFCCC, 2014).

Based on a desktop review of international best practice and Ireland's national context, this study aims to propose a draft MRE framework with relevant draft adaptation indicator sets for assessment of local and sectoral preparedness for climate change in Ireland. The study is part of the 2014 Environmental Protection Agency (EPA) Research Call: Climate 2014 Call – Project 8 and the scope of this desktop

research is to provide a starting point and basis for Irish adaptation indicator development for sectors and local authorities. The authors envision that the results can be taken forward with relevant stakeholders representing sectors of interest and local authorities to develop operational adaptation indicators that can be implemented in Ireland to assess progress towards achieving sectoral and local authority-specific adaptation objectives.

2 Literature Review

2.1 Monitoring, Reporting and Evaluation

Monitoring, reporting and evaluation is not a new concept and has been used as a tool to measure progress, for example in sustainable development, public health initiatives and economic expenditure (UNDP, 2002). At first, MRE associated with climate change focused on mitigation in line with initial policy development. Monitoring, evaluation, reporting, verification and certification (MERVC) enables climate change mitigation project developers to demonstrate how their project will reduce GHG emissions or sequester carbon, for example in answer to obligations under the Kyoto Protocol (UNFCCC, 1997; Vine et al., 1999). At an international level, MRE is now progressively being used to measure progress in adaptation and evaluate outcomes of adaptive actions in the short, medium and long term, reflecting on the recent trend towards the development of adaptation plans and actions (EEA, 2015; OECD, 2015).

Monitoring, reporting and evaluation of adaptation has two overall objectives:

1. to facilitate learning from the process of adaptation to ensure that adaptation measures are fit for purpose;
2. to provide some measure of accountability of actions through reporting (OECD, 2015).

Monitoring, reporting and evaluation are three complementary techniques used in reviewing progress in developing plans, strategies and policies for adaptation and the outcomes of these. The three aspects of MRE, although similar, are nonetheless separate and distinct from one another and as such facilitate a better understanding of the process of adaptation and its successes and failures as well as enabling learning from the process. The key differences between MRE (adapted from EEA, 2014) are as follows:

- *Monitoring:* In general, monitoring is ongoing throughout the life of a project, measuring whether the intended actions are undertaken and whether they are in line with what was initially planned. Monitoring is undertaken, for example, throughout a development programme, potentially in stages, with the aim of understanding whether progress is being made and whether it is suitable for reaching the desired results.
- *Reporting:* Reporting can be viewed as communication of information on progress, e.g. towards adaptation or adaptation outcomes, to key stakeholders. Reporting can also reflect on local and regional progress towards national goals and on national progress towards EU requirements.
- *Evaluation:* Evaluation examines what has been achieved by a project or programme and whether it has been successful in delivering the desired outcomes. It highlights lessons learned and useful tools for future developments and plans. Evaluation assesses a project as a whole and its successes and failures.

Regardless of the differing objectives of the different components of MRE, the aim of the different components remains the same. MRE can be used to measure the preparedness of authorities and governments to adapt to climate change, measure progress in building adaptive capacity, monitor and evaluate the successes of implementing adaptation actions and assess the delivery of suitable adaptation outcomes.

Monitoring, reporting and evaluation requirements need to be addressed at a range of scales – global, regional, national and local (UNFCCC, 2010) – and have been a critical focus of the development of adaptation policy, as reflected in the EU Adaptation Strategy (EC, 2013a). Monitoring and evaluation of successes in the adaptation process requires consistency across sectors and local authorities so that a coherent assessment of national progress can be undertaken. The European Commission will use reporting from Member States to create an overall assessment of Europe's progress towards adaptation and is currently developing adaptation indicators to support the implementation of adaptation (EC, 2013b). The EU Adaptation Strategy specifically discusses the need for MRE to monitor progress in adaptation across Member States and allow for comparison (EC, 2013b).

Indicators are recognised as an important tool for measuring adaptation progress and therefore essential within MRE of an adaptation process (Ford and King, 2013). Policy tools have been developed at EU level for reporting the progress of Member States, such as the Adaptation Preparedness Scoreboard, which was a reporting framework developed to assess progression in adaptation across Member States (EEA, 2014). The Adaptation Preparedness Scoreboard was completed in 2015 and central to this approach was the use of indicators.

2.1.1 MRE indicators and adaptation

The Organisation for Economic Co-operation and Development (OECD, 1993) defines an indicator as "a parameter or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/environment/area with a significance extending beyond that directly associated with a parameter value". Indicators can be used to measure information from a wide range of sectors, from economics to environmental conservation, but are also applicable when measuring climate change adaptation. Indicators provide a useful way of tracking changes and trends as well as communicating progress in adaptation (Harley *et al*., 2008). They allow the user to assess whether or not progress has been made towards the desired outcomes or whether or not those outcomes have been reached (Eriksen and Kelly, 2004). For national governments, indicators offer a useful way of measuring progress in national and regional adaptation and evaluating successes and provide a platform for comparison with other countries (Climate-Eval Community of Practice, 2015).

The IPCC (2007), in assessing mitigation actions for sustainable development, suggested that indicators are essential for creating a stable evidence base for successful mitigation through measuring sustainable development. Indicators can be used as a tool within MRE of adaptation to climate change to support the measurement of progress towards wider adaptation outcomes and the suitability of the adaptation process (Harley *et al*., 2008; Lamhauge *et al*., 2011).

Development of adaptation indicators globally is an ongoing process and there is much to be learned from approaches used in other countries. Ongoing efforts across EU Member States are diverse but typically follow a pattern of national adaptation strategy development subsequently triggering the need for adaption indicator development, predominantly employing process-based indicators, but also utilising outcome-based indicators when available and appropriate (Hinkel, 2011; GIZ, 2013; Oberlack and Eisenack, 2014).

A number of key messages arise from research into MRE that are useful to consider for the development of indicators for MRE in Ireland; these have been summarised by the OECD (2015) and are outlined in Box 2.1.

Although many different approaches are being taken in indicator development and implementation, there are generally three different categories of indicators used that can be usefully applied in the adaptation process (adapted from Harley and van Minnen, 2009):

- *Process-based indicators:* Process-based indicators are employed to outline key stages in the adaptation process and define procedures that aim to achieve the best possible implementation of adaptation measures. Process-based indicators do not define the likely outcome at an end point but rather assess if necessary steps towards a range of outcomes are being taken. For example, process-based indicators can be employed to display progress in building adaptive capacity at a range of levels (Sniffer, 2012). It is important

Box 2.1. Summary of key messages in *National Climate Change Adaptation: Emerging Practices in Monitoring and Evaluation* (OCED, 2015)

- The nature of adaptation and adaptation actions is diverse and, as a result, a suite of MRE approaches and tools is required to effectively reflect on lessons learned and progress being made.
- Objectives of MRE should be focused on learning and accountability. Assessing spending and value for money is important but should not be the main driver of MRE.
- Existing environmental and socio-economic data already being gathered in a country may be useful for informing MRE of adaptation. Information gaps can be filled gradually during adaptation planning.

to note that, although a process indicator may indicate progress, this does not necessarily equate to successful adaptation and, as such, other indicator types should be employed alongside process indicators (Harley *et al*., 2008).

- *Output-based indicators:* Output-based indicators are employed to outline the "products" or tangible results of implemented measures. They reflect on the end product of adaptation actions. An example of this would be the completion of a sea wall in an effort to reduce coastal flooding. They are usually associated with specific targets and are most commonly measured.
- *Outcome-based indicators:* Outcome-based indicators measure the overarching achievements and goals of adaptation actions. Rather than a specific product, here the goal is to measure the success of a range of products or outputs in creating a result or change in situation. An example of this would be reduced levels of coastal flooding as a result of a sea wall being built. These indicators are the most challenging as attributing change specifically to a particular indicator is challenging. They highlight the objectives and benefits of achieving a combined set of outputs (Spearman and McGray, 2011).

Process-based, output-based and outcome-based indicators are applied at different stages of the cycle of adaptation and allow monitoring and evaluation of both individual actions (outputs and outcomes) and the process itself (process based) (Figure 2.1). However, it is important to recognise that, although individual indicators may give a snapshot of the current situation in one adaptation action, a relevant set of these indicator types should be used to obtain a broad and well-informed picture of "how well are we adapting?" (Bours *et al*., 2014b). In addition, because of the long timescale involved in adapting to the impacts of climate change, some outcomes of adaptive actions may not become apparent for many years.

2.1.2 Summary

Indicators are an essential tool within an MRE framework that can provide a means to measure progress towards climate change adaptation. They also aid in disseminating information regarding this progress in national reporting and in disseminating information to wider audiences and the relevant stakeholders. It must be recognised, however, that MRE is a complex process with many uncertainties and no definitive end point. Issues surrounding attribution of climate change to observed impacts or attribution of adaptation actions to change and establishment of baselines, long timescales and a variety of spatial scales have to be considered (UNDP, 2007; Lamhauge *et al*., 2011; Spearman and McGray, 2011; Olivier *et al*., 2012; Dinshaw *et al*.,

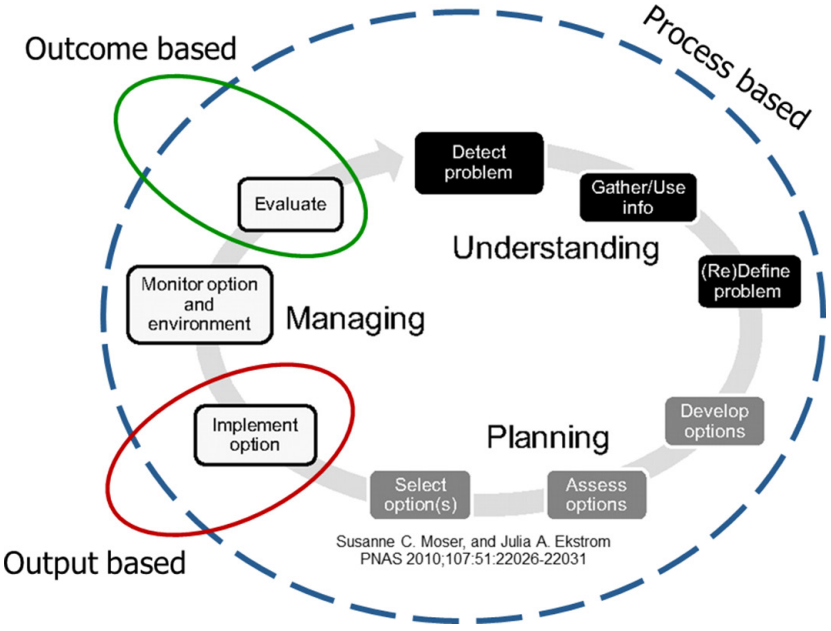

Figure 2.1. The adaptation cycle with relevant indicator types identified (adapted from Moser and Ekstrom, 2010).

2014). Developing indicators while reflecting on these issues is challenging and limitations and constraints of indicators have to be considered.

There is no one discreet, recommended MRE indicator framework that can be applied to adaptation to climate change, partly because of the complexity of the adaptation process and partly because there are a variety of stakeholders requiring indicators for often diverse purposes. From providing a system for tracking changes in climate impacts as a result of adaptation actions to evaluating adaptation actions and communicating to stakeholders and the public, indicators are multipurpose tools (Bours *et al*., 2014b). As a consequence, developing indicators is not only challenging but also has a subjective component. The following sections of the report outline relevant EU and national policies and legislation to provide context and examine existing MRE approaches and international indicator development to glean from best practice indicators that may be suitable for use in assessing adaptation in Ireland and criteria for assessing the suitability of indicators.

2.2 Climate Change Adaptation Policies and Legislation

2.2.1 European

The European Union Climate Change Adaptation Strategy

The EU Adaptation Strategy was adopted in April 2013. The strategy has three key objectives: promote adaptation within Member States, mainstream adaptation in key EU policies and provide better adaptation information for decision makers. National and local-level adaptation policies within Ireland are loosely developed based on objectives set out at EU level, as a way of best practice; however, as there is no directive in place, national and local-level policies are not mandated to the EU Adaptation Strategy. In 2015, 14 European countries were stated to have systems in place or under development for monitoring, reporting and/or evaluation of adaptation (EEA, 2015).

2.2.2 National

For effective employment of indicators for adaptation preparedness in Ireland, it is essential that indicators directly address national climate policy and legislative requirements, for example the Climate Action and Low Carbon Development Act 2015 and the National Climate Change Adaptation Framework (NCCAF) (DEHLG, 2012).

Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act (Government of Ireland, 2015) provides for the development of a national framework in order to achieve a low carbon, climate resilient and sustainable economy by the year 2050. The objectives of the Act will be achieved through a national mitigation plan, a National Adaptation Framework (NAF)[1] and sectoral plans. The NAF must be completed and submitted to the government by December 2017. The NAF will be a strategy for implementing adaptation measures across different government sectors and local authorities. Each government department will be tasked with developing tailored sectoral plans, which will then be implemented directly either by the sectors or by local authorities, taking a top-down approach.

The National Climate Change Adaptation Framework

The NCCAF was published in December 2012 (DEHLG, 2012). The NCCAF aims to ensure that climate change adaptation in Ireland is in line with EU and international best practice. The NCCAF includes the development of national and local-level plans aimed at increasing Ireland's adaptation capabilities (DEHLG, 2012). Ireland is now one of 21 EU Member States to have developed an adaptation strategy or plan for climate change adaptation. Ireland's NCCAF outlines governance requirements at a national, sectoral and local level in order to facilitate adaptation (DEHLG, 2012).

1 See http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/print#sec5 (accessed 2 August 2018).

2.2.3 National requirements for MRE indicator development

Under the NCCAF, relevant government departments, state agencies and all local authorities were mandated to commence the preparation of sectoral and local adaptation plans by the end of 2014, which means that local authorities will be key players in implementing plans at local and sectoral levels (DEHLG, 2012). There currently exists a commitment to review these plans every 5 years. It is likely that the commitments in the NCCAF will be replaced by new commitments as outlined in the Climate Action and Low Carbon Development Act 2015. The Act commits to the development of a NAF, which will be reviewed every 5 years. The overarching focus of the new adaptation framework is envisioned to develop a "climate resilient Ireland", with key objectives being implemented through activities at sectoral, regional and local level (DECLG, 2016). These key objectives are to:

- enhance adaptive capacity;
- strengthen the resilience of social, economic and environmental systems to current and future climate change;
- reduce vulnerability to climate change; and
- take advantage of any opportunities that might arise from climate change (DECLG, 2016).

To assess the effectiveness of actions required under current legislation at national, regional and local scales, a suite of indicators is required to measure our progress towards adaptation objectives and to avoid maladaptation and as a tool for increasing our awareness and understanding of adaptation to climate change.

2.3 Establishing MRE Requirements for Ireland

This section of the literature review examines existing international best practice in MRE of climate adaptation and evaluates the requirements for MRE adaptation indicator development in an Irish context. The review includes an in-depth assessment of EU guidance and best practice for MRE framework and indicator development. This section starts with a summary of MRE approaches and framework development at the international level to provide context and follows on with an overview of adaptation indicator development at the national level by both EU and non-EU countries. Based on this, recommendations are made for the requirements of a national MRE indicator set. This section aims to:

- identify/establish common steps of international best practice used in MRE framework and indicator development;
- identify existing and relevant MRE indicator criteria employed in MRE processes;
- establish the national context for the development of MRE indicators for national adaptation objectives.

2.3.1 International research and development organisations: MRE framework and indicator development

Development and international funding organisations have advanced MRE mechanisms to reflect on the effectiveness of adaptation actions, to justify investment in a range of countries and to improve future actions (Lamhauge *et al*., 2011). As a result, these MRE systems have been tested and applied in a range of countries and refined through this process. It is useful to reflect on these MRE systems and to assess whether best practice established through the use of MRE in a range of contexts can help inform the development of MRE for Ireland. A number of different approaches have become established in recent years in frameworks for MRE, which are outlined in Table 2.1.

The constraints and challenges of MRE systems are highlighted several times (UNDP, 2007; Lamhauge *et al*., 2011; Spearman and McGray, 2011; Olivier *et al*., 2012) concerning mainly:

- a high degree of uncertainty in climate change;
- attribution of climate change;
- relevance of adaptation actions in relation to long time scales;
- variety of time scales; and
- the calibration of baselines.

For the most part, agencies suggest the use of criteria to ensure the suitability of indicators for purpose as part of MRE frameworks (OECD, 1993, 2008; UNDP, 2007; Spearman and McGray, 2011; Olivier *et al*., 2012; UNWFP, 2014). Many of the criteria reflect each other and thematically overlap, with some minor variations (UNDP, 2007; Spearman and McGray, 2011.) The UNDP (2009) and UNWFP

Table 2.1. Summary of best practice MRE frameworks

Framework	Organisation	Overall aim	Objective	Indicator information	Scale
Assessment of M&E Frameworks (OECD, 2013)	OECD	To deliver adaptation actions	Explores methodological approaches that can be used to monitor and evaluate climate change adaptation initiatives at project and programme level	Outcome and output indicators	National scale
Tracking Adaptation and Measuring Development (TAMD) Framework (Brooks *et al*., 2013)	International Institute for Environment and Development (IIED)	To deliver adaptation actions	Reflects on risks and vulnerabilities following how successful an agency or government is being in implementing adaptation actions	Outcome indicator	National and local scale
UKCIP AdaptME toolkit: adaptation monitoring and evaluation (Pringle 2011)	United Kingdom Climate Information Platform (UKCIP)	To build understanding	Evaluate adaptation activities	Output and outcome indicators	National and local scale
Making Adaptation Count: Concepts and Options for Monitoring and Evaluation of Climate Change Adaptation (Spearman and McGray 2011)	World Resources Institute	To deliver adaptation actions	Provide adaptation and development practitioners with a practical framework for developing M&E systems that can track the success and failure of adaptation initiatives in the development context	Output and outcome indicators	Multiple scales
Framework – Adaptation Made to Measure (Olivier *et al*., 2013)	Gesellschaft für Internationale Zusammenarbeit (GIZ)	To deliver adaptation actions	Develop a results-based adaptation monitoring system	Output and outcome indicators	Multiple scales
Monitoring and Evaluation Framework for Adaptation to Climate Change (UNDP, 2007)	United Nations Development Programme (UNDP)	To deliver adaptation actions	Guide UNDP planners in developing MRE at the level of individual projects as well as assessing progress towards wider objectives of the adaptation portfolio globally	Output and outcome indicators and SMART criteria	Multiple scales
Monitoring and Evaluation Guidelines: Identifying M&E Indicators (UNWFP, 2014)	United Nations World Food Programme (UNWFP)	To build understanding	Explains how to use indicators in a logical framework	Output and outcome indicators and SMART criteria	Multiple scales

(2014) are using SMART criteria to develop indicators for monitoring and evaluation. In their essence the criteria introduced for most MRE approaches outlined in Table 2.1 reflect the SMART criteria, which are widely referenced and supported as a suitable tool for defining indicators for monitoring and evaluation of adaptation (GIZ, 2013; IUCN, 2013; Sida, 2013). The SMART criteria technique is outlined in Table 2.2 and will provide the starting point to develop criteria for adaptation indicator development in Ireland.

Despite a range of different approaches being used in international development of MRE systems and indicators, a number of similarities have been identified, which should be considered in an Irish context, including the need:

- to establish an MRE framework in which indicators are used as a tool;
- for a concise baseline which has been highlighted by a number of agencies and studies (UNDP, 2007; Lamhauge *et al*., 2011; Spearman and McGray, 2011; Olivier *et al*., 2012; Dinshaw *et al*., 2014), to facilitate effective monitoring against a starting point in adaptation.

Table 2.2. SMART criteria for indicator development

S: Specific	M: Measurable	A: Achievable/agreed	R: Relevant	T: Time-bound
Impacts, outcomes and outputs should be precise. They should describe future conditions and use language of change, describing a future state or condition	Measurable: indicators should be measurable in some format, whether through qualitative or quantitative means, in order to assess whether they have been achieved	Achievable/agreed: all indicators should be achievable and should be agreed by stakeholders or users	Relevant: indicators should represent progress towards priorities and goals	Time-bound: a timeline or time-oriented goal is important to consider for indicators. A timeline or time-oriented goal is important to consider for indicators

Sources: IUCN (2013), Olivier *et al.* (2013) and Turner *et al.* (2014).

2.3.2 International indicator development by non-EU national governments

USA

The US EPA has developed a set of national indicators against which to measure climate change progression (US EPA, 2014). The indicators were developed through a series of steps to measure environmental changes that can be attributed to impacts of climate change, addressing one of the main challenges for MRE systems highlighted in the previous section. The approach utilises criteria to ensure more robust sets of indicators, which reflects previously outlined recommendations from a range of development agencies (UNDP, 2007; Spearman and McGray, 2011).

South Africa

In 2011 the South African Department of Environmental Affairs developed a national climate change response White Paper (Department of Environmental Affairs, 2011). The document outlines strategic national-level priorities for risk reduction and management; mitigation actions with significant outcomes; sectoral responses; policy and regulatory alignment; informed decision making and planning; integrated planning; technology research, development and innovation; facilitated behaviour change; behaviour change through choice; and resource mobilisation. The National Climate Change Response also includes a risk-based process to identify and prioritise short- and medium- term adaptation interventions to be addressed in sectoral plans (Department of Environment, 2011). The National Climate Change Response also highlights the importance of engagement with stakeholders such as business and industry, civil society and academia and scientists in order to implement the objectives set out in the plan.

Australia

The government of Western Australia, in an attempt to include international best practice for monitoring and evaluation of adaptation actions in the development of its own monitoring and evaluation framework, undertook a review of worldwide policy and recommendations for indicator development (Turner *et al.*, 2014). This review focuses on international guidance papers and highlights common criteria used in defining indicators. The review discusses the advantages and disadvantages of both process- and outcome-based indicators, which are summarised in Table 2.3. Based on best practice, Turner *et al.* (2014) suggest the use of a combination of the two indicator types for measuring adaptation and conclude that there are a range of approaches suitable for identifying indicators but that looking for commonality between these approaches can assist in streamlining the development of indicators. The study also supports the use of SMART criteria as well as noting the importance of establishing an adaptation baseline against which progress can be measured (Turner *et al.*, 2014). The review underpins previously highlighted areas of best practice for adaptation indicator development relevant to this study such as the use of a combination of indicator types, which will be considered for the development of Irish draft indicators to assess preparedness for climate change.

More recently, Mathew *et al.* (2016) reflected on the different indicator types used by the Local Government Association of South Australia (LGSA). The LGSA

Table 2.3. Advantages and disadvantages of process- and outcome-based indicators

Indicators	Advantages	Disadvantages
Process-based indicators	Allow stakeholders/sectoral experts to choose the most appropriate adaptation action to meet an outcome Flexible approach – can adjust to new information as it becomes available	Defining a process does not guarantee successful adaptation A different approach from most other government targets, often unfamiliar to practitioners May make it difficult to integrate adaptation objectives with objectives in other policy areas. Not necessarily sector-specific
Outcome-based indictors	Most government policy objectives/targets are outcome-based May be possible to link adaptation objectives with objectives in other policy areas Likely to be sector-specific	Defining an outcome does not guarantee successful adaptation Risk of being overly prescriptive of adaptation options (specifying suboptimal options) May be inflexible and make it difficult to introduce new information (though great scope for flexibility in implementing specific actions to achieve outcome)

Source: Turner *et al*. (2014).

uses a range of outcome, output and impact indicators for its climate adaptation plans, again highlighting the value of using a combination of indicator types. Mathew *et al*. (2016) also use an example from Western Australia (City of Mandurah) where the local council built monitoring and evaluation (M&E) capacity within its own staff, leading to a proactive bottom-up management approach. A mix of top-down and bottom-up approaches to climate change adaptation indicator development is something that should be considered within the Irish framework and this is reflected in the example of framework operation for Ireland provided later in this report.

Summary

In summary, the most notable example of indicator development by non-EU national governments is the US EPA approach to MRE and indicator development because it addresses one of the main challenges highlighted in MRE and indicator development for adaptation – the attribution of change to climate change.

Both the US EPA and the South African approaches support the development of an MRE framework that utilises indicators as tools. Use of the SMART criteria for indicator development is reflected to some extent in all approaches (Table 2.4), including a direct recommendation in the best practice review from Australia. Table 2.4 highlights how SMART criteria align with identified criteria for indicator development and shows that they are most strongly reflected for the South African approach, with criteria from the US EPA larger in number but still able to be linked.

2.3.3 EU guidance and best practice for MRE framework and indicator development

The EU has begun to focus on recommendations for the development of indicators for successful adaptation in Member States. A number of studies and guidance notes have been developed in recent years to assist stakeholders in developing adaptation plans, strategies and MRE. These guidance notes (EEA, 2013, 2014, 2015) have been adapted to certain audiences. Although monitoring and evaluation is a

Table 2.4. Best practice examples of SMART techniques

SMART criteria	US EPA	South Africa	Western Australia
Specific	Actual observations	Well defined	Simple; specific
Measurable	Peer-reviewed data; usefulness	Reliable; verifiable	Measurable
Achievable/agreed	Feasible to construct; reproducible and objective; understandable to the public	Cost-effective; appropriate	Achievable/agreed
Relevant	Broad geographic coverage; connection to climate change	Relevant	Realistic; relevant
Time-bound	Trends over time; uncertainty	Time-bound planning horizons	Time-bound; time sensitive

relatively new process for adaptation in Europe, some Member States have progressed significantly in terms of indicator development and lessons can be learned from those approaches. The EU Adaptation Strategy (EC, 2013a) aims to ensure that adaptation action across Member States is consistent with its climate adaptation objectives, particularly on agriculture, fisheries and cohesion policy. Guidance provided by this strategy, as well as from EU agencies, can steer Member States in terms of identifying suitable indicators for adaptation actions.

France

France's focus on adaptation began in 2006 with the publication of a National Adaptation Strategy.[2] France's Plan National D'Adaptation (French NAP) (2011–2015) outlines the measures and actions through which adaptation will be enabled in France. It highlights 20 action sheets of focus for adaptation actions on a national scale and a set of specific measures for each of the actions. Action areas or sectoral fields are a useful way to reflect on adaptation actions and their impacts across society, which is also highlighted in other best practice examples, for example the UNDP (2007, 2009, 2011) and the German approach (Schönthaler and von Andrian-Werburg, 2015).

Annual monitoring is integrated into the French NAP to ensure that progress is being made in each of the action areas and indicators are identified as an essential part of this monitoring system. Stakeholder input to indicator development has been collected in the form of stakeholder proposals following a common adaptation framework, which reflects best practice. Stakeholder engagement in the development of France's national adaptation policy has been significant. The stakeholder proposals were collected through consultations with the metropolitan and overseas administrations. Private industry and interested groups were included in the consultation process, as well as the scientific community and general public, who were invited to public consultations (online) on the draft policy. Although stakeholder engagement is outside the bounds of this study, significant stakeholder engagement similar to that implemented in France would help to strengthen indicators developed for climate change adaptation in Ireland.

Although a set of indicators has been developed within the French monitoring system, only a single indicator per sector is currently used by the French NAP (2015). The focus of these indicators is to reflect on progress towards implementation of specific actions for specific sectors (Prutsch *et al*., 2014).

Regional responsibility for adaptation lies with Regional Climate Air and Energy Programmes (SCARE) and Regional Climate – Energy Plans (PCET), which are currently being developed at the local level. The Observatoire National sur les Effets du Réchauffement Climatique (ONERC) supports local communities with tools for adaptation planning, including indicator development, with a focus on observed climate change. If ONERC support comes to fruition at local level, realising local-level indicators with a focus on observed climate change may be able to address attribution of change to climate change. Furthermore, such local-level indicators would allow the establishment of a baseline for local communities, thus enabling future monitoring against a starting point of adaptation, which is stressed as a requirement in numerous best practice approaches for MRE development as well as indicator development within MRE (UNDP, 2007; Lamhauge *et al*., 2011; Spearman and McGray, 2011; Olivier *et al*., 2012; Dinshaw *et al*., 2014).

United Kingdom

The UK Committee on Climate Change was established in 2008 to provide "independent, evidence-based advice to UK Government and Parliament". In 2010, the Adaptation Sub-committee (ASC) published its first progress report examining how prepared the UK was to adapt to climate change (ASC, 2010). The ASC's first report sets out its initial approach to assessing preparedness and introduces the UK's adaptation framework, known as the preparedness ladder. The ladder provides a useful framework under which priorities for successful adaptation can be created (ASC, 2010). The ASC report represents the first national assessment of the UK's progress on preparing for climate change. Using the preparedness

2 See https://www.ecologique-solidaire.gouv.fr/sites/default/files/ONERC_Rapport_2006_Strategie_Nationale_WEB.pdf (accessed 3 August 2018).

ladder, the overall progress towards adaptation in the UK was measured, which also established a baseline of expected adaptation outcomes and assessed preparedness to deliver those outcomes. Five priority areas were defined in the first report for the focus of adaptation actions: land-use planning; managing natural resources; design and renovation of buildings; providing national infrastructure; and effective emergency planning (ASC, 2010).

In its second report, *Managing the Land in a Changing Climate: Measuring Progress*, the ASC aimed to build on the preparedness ladder by creating a set of indicators against which adaptation progress could be measured (ASC, 2011). The focus of indicator development is on outcome indicators to assess whether the UK is becoming more or less vulnerable to climate change (ASC, 2011). Subsequent reports have been published annually to assess progress towards adaptation in the UK, with a change in focus in each report (ASC, 2012, 2013, 2014). The UK's indicator development is focused on outcome indicators in relation to vulnerabilities to climate change and the development of indicators took place as part of an overall framework, supporting previously established best practice in MRE. Furthermore, the UK framework allows for prioritising of adaptation actions, which is highlighted as best practice through the OECD (2015), in which indicator development linked directly to adaptation priorities, and through the UNDP (2007), in which thematic areas were chosen based on key climate priorities and sensitivities. In addition, the framework tackles the issue of establishing a baseline, a requirement highlighted as best practice for MRE and indicator development (UNDP, 2007; Lamhauge *et al*., 2011; Spearman and McGray, 2011; Olivier *et al*., 2012; Dinshaw *et al*., 2014).

Scotland

Scotland's National Adaptation Programme was published in May 2014 (Scottish Government, 2014). The programme has three themes: natural environment, buildings and infrastructure and society. Each theme has an outcome that sets out the long-term goals of the plan (up to 2050). The outcomes for the themes are as follows:

- Climate Ready Natural Environment Theme. Outcome = a Scotland with a productive, healthy and diverse natural environment which is able to adapt to change.
- Climate Ready Buildings and Infrastructure Networks Theme. Outcome = a Scotland with well-managed, resilient infrastructure and buildings providing access to the amenities and services we need.
- Climate Ready Society Theme. Outcome = a Scotland with strong, healthy, resilient communities which are well informed and prepared for a changing climate. (Scottish Government, 2014)

Major public bodies in Scotland are now legally required to report on adaptation (Scottish Government, 2016). The ASC of the UK is the independent reviewer of the Scottish National Adaptation Programme.

The Scottish Climate Change Adaptation Framework (Scottish Government, 2009a) includes 12 sectoral plans. These plans are overseen by key stakeholder groups. The Climate Change Adaptation Framework feeds information to the Climate Change Delivery Board, which is a cross-governmental board responsible for delivering the provisions under the Climate Change (Scotland) Act 2009 (Scottish Government, 2009b). The information from the Climate Change Delivery Board is fed to the Scottish Ministers, who report annually to the Scottish Parliament on progress in adapting to climate change. The UK Committee on Climate Change Adaptation provides advice to the Scottish Ministers. Essentially, the Scottish Climate Change Adaptation Framework operates in a bottom-up manner with advice and scrutiny from stakeholder groups and the UK Committee on Climate Change Adaptation.

Germany

The German Adaptation Strategy (DAS) was published in 2008[3] and outlines a 5-year process of prioritisation and indicator development. The strategy is focused on intensive stakeholder involvement to help identify relevant data for monitoring and evaluation, as well as an agreed set of indicators. The DAS also focuses on key action areas in which to undertake adaptation actions. In 2010, the concept of the German indicator

3 See https://www.bmu.de/fileadmin/bmu-import/files/english/pdf/application/pdf/das_gesamt_en_bf.pdf (accessed 8 August 2018).

system (Schönthaler *et al*., 2010) was put forward for further development in 2011 (Schönthaler *et al*., 2011) and subsequent revision with a focus on indicator gaps, cross-cutting indicators and technical and political agreement on indicator-based monitoring (Schönthaler and von Andrian-Werburg, 2015).

The developed indicator system is a tool to support the process of implementing the DAS and reflects on current knowledge and debate in the field of adaptation; as such it can be updated but is not meant to replace any sectoral- or theme-specific reporting on adaptation. The system is intended to provide a national thematic overview, restricting the number of indicators to avoid getting lost in detailed descriptions (Schönthaler and von Andrian-Werburg, 2015). German indicators are split into two groups: impact indicators and response indicators. Impact indicators focus on assessing the impacts of climate change on the prescribed key action fields in Germany. The 2015 indicator report (Schönthaler and von Andrian-Werburg, 2015) highlights that attributing a reduction in impacts directly to adaptation actions is challenging and response indicators are employed to monitor progress towards adaptation. Response indicators are focused on looking at actions taken towards adaptation and can be classified into two distinct indicator areas: those that review measures taken by an organisation to implement adaptation and those that review the facilitation of adaptation actions.

In summary, the use of thematic areas in Germany allows for some simplification of the complexity surrounding adaptation, which reflects UNDP (2009) recommendations. The German indicator system requirements (Table 2.5) reflect best practice criteria for indicator development such as the SMART technique. Of note is the strong element of stakeholder engagement in the development of both the DAS and the indicator system, which aligns with best practice and emerging key messages relevant for an Irish context, such as:

- adaptation is an iterative process;
- requirement of multi-level governance;
- mainstreaming being key to ensure integration into sectoral policy;
- requirement of broad commitment/participation from a range of stakeholders;
- use of response indicators to assess progress towards adaptation.

2.3.4 Summary of EU best practices

Best practice in the EU reflects previously discussed approaches such as the development of indicators as a tool within an overall MRE framework (e.g. UK and Germany), the use of thematic focus areas or sector fields (e.g. UK, Scotland, Germany and France) and establishing a baseline (UK) and stakeholder engagement (Germany). In terms of identifying criteria for indicator development in Ireland, the German approach corresponds to best practice and reflects aspects of the SMART criteria. The use of action areas or sectoral fields to approach adaptation provides a useful method of reflecting on adaptation actions and their impacts across society and is reflected in best practice at fund or development organisation level, for example the UNDP, or for national assessments, for example Germany (Schönthaler and von Andrian-Werburg, 2015).

Table 2.5. Indicator system requirements for Germany

Criteria	Requirements
Updatability	Climate change, and as a result adaptation, is a long-term process and, as such, may change over time. As a result of extreme timelines, any attempts to assess progress towards adaptation should be flexible enough to be updated as required
Comprehensible; prioritisation	The indicator system must be clear and easy to apply. As a result, prioritising across themes to allow for effective adaptation is important
Applicable across policy levels and sectors	Must be useable for a range of sectors and governance levels
Realisable	Indicators should be ready to use immediately and, as such, should be based on data that are already available. Areas of adaptation that have data gaps should be identified so that progress towards adaptation can be measured from the current baselines
Acceptability	Development of indicators requires buy-in from sectors and local government. Data availability or ease of use may influence acceptability

2.3.5 *Contextualising indicator development for Ireland*

National legal and policy requirements

For the effective employment of indicators for adaptation preparedness in Ireland, it is essential that the indicators address national policy and legal requirements as set out in the Climate Action and Low Carbon Development Act 2015 and the NCCAF (2012). The Climate Action and Low Carbon Development Act 2015 and NCCAF (2012) require that adaptation actions are underpinned by appropriate action at sector and local levels. In addition, the NCCAF (2012) provides a clear mandate for:

- All government departments and state agencies to develop adaptation strategies and objectives, which are to be revised and updated every 5 years.
- All local authorities to develop adaptation plans and have a key role in the development of climate action at the local level, incorporating both national and local objectives through their spatial plans (Figure 2.2). Once adopted, local plans will be reviewed thereafter in line with the cycle of development plan review under the planning and development legislative code. It is anticipated that this tiered approach (indicated in Figure 2.2) will be continued in the new NAF, which will be prepared under the Climate Action and Low Carbon Development Act 2015.[4]

Relevant indicator development in Ireland

The need to develop adaptation indicators is now beginning to emerge as an issue for local authorities in Ireland. Although this may seem to represent a new process, plenty of examples and experience of developing indicators in general exist within the planning and development sector. Climate adaptation indicator development may be similar to that in other development programmes; it can therefore be extremely helpful to examine the development and use of indicators in other development areas (Bours *et al*., 2013).

Indicators developed under the EU Strategic Environmental Assessment (SEA) for Ireland (Donnelly and Jones, 2007) used criteria that align with the SMART criteria used in this study. The applied criteria, for example, ensure that developed indicators are relevant to policy, are understandable, prioritise key issues and are adaptable. The final set of criteria for the environmental indicator development, required under the SEA Directive (Directive 2001/42/EC), was "based on criteria widely used elsewhere, both nationally and internationally, while at the same time accommodating SEA needs and requirements" (Donnelly *et al*., 2007, p. 174). Such practice is reflected in the draft adaptation indicator development in this study, incorporating international best practice as well as national policy and legal requirements.

Furthermore, in line with best international practice, criteria for SEA indicator selection for Ireland included stakeholder engagement through a workshop-based approach, which included input from SEA practitioners and planners from local authorities (Donnelly *et al*., 2007). Identified challenges related to data availability for SEA indicator development. In general, SEAs require the use of currently available data; however, if essential data do not exist, the SEA Directive requires that data gaps are to be flagged to data providers, which provides a starting point towards focused future data collection (Donnelly and Jones, 2007). Correspondingly, future data collection for climate change adaptation in Ireland can be supported through this study based on identified data gaps, to populate the developed draft adaptation indicators.

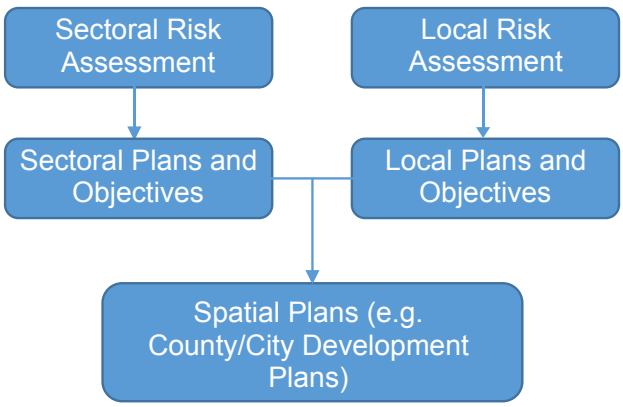

Figure 2.2. Structure for the development of spatial plans.

4 See http://www.irishstatutebook.ie/eli/2015/act/46/enacted/en/print#sec5 (accessed 2 August 2018).

In 2004, the Department of the Environment, Heritage and Local Government (DEHLG) published a set of national customer service indicators for local authorities as well as guidelines for how they were designed (DEHLG, 2004). This undertaking proved extremely useful for this study as indicators had to be assessed by each authority and aggregated at a national level to provide an overall picture of customer service by local governments in Ireland. Although the report focuses on delivering improvements in customer service through the use of indicators (DEHLG, 2004), reflecting on the findings and recommendations corresponds to the remit of this study and is useful in the development of adaptation MRE for local authorities. The report highlights the benefits of using indicators for local authorities and suggests that they are not without limitations. The benefits highlighted in 2004 have been revised within the context of climate change adaptation for the purpose of this study and are outlined in Table 2.6.

The report also outlines potential constraints and difficulties that may be faced in developing indicators for Ireland. These have been modified to reflect the adaptation context and are outlined in Table 2.7.

Based on a review of the national customer service indicators for local authorities (DEHLG, 2004), a series of criteria was recommended for the development of indicators, which is outlined in Table 2.8. It was also stated (DEHLG, 2004) that it can be extremely difficult for an indicator to fulfil all criteria and it is common to make allowances for this fact.

A number of useful conclusions and recommendations (DEHLG, 2004) from this research can be applied in an adaptation scenario for Ireland:

- A set of national indicators should be supplemented by local indicators. Local authorities should develop a set of local indicators, to reflect on local priorities that may not be reflected in national indicator sets.
- Where possible, indicators should be reported on annually and should be compared year-on-year to examine change and trends over time.
- Use of annual reports or other text supports is encouraged, to provide context and a wider narrative to the indicators as well as outline action to be taken as a result of the indicator figures.
- The use of the indicators should not be an end in itself but a tool to identify where problems and successes exist and outline actions based on results.

Furthermore, the DEHLG-developed criteria reflect international best practice in MRE and indicator development as well as the outlined benefits and limitations, which provide to some extent a framework of how indicators should be viewed and used and contribute to creating a context base for indicators.

Table 2.6. Benefits of using indicators at local authority level

Criteria	Benefits
Service improvement	Indicators can point the way towards both problems and good practice and thus can assist in the process of continuous improvement in service. For climate change adaptation, indicators aid in the identification of suitable measures as well as issues, to highlight if we are adapting correctly
Monitor progress in achieving objectives	This can be achieved through linking objectives to indicators
Cost savings	Indicators may be used to identify where efficiency savings can be made through the adaptation process
Enhanced accountability	Local authorities can be held to account by both elected members and the public for the manner in which services are provided, through examining issues such as outcome achieved for the resources used. Results can be communicated to the public leading to enhanced accountability and public trust
Sending a strong signal	Reporting on indicators sends out a message that local government is committed to building on progress already made in the adaptation process to date

Source: adapted from DEHLG (2004).

Table 2.7. Difficulties for the development of indicators at local authority level

Criteria	Difficulties
Financial resources	This may affect the implementation of adaptation actions or may impact on the ability to collect data regarding certain conditions
Geographical factors	Different indicators may be required in urban areas and rural areas. It may be the case that adaptation actions are unfounded in areas where the impacts of climate change on society will not be felt as keenly as other areas and prioritising is required as a result
Overemphasis on process over outcomes	The focus should be on actual changes in a state and improvements, rather than on what can be easily measured
Narrative and attribution	It is important to note that, although an indicator may give a snapshot of the current state of play, it is important to reflect on the indicator within the wider narrative of adaptation as well as other influences on adaptation. Supplementary information may be required in order for an indicator to be relevant or accurate at reflecting the actual realities of adaptation
Data limitations	Users of comparative data should be aware of the inherent data limitations and ask appropriate questions before forming conclusions regarding performance
Context	It may also be useful to highlight the overarching context in which the indicators are being used. Comparing indicators for counties with large, highly urbanised areas with indicators for counties that have predominantly rural or coastal areas may not be in the interests of successful adaptation

Source: adapted from DEHLG (2004).

Table 2.8. Series of desirable elements for the development of indicators, as outlined in DEHLG (2004)

Criteria	Desirable elements
Comparable	It should be possible to compare indicators either over time or between local authorities, or both. It is often easier to compare results over time (usually a number of years) within the same local authority. Comparisons between local authorities are more problematic and difficult to achieve because of the need for agreed and consistent definitions (see Table 2.7, “Geographic factors” and “Context”) and because of different operating environments (see “Unambiguous” and “Avoiding perverse indicators” in this table). It may be necessary to supply information on the context in which comparison is taking place
Verifiable	Data should be collected and calculated in such a way that they can be verified
Cost effective	Where possible, indicators should be based on information already available and existing data collection activities; if new indicators are necessary, they should be designed to minimise the burden on local authorities
Unambiguous	Indicators should clearly show whether trends in data show either an improvement or a deterioration in services, rather than being open to interpretation. Improvements in the indicator should generally be possible only when there is an improvement in the service. It must be borne in mind that it is possible that a reported improvement in an indicator may be the result of other factors. For example, the number of complaints could be used as an indicator of the quality of a service – an increasing number of complaints could be interpreted to indicate that a problem is developing in a certain area whereas a low number of complaints could indicate that users are largely happy with the service. However, a low number of complaints might have more to do with the system for processing complaints than the quality or otherwise of the service – for example, it could also be the case that users have given up complaining because of a bad experience with the handling of complaints
Attributable	Service managers should be able to influence the performance measured by the indicator. Service measurement systems are usually introduced to accompany greater control for senior managers over financial and human resources. If the indicator is not at least partially within the control of a local authority (or a particular section within a local authority), frustration is likely to set in. Where accountability is blurred, it can lead to a “blame game”
Responsive	Indicators should be responsive to change. Indicators will be of limited use when changes in performance are likely to be too small to register
Avoiding perverse indicators	Care must be taken to ensure that indicators do not allow problems to be shifted to areas that are not measured or that disproportionate resources are allocated to those areas that are measured. For example, measuring the average waiting time for calls to be answered has in some organisations led to operators taking less time to ensure that callers are correctly put through, leading to an increase in misdirected calls
Allowing innovation	Indicators should not prevent organisations from developing alternative and innovative methods of improving service delivery. Indicators focused on outcomes rather than inputs are more likely to provide flexibility to local authorities to develop innovative processes
Statistically valid	Indicators that are based on small numbers of cases may show extreme fluctuations. A large sample size may show more valid trends. For example, the number of deaths due to fire could be very small in some areas and subject to random fluctuations – in this case a 5-year moving average might provide a more accurate reflection of trends
Timely	Where possible, indicators should be based on data that are available within a reasonable time frame

2.4 Summary and Recommendations for MRE Indicator Development for Ireland

Indicators provide a snapshot of information (DEHLG, 2004; Bours *et al*., 2014b) and have to be viewed within a wider narrative of adaptation (OECD, 2015) and therefore attribution of information is as valid for each indicator as it is for MRE as a whole process. Providing a context in which indicators are being used is important (Brooks *et al*., 2013), for example at what spatial scale is an indicator employed in relation to what purpose, for example is the indicator applied at local authority level to prioritise steps in an adaptation process for a region or at national level in an aggregated format for reporting. Best practice advocates aligning indicators to adaptation priorities and linking with definite objectives (DEHLG, 2004; Donnelly *et al*., 2007; UNDP, 2007; Lamhauge *et al*., 2011; OECD, 2015), which can contribute to providing an overall context and narrative.

Quantitative indicators provide a useful measure to indicate progress towards adaptation goals. However, without a narrative to provide perspective, the wider picture of adaptation preparedness and progress may be lost. Qualitative indicators, although difficult to measure, can contribute to an overall context in which the quantitative data are extracted from. To make an MRE process more effective, outcome and output indicators are often employed in combination (Hinkel, 2011; GIZ, 2013; Oberlack and Eisenack, 2014). Best practice in the EU reflects approaches such as the development of indicators as a tool within an overall MRE framework (e.g. UK and Germany), the use of thematic focus areas or sector fields (e.g. UK, Germany, Scotland and France), establishing a baseline (UK) and stakeholder engagement (Germany and France).

In terms of identifying criteria for indicator development in Ireland, the German and the Irish approaches correspond to best practice and reflect aspects of the SMART criteria. In addition, the identification of benefits and limitations of indicator development for Irish local authorities in 2004, which was modified for this study for an adaptation context, can contribute to establishing context and narrative in the absence of an overall framework. The literature review in this study highlights a number of aspects that should be considered for successful adaptation indicator development and the authors would recommend the following:

1. development of an MRE framework for Ireland that incorporates a suite of approaches and tools, including indicators, with the objectives to facilitate learning from an adaptation process in Ireland and accountability;
2. development of indicators within a wider narrative of an MRE framework aligning with adaptation priorities for Ireland and definite objectives set for local authorities, relevant sectors and at national level;
3. engagement of relevant stakeholders from local authorities, relevant sectors and national bodies in the adaptation indicator development;
4. application of criteria for indicator development in Ireland based on best practice that also maintain their suitability for Ireland;
5. establishment of a baseline that facilitates monitoring against a starting point;
6. employment of a combination of indicator types in order to facilitate applicability to different stages within MRE of an adaptation process;
7. implementation of MRE and associated indicators at all stages of adaptation:
   - building adaptive capacity/preparedness;
   - designing suitable adaptation actions; and
   - delivering successful adaptation outcomes.

Points 1, 2, 4 and 6 will be further examined within the remit of this study to establish a starting point in adaptation indicator development for Ireland and suggest a draft adaptation indicator set, whereas points 3, 5 and 7 are essential for finalising any draft adaptation indicators and their implementation, which falls outside the remit of this study.

3 Developing a Draft Indicator Set for Ireland

The development of a draft adaptation indicator set for Ireland is based on international best practice and was begun by reflecting on a number of questions:

- What is being measured? A vital part of the MRE process is an understanding from the outset of what the indicators will be reflecting on (Pringle, 2011). It is an important part of the process to understand what is driving the development of MRE and to understand what indicators are being designed to reflect on. The UNFCCC (2010) suggests that, although developing indicators for a specific adaptation project can be relatively straightforward, reflecting on adaptation policies, plans and long-term programmes is more challenging because of the complex nature of relationships between key stakeholders and bodies involved. This study is aiming to provide a starting point through the development of draft adaptation indicators that reflect on levels of preparedness for climate change at national, local authority and sector levels. Operational and implemented adaptation indicators are envisioned to measure progress towards adaptation objectives in order to assess levels of preparedness for climate change.
- Who will be using the information from indicators and how will it be used? Defining the target audience and users early in the process is important so that indicators are fit for purpose and reflect on the questions being asked at a range of governance levels. For this study, the developed draft indicators should be tested and refined at different levels of target audiences and users, namely the local authorities, relevant sectors and national bodies. The outcome of this study should enable target audiences to advance existing draft adaptation indicators and refine these with stakeholder input and as such facilitate learning from the process of development.
- How will success be determined? As is widely observed, there is no clearly defined end point in adaptation and defining success is not always easy (Bours *et al*., 2014a; Dinshaw *et al*., 2014). Establishing a baseline from which to measure change is an important step in the adaptation process (Dinshaw *et al*., 2014) to enable indicators to capture information from multiple levels of progress in adaptation, at different spatial scales for different purposes (e.g. at sector and local authority levels, and for national reporting), while reflecting a complex policy landscape. To get a clear picture of whether we are adapting successfully, MRE and indicators will be required at all stages of the adaptation process. These stages can broadly be categorised as outlined in the following sections.

3.1 Building Adaptive Capacity/ Preparedness

In its fourth assessment report, the IPCC defines adaptive capacity as “The ability or potential of a system to respond successfully to climate variability and change, and includes adjustments in both behaviour and in resources and technologies” (IPCC, 2007, p. 727). Building adaptive capacity can include measures as simple as identifying an adaptation team or developing an adaptation strategy. Preparedness to adapt as a concept can be compared with readiness to adapt and also the development of the adaptive capacity of sectors, authorities and regions (Biesbroek *et al*., 2010; Preston *et al*., 2010; Ford and King, 2013). Shine and Desmond (2011) undertook a baseline review of Ireland’s adaptive capacity to help identify areas of priority focus for policy and plan development. A key recommendation was that policy development at a range of scales should integrate adaptation using existing tools and strategies to gradually reduce exposure to climate risks and that indicators should be developed to monitor this process.

3.2 Designing Suitable Adaptation Actions

Developing suitable adaptation actions can reduce risk and vulnerability to the current and long-term impacts of climate change but can also relate to implementing relevant policy and administrative management or education, training and increasing awareness. Suitable adaptation actions can also concern research activities, for example in relation to building resilience

or co-ordination of specific measures to, for example, reduce the sensitivity of communities to the impacts of climate change.

3.3 Delivering Successful Adaptation Outcomes

Desired adaptation outcomes will need to be defined for Ireland and the different target audiences. Defining an outcome does not, however, guarantee successful adaptation but, as most government policy objectives and targets are outcome based (Bours *et al*., 2014b; Turner *et al*., 2014), the opportunity to link existing objectives and targets with adaptation objectives should be explored. Furthermore, adaptation outcomes will also be sector specific.

3.4 A Proposed MRE Framework for Ireland

We propose a generic adaptation MRE framework based on the national legal and policy context, as illustrated in Figure 3.1. Within this framework, monitoring and evaluation of adaptation to climate

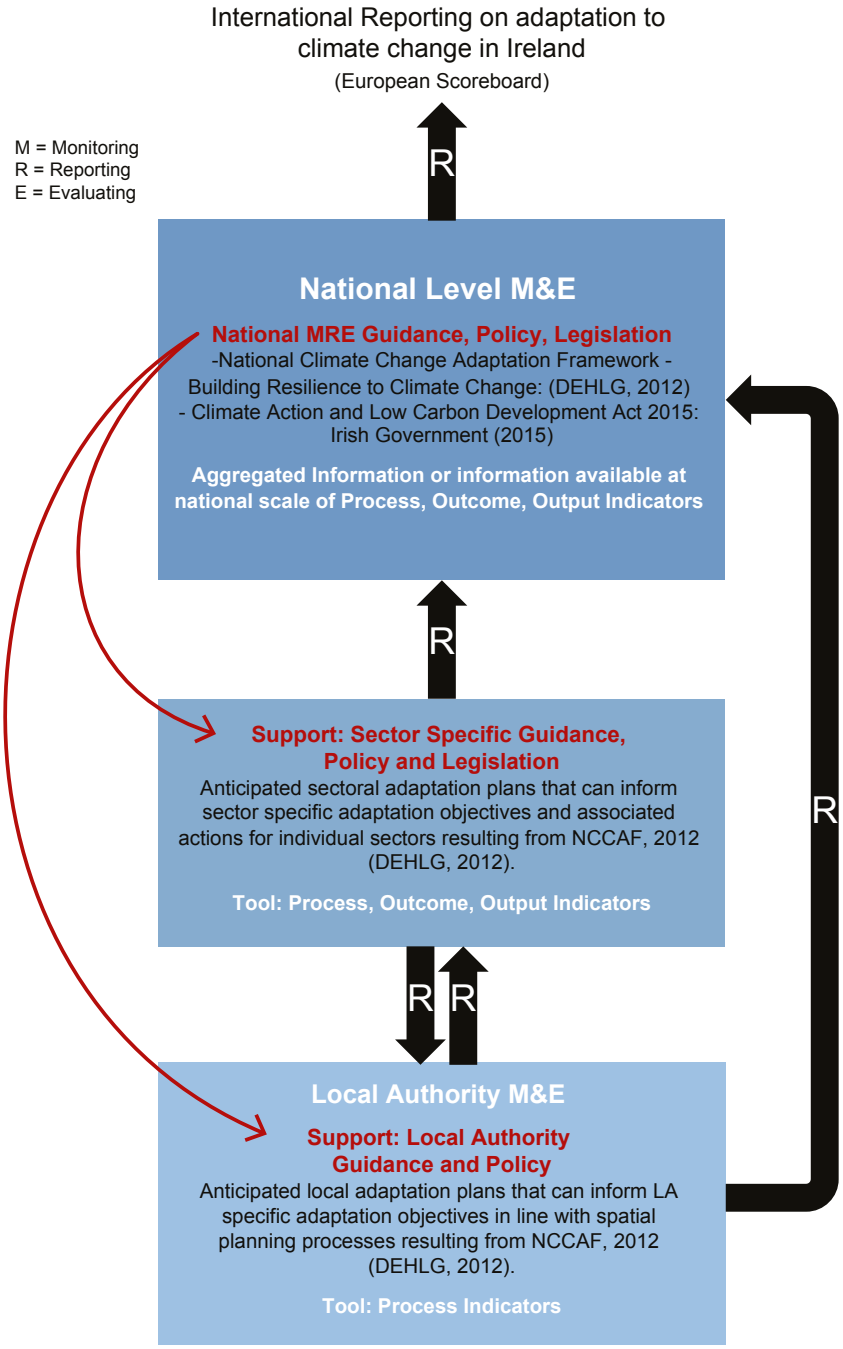

Figure 3.1. Proposed draft MRE framework for Ireland.

change takes place at local and sector levels. Indicators are a tool within the framework to gather and report relevant information. Sector- and local-level information feeds into the national level, allowing national MRE reporting on adaptation to climate change relevant to international reporting requirements (e.g. Adaptation Preparedness Scoreboard or UNFCCC). The proposed MRE framework provides the high-level building blocks for indicator development, delineating where and what type of indicators are employed to support each level of MRE – from national stated objectives to sectoral implementation to local levels on the ground – and facilitates national, sector-specific and local authority-level assessment of the level of preparedness for the impacts of climate change, as information at local and sector levels feeds into national-level monitoring and evaluation.

The suggested MRE framework proposes support of MRE activities via national guidance, policy and legislation, for example the NCCAF (DEHLG, 2012) and the Climate Action and Low Carbon Development Act 2015 (Irish Government, 2015), as well as any future relevant national guidance and support. The national guidance and support filters down to sector and local levels, for example anticipated sector and local adaptation plans as outlined in the NCCAF (2012), which can be updated with other future guidance and support at these levels. The specific sector and local authority adaptation objectives are identified in relation to the sector or local authority support provided and/or directly link to objectives outlined within the legal, policy and guidance documents. The sector and local authority adaptation indicators are identified based on their ability to measure progress to achieve the adaptation objectives and to reflect on the level of preparedness for impacts of climate change.

3.5 Requirements of a National MRE Indicator Set

Based on international best practice, criteria for indicator development most commonly relate to, or represent to some extent, modifications of the SMART criteria. The use of criteria for indicator development ensures integrity of the indicators and maintains their suitability for MRE. It is important to select indicators that provide accurate information on all main aspects of adaptation and the use of criteria ensures that indicators are fit for purpose. A review of criteria for indicator development used in 10 approaches either at national level or organisation level was undertaken (see Table 2.4 and Table 3.1 for relevant examples illustrating reference to the SMART criteria, as well as commonalities).

Common criteria were refined into a set of criteria suitable for Ireland (Table 3.2) based on best practice and for the purpose of this project. The criteria align with elements of the SMART criteria and were chosen based on usability and to fulfil the remit of this study to facilitate the assessment of preparedness for climate change at the local, sectoral and national levels and reporting. The set of criteria should ensure that indicators will be able to contribute to reporting on progress towards adaptation in Ireland and help stakeholders learn from the process. Indicators should represent progress towards priorities and goals.

Table 3.1. Examples of SMART criteria and commonalities

Example	SMART criteria (e.g. UNDP, 2009; IUCN, 2013; Turner *et al.*, 2014)				
	Specific	Measurable	Achievable/agreed	Relevant	Time-bound
OECD (1993)		Measurability	Policy relevance and utility for users	Analytical soundness	
Spearman and McGray (2011)	Precise; sensitivity	Reliability	Practical; affordable and simple; owned	Validity; meaning; clear direction; utility	
Olivier *et al.* (2012)	Precise meaning	Reliability	Validity	Sensitivity and relevance	
Schönthaler *et al.* (2010)	Comprehensible prioritisation	Realisable	Acceptability	Applicable across policy levels and sectors	Updatability
DEHLG (2004)	Clear definition	Verifiable; comparable; unambiguous	Easy to understand; cost-effective	Relevance	Attributable

Table 3.2. Criteria for suitable indicators in Ireland

Criteria	Suitable indicators
Specific and precise	Indicators must be clear, representing progress towards priorities
Measurability	Indicators must be measurable in either a quantitative or a qualitative fashion
Participatory	Indicators must be agreed and accepted by stakeholders and experts
Applicable on a variety of scales	Indicators must be relevant to local authorities and/or sectors in Ireland and allow for some level of aggregation
Data availability	Indicators should be populated as much as possible with available data and information to be cost-effective
Facilitates reporting	Indicators must provide information that is required by target audiences and users to report on adaptation progress at local, sector and national levels
Long-term viability	Indicators must be applicable across long time scales or be updatable to react to change

4 A Suite of Draft MRE Indicators for Ireland

A set of draft indicators was developed based on the outcomes from the literature review. Indicator development is nested within the above proposed MRE framework and took place through a step-by-step process (outlined in Figure 4.1).

4.1 The Step-by-step Approach to Draft Adaptation Indicator Development

The steps indicated in Figure 4.1 are undertaken for the development of each individual adaptation indicator and are therefore repeated multiple times for each sector of interest and at each local authority level. Adaptation indicators measure progress in achieving an individual adaptation objective and an identified adaptation objective can have multiple adaptation indicators to allow for a more complete picture. The steps are illustrated using sector- and local authority-specific examples and the following bullet list summarises the information gathered for one draft adaptation indicator example to provide an overview of the type of information collated through the step-by-step approach:

- Adaptation objective: increased water resilience in agriculture.
- Draft adaptation indicator: percentage increase in water demand met by current supply levels.
- Type of indicator: outcome indicator.
- Relevant bodies and organisations that can provide relevant data and information: Department of Agriculture, Food and the Marine, Bord Bia, Teagasc.
- Evidence of available data and information that can populate a potential draft adaptation indicator: Hess, T.M., Chatterton, J. and Williams, A., 2012. *The Water Footprint of Irish Meat and Dairy Products*. Bord Bia and Department of Environmental Science and Technology, Cranfield University. URL: https://dspace.lib.cranfield.ac.uk/bitstream/1826/8756/3/The_Water_Footprint_of_Irish_Meat_and_Dairy_Products-2012.pdf (accessed 3 August 2018).
- Indicator context: increased water security in the agricultural sector signals an increased resilience to impacts of climate change based on the identified vulnerability of this sector to drought effects in Ireland.
- Scale of data available: national.

4.1.1 Step 1: define adaptation objectives

Based on best practice, indicators should be linked to adaptation objectives and developed within a wider narrative of an MRE framework, which provides adaptation priorities and objectives, for example:

- **Marine and fisheries:** the draft adaptation indicator example “Number of instances of marine invasive species” links to the adapation objective “Current impacts and risks in the marine and fisheries sector are understood”.
- **Agriculture:** the draft adaptation indicator example “Percentage increase in water demand met by current supply levels” links to the adaptation objective **“**Increased water resilience in agriculture”.
- **Local authority:** the draft adaptation indicator example “Local adaptation team in place” links to the adaptation objective “Initial planning for adaptation is undertaken”.

A high-level framework has been suggested for the purpose of this study and adaptation objectives have been selected for draft indicator development based on the stages of the adaptation cycle (Figure 4.2).

Furthermore, using the stages of the adaptation cycle to develop the adaptation objectives allows adaptation objectives and associated indicators to be linked to the individual steps of the Adaptation Preparedness Scoreboard. The adaptation objectives incorporate information from relevant policy and legislation as well as documented sector-specific climate vulnerability where appropriate and as outlined in the following sections.

High-level and national adaptation objectives

- EEA (European Environment Agency), 2012. *Climate Change, Impacts and Vulnerability in Europe 2012*. EEA, Copenhagen.

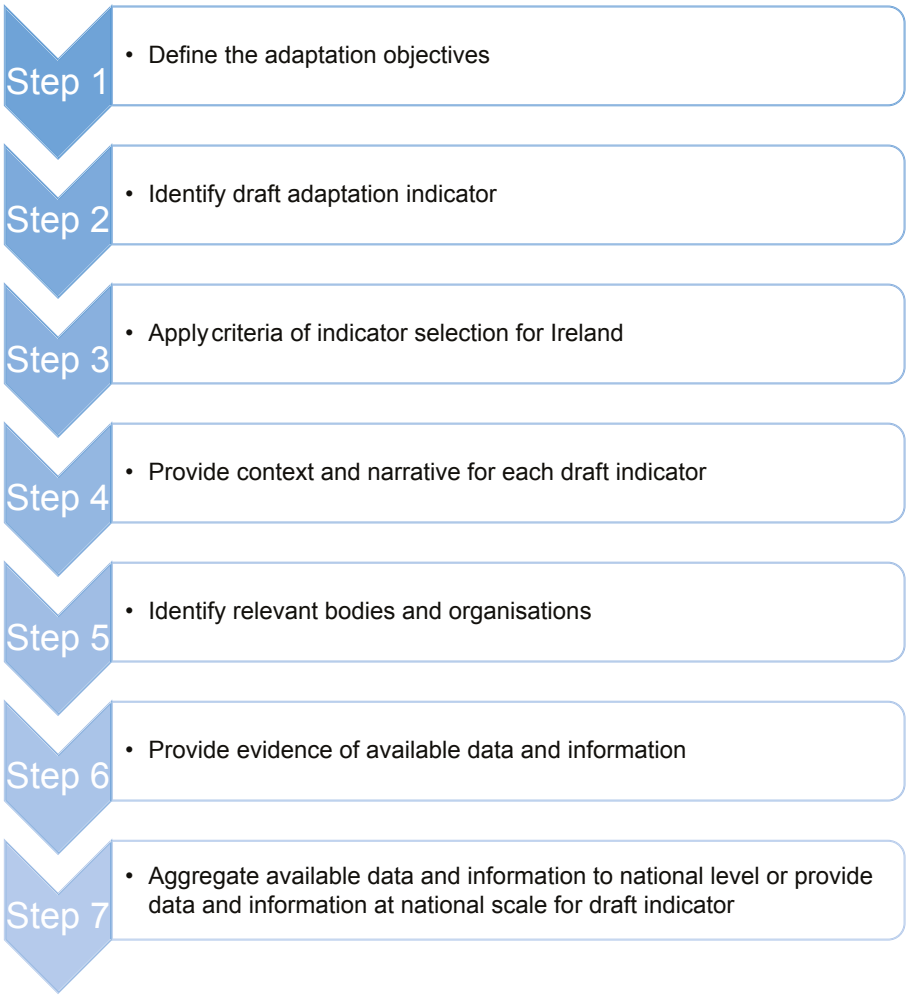

Figure 4.1. Step-by-step process of indicator and adaptation framework development for Ireland.

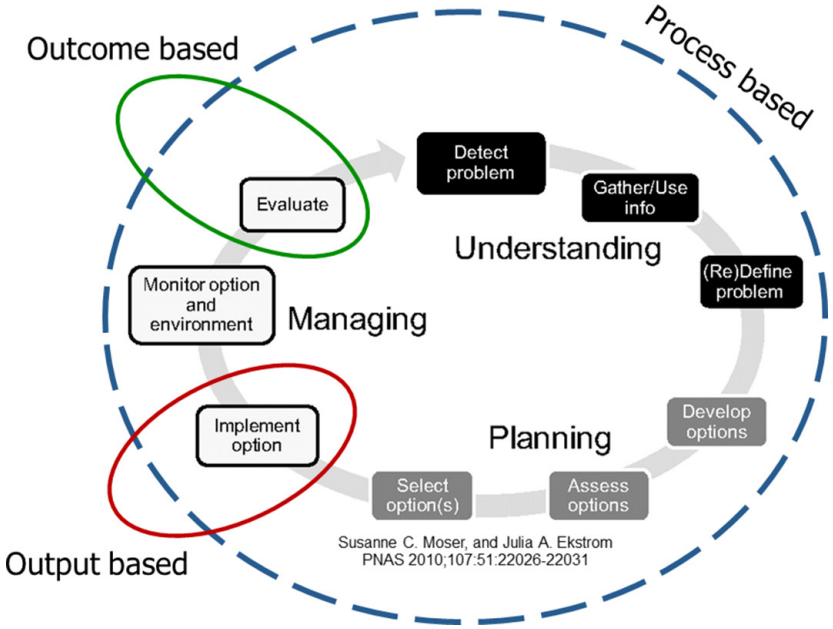

Figure 4.2. The adaptation cycle with relevant indicator types identified (adapted from Moser and Ekstrom, 2010).

- DECLG (Department of the Environment, Community and Local Government), 2012. *National Climate Change Adaptation Framework – Building Resilience to Climate Change*. DECLG, Dublin.
- Government of Ireland, 2015. *Climate Action and Low Carbon Development Act 2015*. Office of Public Works, Trim, Ireland.

Local/sectoral – lower-level adaptation objectives

- Falaleeva, M., Gray, S., O'Mahony, C. and Gault, J., 2013. *Coastal Climate Adaptation in Ireland: Assessing Current Conditions and Enhancing the Capacity for Climate Resilience in Local Coastal Management*. Environmental Protection Agency, Johnstown Castle, Ireland.
- Kelly, B. and Stack, M., 2009. *Climate Change, Heritage and Tourism: Implications for Ireland's Coast and Inland Waterways*. Heritage Council & Failte Ireland, Kilkenny, Ireland.
- Coll, J. and Sweeney, J., 2013. *Current and Future Vulnerabilities to Climate Change in Ireland*. Environmental Protection Agency, Johnstown Castle, Ireland.
- Flood, S., 2013. *Projected Economic Impacts of Climate Change on Irish Agriculture: Stop Climate Chaos*. Stop Climate Chaos Ireland, Dublin.
- Hendrick, E. and Black, K., 2009. *Climate Change and Irish Forestry*. COFORD, Dublin.
- DECLG (Department of the Environment, Community and Local Government), 2012. *Sector Specific and Local Adaption Plans that are Foreseen to be Developed in the National Climate Change Adaptation Framework – Building Resilience to Climate Change*. DECLG, Dublin.

Example of the framework operation

Figure 4.3 provides an example of a top-level climate change adaptation objective that has been filtered down to EU, national and local/sectoral levels, with a draft adaptation indicator at sectoral level used to measure progress towards an adaptation objective. The framework presented in Figure 4.3 can also work in a bottom-up approach, where local authorities and sectors can influence national policies and objectives, national policies and objectives can influence EU-level policies and objectives, and EU policies and objectives can influence international policy and objectives. Currently in Ireland, the approach to climate change adaptation is a top-down approach; however, increased engagement with stakeholders by relevant government departments is strengthening a bottom-up approach.

4.1.2 Step 2: identify potential draft adaptation indicators

Potential draft adaptation indicators are identified according to their aim of measuring progress of the sector and/or local authority towards achieving a specific adaptation objective, which largely influences the indicator type. Identified draft adaptation indicators are mainly process indicators, whereas outcome and output indicators for sectors have been identified based on documented climate change vulnerability of individual sectors. Outcome and output indicators are aspirational; testing these indicators in the future can help to improve their robustness and build on the information gathered. The aim of the draft adaptation indicator is to measure progress towards the identified adaptation objective, in this case *increased water resilience in agriculture*. This specific example relates to creating a baseline and under step 5 the indicator context is explained.

- **Adaptation objective:** increased water resilience in agriculture.
- **Linked draft adaptation indicator example:** percentage increase in water demand met by current supply levels (outcome indicator).

Example of an adaptation objective and corresponding draft adaptation indicators for a local authority: Multiple draft adaptation indicators linked to one adaptation objective allow a more complete picture of progress to be gleaned. The draft adaptation indicators in this example aim to measure the progress of a local authority towards the adaptation objective:

- initial planning for adaptation is undertaken:
  - local adaptation team in place (process indicator);
  - responsibilities and roles of local authority, sectors and other competent authorities are identified in relation to adaptation to climate change (process indicator);

International

UNFCCC (1992)

Article 4 – Commitment of the parties – Objective: "Cooperate in preparing for adaptation to the impacts of climate change; develop and elaborate appropriate and integrated plans for coastal zone management, water resources and agriculture, and for the protection and rehabilitation of areas, particularly in Africa, affected by drought and desertification, as well as floods" (UNFCCC, 1992, p. 5).

EU

EU Adaptation Strategy (EU, 2013)

Objective: "Promoting adaptation in key vulnerable sectors through agriculture, fisheries and cohesion policy, ensuring that Europe's infrastructure is made more resilient, and encouraging the use of insurance against natural and man-made disasters" (EU, 2013).

National

NCCAF (2012)

Objective: "The integration of climate adaptation into planning for protected areas and in agriculture and natural resource management plans" (DEHLG, 2012, p. 31).

The NCCAF (2012) will result in sectoral adaptation plans with adaptation objectives and associated actions for individual sectors. In the absence of final sectoral adaptation plans, sectoral adaptation objectives for this study are based on identified sector-specific vulnerabilities and risks. Some sectors have published draft adaptation plans, which are currently under public consultation and may be subject to change but provide the best available information.

Sectoral

Agriculture

The Draft Adaptation Plan for the Agriculture and Forest Sector (DAFM, 2017) states that:

> Drier summers and expanding herd populations, particularly in the dairy sector, will place additional demands on existing water supplies for agriculture, heightening competition for water resources

and

> Resilience to reduced water availability may become an important adaptation action for some livestock farmers during summer periods of drought. While water is a key requirement for agriculture, agricultural activity at the same time may impact on the quantity and quality of the water supply

→ Identified adaptation objective: increased water resilience in agriculture

Figure 4.3. Climate change adaptation objective framework operation.

- stakeholder engagement and communication plan for adaptation to climate change in place (process indicator).

4.1.3 Step 3: identify relevant bodies and organisations that can provide relevant data and information and collate evidence of available data and information that can populate a potential draft adaptation indicator

The identification of organisations and bodies relevant to potential draft adaptation indicators provides a starting point for identifying source data and information that can populate the draft indicators. This step also allows identification of potential sector-specific data and information holders, whose data may not be readily available or whose data are public but are still relevant. Evidence of publicly available data and information to populate the draft indicator is provided for some draft indicators below; however, relevant information and data may be held in organisations or within private entities, for example they may be non-public or not readily accessible. Further data discovery and data quality evaluation with relevant stakeholders is recommended. This would also ensure that the limitations of existing data are assessed, ensuring that data and information are suitable for populating the associated draft indicator.

- **Indicator example: agriculture** – percentage increase in water demand met by current supply levels (outcome indicator).
- Relevant bodies with potential publicly accessible sources of data/information: Department of Agriculture, Food and the Marine, Bord Bia, Teagasc.
- Evidence of data and information availability:
  - Hess, T.M., Chatterton, J. and Williams, A., 2012. *The Water Footprint of Irish Meat and Dairy Products*. Bord Bia and Department of Environmental Science and Technology, Cranfield University. URL: https://dspace.lib.cranfield.ac.uk/bitstream/1826/8756/3/The_Water_Footprint_of_Irish_Meat_and_Dairy_Products-2012.pdf (accessed 8 August 2018).
- **Indicator examples: local authories** – local adaptation team in place (process indicator).
- Relevant bodies with data/information and evidence of data and information availability: data and information need to be collated at local authority level, e.g. for each draft adaptation indicator a local authority provides a “yes” or “no” answer on a checklist.

4.1.4 Steps 4 and 5: select draft adaptation indicators by applying criteria for adaptation indicator development in Ireland and provide context and narrative for each selected draft adaptation indicator

The criteria for adaptation indicator development for Ireland (see Table 3.2) are applied to potential indicators to select draft adaptation indicators, ensuring their integrity and suitability for monitoring and evaluating preparedness for climate change, and reporting about the level of preparedness for climate change. Context for the draft adaptation indicators is provided in relation to the proposed high-level MRE framework (see Figure 4.2) and further developed through associated adaptation objectives using methods described for step 1. The context provides information on how the indicator signifies progress towards achieving the adaptation objective, and determines indicator type, while linking back to high-level adaptation objectives, for example at the national, EU and international level, and therefore allows reporting, for example in relation to the steps of the Adaptation Preparedness Scoreboard or UNFCCC.

- **Indicator example: agriculture** – percentage increase in water demand met by current supply levels (outcome indicator). **Indicator context:** increased water security in the agricultural sector signals an increased resilience to impacts of climate change based on the identified vulnerability of this sector to drought effects in Ireland.
- **Indicator examples: local authorities:**
  (a) local adaptation team in place (process indicator);
  (b) responsibilities and roles of local authority, sectors and other competent authorities are identified in relation to adaptation to climate change (process indicator);
  (c) stakeholder engagement and communication plan for adaptation to climate change in place (process indicator).

- **Corresponding indicator context:**

  (a) signals towards identification and inclusion of relevant departments, skillsets and disciplines across a local authority;

  (b) signifies understanding of jurisdiction, decision making and administrative powers for different circumstances and areas in relation to adaptation to climate change;

  (c) prepares the ground for effective and relevant stakeholder and community engagement, communication and education.

4.1.5 Step 6: aggregate available data and information to national level or provide data and information at national scale for draft indicator

Data and information provision to the national level from local authority and sector level is crucial to fulfil national reporting requirements and to allow for adjustment of national-level MRE guidance and relevant policy and legislation as new information is emerging. Data and information collated for individual draft indicators may be aggregated per indicator or data and information may be supplied at the national scale if appropriate, for example for sectors. Such data and information should be considered within the context provided for individual draft indicators of interest and within the larger narrative of the proposed MRE framework to avoid misinterpretation of provided data and information. The information flow is indicated in the proposed MRE framework (see Figure 3.1), in which draft indicator data and information are fed from local and sector level, whereas relevant policy, legislation and guidance are filtering from national level to the sectors and the local authorities.

- **Indicator example: agriculture** – percentage increase in water demand met by current supply levels (outcome indicator). **Scale of data available:** national.
- **Indicator examples: local authorities** – local adaptation team in place (process indicator). **Scale of information collated/available:** local authority level.
- **Information aggregated to inform national overview**: information is agregated by number of local authorities that checked “yes” for the individual indicator out of the overall number of local authorities in relation to the corresponding shared adaptation objective, **“**Initial planning for adaptation is undertaken”. This will allow for reflection on the level of prepardeness of local authorities in Ireland. A top-down process is required as an overview and guidance should be provided to support local authorities to ensure that activities undertaken align with national adaptation objectives.

4.2 Guidance Table for Draft Indicator Development

A separate Microsoft Excel spreadsheet document “Draft Adaptation Indicators” was developed to support draft indicator development following the six steps outlined above and contains all identified draft adaptation indicators. The number of identified draft adaptation indicators and associated data availability are provided per sector in Table 4.1.

The Microsoft Excel document acts as an indicator development framework nesting within the three levels of the larger MRE framework. This indicator development table guides the user through table headings (see Appendix 1) and rows supporting the development of new indicators, facilitating the collection of data and information for existing draft indicators, and is therefore updatable as new information emerges.

The draft indicator development and associated data and information search concentrated on local authorities and the agriculture and marine and fisheries sectors. The draft indicator factsheets (see Appendix 2) include all identified draft adaptation indicators for local authorities and the agriculture and marine and fisheries sectors. For local authorities 18 indicators (see Table A2.1) have been identified and information to populate these indicators should be collected at local authority level. The “Draft Adaptation Indicators” table suggests a number of draft adaptation indicators for additional sectors of interest, which is intended as a starting point for potential further development. The additional sectors of interest (see Table 4.1) are based on current sectors noted on the Climate Information Platform for Ireland (O’Dwyer and Gault, 2017), linking to ongoing relevant EPA projects.

The “Draft Adaptation Indicators” table links to all levels of the generic MRE framework through provision

Table 4.1. Summary of number of identified draft adaptation indicators by sector in relation to available data

Sector	Total number of indicators identified	Number of indicators with data available at national and/or organisational level	Number of indicators without evidence of available data
Marine and fisheries	25	14	11
Agriculture	27	18	9
Coastal areas	37	19	18
Biodiversity	16	9	7
Water management	23	8	15
Tourism, landscape and heritage	31	10	21
Health	30	7	23
Business	19	7	12
Critical infrastructure	15	3	12
Forestry	26	18	8

of indicator-specific information for local authorities and sectors and by outlining how that information feeds to the national level (see Appendix 1). In addition, the table links each individual indicator to the individual steps of the Adaptation Preparedness Scoreboard (see Appendix 1). Information fields under table headings (see Appendix 1) ensure that information related to all six steps of the adaptation cycle by Moser and Ekstrom (2010) (see Figure 4.2) can be added within a supporting structure.

The table also contains a number of additional fields (see Appendix 1) to provide support for more detailed applied indicator use or indicator development. The additional information fields in the table are outlined below in bullet format and some may be more relevant for sector-specific indicator development:

- Relevant bodies with potential publicly accessible source of data/information: allows for the identification of potential sector-specific data and information holders. This is a starting point for a data and information search in order to populate the indicator.
- Evidence of data and information availability: allows for the identification of available data and information that can populate individual draft indicators.
- Checklist yes/no: allows the user to apply quick summary judgement at individual indicator level based on available data and information within the table.
- Proxy indicators: allows for the addition of potential proxy indicators if data are available and the information cannot populate a draft indicator directly but provides relevant or complementary information towards the draft indicator.
- Adaptation Preparedness Scoreboard relevance: allows for indicator information to be linked to the steps of the Adaptation Preparedness Scoreboard for reporting requirements.
- Scale of available data: allows the user to indicate or see at what scale data are available and to judge if that scale is appropriate for purpose, e.g. national-scale sector-specific data may be used for national-level reporting.
- Information aggregated for national level: indicates how data and information can be aggregated to national level.

Development of new draft indicators within the indicator development framework table should be carried out using the steps outlined above (see Figure 4.1), placing any new draft indicator and associated information within the relevant column and row. This process would start with deciding if new draft indicators are to measure progress towards already suggested adaptation objectives or if new adaptation objectives should be added, ensuring that draft indicators are linked to adaptation objectives. Adding new adaptation objectives should be carried out with relevance to an MRE framework, with reference to international and national legal and policy requirements, in line with steps 1–5 of the Adaptation Preparedness Scoreboard and the step-by-step approach of the adaptation cycle (Moser and Ekstrom, 2010). Adding a new draft indicator requires context to outline how this indicator can signify progress

towards reaching an associated adaptation objective. Establishing context and narrative in relation to the adaptation objective is influenced by and influences indicator type and where within the adaptation cycle the indicator is applicable (see Figure 4.2).

4.3 The Adaptation Indicator Development Process

The adaptation indicator development process developed through this desktop research should be taken forward with the relevant stakeholders (see Figure 4.2) to refine suggested adaptation objectives and associated draft adaptation indicators and develop new adaptation objectives and relevant indicators that measure progress and allow reflection on levels of preparedness for the impacts of climate change at local, sector and national levels in Ireland. Figure 4.4 outlines who those stakeholders are and how this process can be undertaken and tested.

National-level stakeholders are ultimately the national government departments responsible for individual sectors and local authorities, as well as climate change, which should provide national guidance, policy and legislation as outlined in the draft MRE framework (Figure 3.1) and shown in Figure 4.4. National-level stakeholders should be able to collate sector-specific information either at national scale via reporting from the sectors or by aggregating local-level indicator and sector-specific information, building on information provided in the "Draft Adaptation Indicators" guidance table. Collated and aggregated information should be evaluated at the national level not only for reporting purposes but also to adjust information, guidance, legislation and policy. Individual sectors can develop and refine sector-specific adaptation indicators through the step-by-step process for each individual indicator and by building on the information provided within the "Draft Adaptation Indicators" guidance table and, if appropriate, through factsheets for the marine and fisheries and agriculture sectors. Sector-specific indicators should allow a sector to evaluate its level of preparedness for climate change and the process of indicator development itself, to ultimately allow improvement of the process and refinement of indicators as new information emerges. Similarly, the development and improvement of local authority

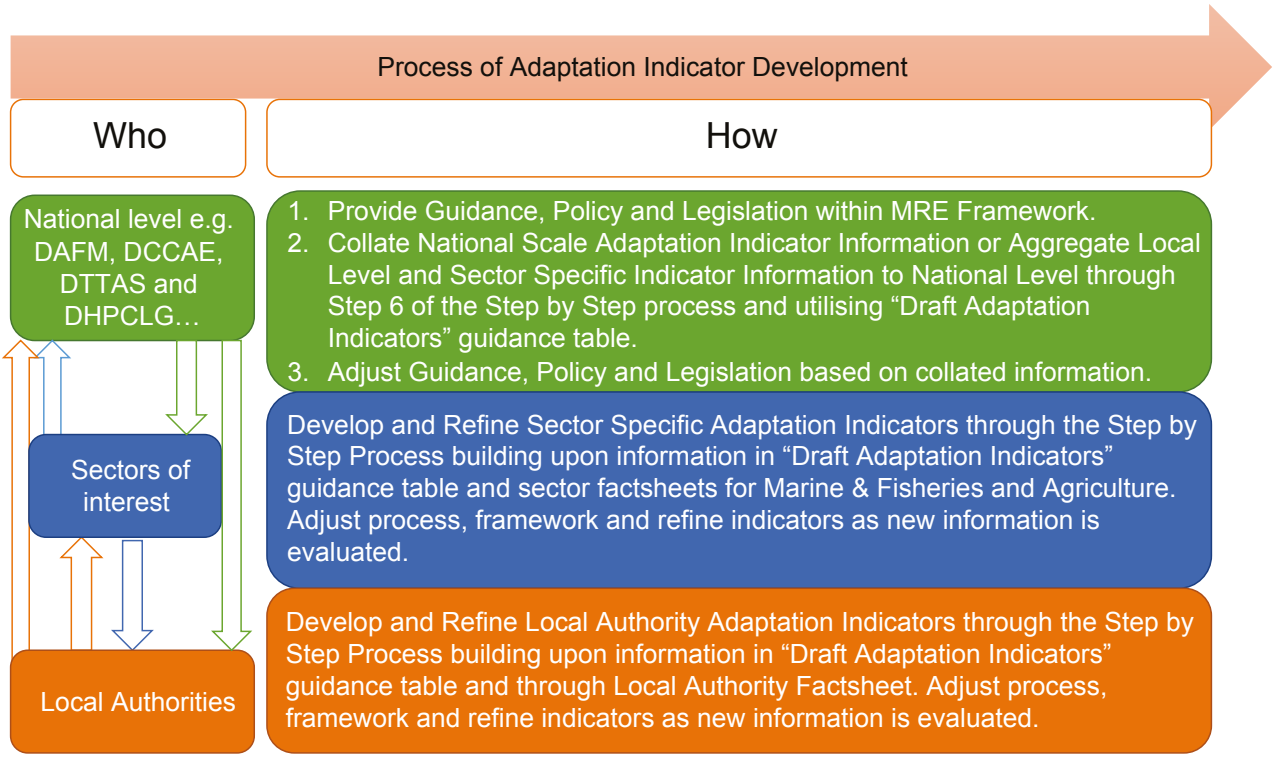

Figure 4.4. Adaptation indicator development process overview – who and how. DAFM, Department of Agriculture, Food and the Marine; DCCAE, Department of Communications, Climate Action and Environment; DHPCLG, Department of Housing, Planning, Community and Local Government; DTTAS, Department of Transport, Tourism and Sport.

adaptation indicators would take place through the step-by-step process for each individual indicator in addition to utilising the information provided within the "Draft Adaptation Indicators" guidance table and the local authority factsheet (see Table A2.1). Implemented final adaptation indicators should allow for evaluation of the levels of preparedness for climate change, as well as improving the indicator development process and existing indicators as new information emerges.

4.4 Draft Indicator Factsheets for Local Authorities and the Agriculture and Marine and Fisheries Sectors

Draft indicator factsheets have been produced as an output of this project (see Appendix 2), providing a segment of information found within the "Draft Adaptation Indicators" table. The factsheets present the draft indicators and essential associated information for local authorities and the agriculture and marine and fisheries sectors. The purpose of the factsheets is to introduce the developed draft indicators and to illustrate the process of draft indicator development described in this chapter with regard to steps 1 and 2 of the step-by-step process. The factsheets provide stakeholders, target audiences and potential users with enough draft indicator-specific information to facilitate learning about the process outlined in this chapter and start the process with stakeholders. Furthermore, the factsheets may act as support for communication and capacity building about adaptation indicators in general and their development in Ireland.

The factsheets are a starting point for further studies and engagement with stakeholders. The "Draft Adaptation Indicators" table related to this report includes a larger volume of indicator information (see Appendix 1). Although this study is desk based, stakeholder engagement will be an important part of indicator development in Ireland and thus it is recommended that the draft indicators presented in the factsheets and in the "Draft Adaptation Indicators" table are used to engage stakeholders and to refine and test existing draft adaptation indicators and develop new indicators in line with stakeholder engagement recommendations coming out of the best practice review.

5 Summary Conclusions and Recommendations

Monitoring, reporting and evaluation frameworks can determine the suitability of an adaptation process, assess advancement towards adaptation objectives and gauge whether appropriate outcomes have been reached. Best international practice advocates the development of indicators as a tool within an overall MRE framework, that indicators are aligned to adaptation objectives, that context and narrative are provided for each indicator and that a baseline is established against which to measure progress and stakeholder engagement at all levels of indicator development. Additionally, best practice encourages the use of a combination of indicators (process, outcome and output indicators) and the use of thematic focus areas or sector fields.

Based on a desktop review of international best practice and Ireland's national context, this study proposes a draft MRE framework for Ireland and draft adaptation indicator sets to assess local and sectoral preparedness for climate change in Ireland. The proposed draft adaptation indicators facilitate reflection on levels of preparedness for climate change at national, local authority and sectoral levels (specifically for the agriculture and marine and fisheries sectors) and provide a starting point for the development of operational and implemented adaptation indicators for Ireland that can measure progress towards specific adaptation objectives.

A generic MRE framework is proposed in reference to international and national policy and legal requirements, which incorporates international best practice. The proposed MRE framework captures the high-level context for Ireland, indicating the flow of information and where indicator development takes place. The proposed framework is generic and updatable and as such permits future legislation, policy and guidance to be included, which in turn allows stimulation of subsequent indicator development to adjust towards emerging adaptation priorities. A suitable set of criteria for indicator development were developed based on best practice and in alignment with elements of the SMART criteria. Draft adaptation indicator development is nested within the proposed MRE framework for Ireland, links to international and national adaption objectives, incorporates sector-specific climate change vulnerabilities and takes place through a step-by-step process.

The "Draft Adaptation Indicators" table, an accompanying document to this report, facilitates the collection of data and information for existing draft indicators, is updatable as new information emerges and supports the development of new indicators. The indicator development table contains all developed draft adaptation indicators and links to all levels of the proposed MRE framework through provision of indicator-specific information and outlines how that information feeds to the national level. Draft adaptation indicator development concentrated on local authorities and the agriculture and marine and fisheries sectors, which altogether resulted in 70 draft adaptation indicators; an additional 197 indicators are proposed for additional sectors of interest. The "Draft Adaptation Indicators" table can be requested from the MaREI Centre via the EPA and associated work and research should be referenced accordingly, acknowledging the authors and the EPA. Draft adaptation factsheets for local authorities and the agriculture and marine and fisheries sectors provide stakeholders, target audiences and potential users with indicator information to facilitate learning about the process and can support communication and capacity building about adaptation indicators for Ireland.

Some aspects of the draft indicator development were not provided through the proposed MRE framework, specifically the provision of adaptation priorities and objectives for local authorities and relevant sectors. Adaptation objectives for sectors and local authorities were subsequently developed based on high-level international and national adaptation objectives, the adaptation cycle (Moser and Ekstrom, 2010) and identified sector-specific climate vulnerabilities. Some best practice recommendations derived from the literature review were outside the remit of this desktop study, for example involving relevant stakeholders in indicator development, which is, however, vital to the development of operational and accepted adaptation indicators. However, implementation of some developed draft indicators will support the establishment of such a baseline. Based on the

literature review and the desktop-based research, the authors would recommend the following:

- development of a specific MRE framework as relevant legislation, policy and guidance becomes available that includes dedicated support for adaptation indicator development and implementation;
- engagement with relevant stakeholders at all levels of indicator development and implementation;
- testing and refinement of the adaptation indicator development process outlined;
- regular evaluation of data and information used to populate identified adaptation indicators;
- development of new adaptation indicators and collation of relevant data and information as they become available;
- prioritise the implementation of adaptation indicators that can support the establishment of a baseline for local authorities and sectors.

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Abbreviations

ASC	Adaptation Sub-committee
DAS	German Adaptation Strategy
DEHLG	Department of the Environment, Heritage and Local Government
EPA	Environmental Protection Agency
EU	European Union
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
LGSA	Local Government Association of South Australia
MRE	Monitoring, reporting and evaluation
NAF	National Adaptation Framework
NAP	Plan National D'Adaptation
NCCAF	National Climate Change Adaptation Framework
OECD	Organisation for Economic Co-operation and Development
ONERC	Observatoire National sur les Effets du Réchauffement Climatique
SEA	Strategic Environmental Assessment
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNWFP	United Nations World Food Programme

Appendix 1 Draft Adaptation Indicators

Table A1.1. Local authority headings

Local authority preparedness				Local authority preparedness (continued)		Information aggregation for national-level reporting	
Indicator aim to measure progress towards the following Adaptation Objectives	**Indicator**	**Checklist yes/no**	**Indicator context**	**Indicator type (see Figure 4.2 in relation to application within adaptation cycle)**	**Relevance to the Adaptation Preparedness Scoreboard**	**Number of local authorities that checked "yes" for individual indicator out of overall number of local authorities**	**Local-level information collection informs national overview**
Initial planning for adaptation undertaken	Local adaptation team in place		Signals towards identification and inclusion of relevant departments, skillsets and disciplines across a local authority	Process	Step 1: preparing the ground for adaptation		Not applicable – top-down process – overview and guidance should be provided to support local authorities and ensure that undertaken activities align with national adaptation objectives
	Responsibilities and roles of local authority, sectors and other competent authorities are identified in relation to adaptation to climate change		Signifies understanding of jurisdiction, decision making and administrative powers for different circumstances and areas in relation to adaptation to climate change				
	Stakeholder engagement and communication plan for adaptation to climate change in place		Prepares the ground for effective and relevant stakeholder and community engagement, communication and education				
	Collaboration plans with other local authorities, relevant authorities and sectors on adaptation to climate change in place		Signals the adoption of a regional approach to adaptation and ensures relevant sectors are engaged				

Table A1.2. Agriculture headings

Agriculture											Scale of data available	Information aggregated into national-level plans
Indicator aim to measure progress towards the following Adaptation Objectives	**Draft indicator**	**Indicator context**	**Indicator type (see Figure 4.2 in relation to application within adaptation cycle)**	**Relevant bodies with potential publicly accessible source of data/ information**	**Evidence of data and information availability**	**Evidence of data and information availability**	**Evidence of data and information availability**	**Checklist yes/no**	**Potential proxy indicator**	**Relevance to the Adaptation Preparedness Scoreboard**		
Stakeholders are engaged in the adaptation process	Consultation, communication and engagement plans are in place to integrate relevant stakeholders in adaptation process	Prepares the ground for effective and relevant stakeholder and community engagement, communication and education	Process	Department of Agriculture, Food and the Marine, Teagasc	Teagasc: http://www.teagasc.ie/publications/view_publication.aspx?PublicationID=2891					Step 1: preparing the ground for adaptation	National	
	Education and training schemes are in place to support future implementation of adaptation actions in agriculture	Preparing the ground to facilitate building adaptive capacity and signifies that the relevant stakeholders can be engaged in a capacity-building process		Department of Agriculture, Food and the Marine, Teagasc	Department of Agriculture, Food and the Marine: Organic Farming Scheme: https://www.agriculture.gov.ie/media/migration/farmingsectors/organicfarming/organicsscheme/organicfarmingscheme/OCISTermsCond120517.pdf				Department of Agriculture, food and the Marine: https://www.agriculture.gov.ie/media/migration/press/pressreleases/2014/DraftConsultation%20DocRDP14%20Jan.pdf		National	National-level training scheme to support the implementation of adaptation actions in agriculture

Appendix 2 Draft Indicator Factsheets

Table A2.1. Local authority factsheet

Adaptation objective	Indicator	Indicator context	Indicator type
Initial planning for adaptation is undertaken	Local adaptation team is in place	Signals towards identification and inclusion of relevant departments, skillsets and disciplines across a local authority	Process
	Responsibilities and roles of local authority, sectors and other competent authorities are identified in relation to adaptation to climate change	Signifies understanding of jurisdiction, decision making and administrative powers for different circumstances and areas in relation to adaptation to climate change	
	Stakeholder engagement and communication plan for adaptation to climate change in place	Prepares the ground for effective and relevant stakeholder and community engagement, communication and education	
	Collaboration plans with other local authorities, relevant authorities and sectors on adaptation to climate change in place	Signals the adoption of a regional approach to adaptation and ensures relevant sectors are engaged	
Current baselines, risks and vulnerabilities are understood	Assessments of current weather impacts and climate vulnerabilities have been undertaken	Signifies increasing understanding of the relevant baselines towards increasing adaptive capacity within the local authority	Process
	Costs of current weather impacts have been estimated		
	Stakeholders affected by current weather impacts are identified and mapped	Signifies increasing understanding of current impacts, setting the scene for prioritisation of stakeholder engagement efforts and associated future adaptation actions	
	Existing policies and measures linked to the management of identified impacts are identified	Signifies progress to integrate existing policies and measures into the adaptation process to avoid discrepancies and duplication of efforts	
Future climate risks and vulnerabilities are understood	Assessments of climate change impacts and vulnerability have been undertaken	Signifies increased adaptive capacity through better understanding of climate change impacts and vulnerabilities	Process
	Future risks have been prioritised	Signals that areas and stakeholders most at risk are the focus of early adaptation option identification and effort	
	Objectives for managing climate risks have been set	Signals increased chances of leading to specific outcomes as risk management objective ensures that uncertainty does not deflect from overall goal of a risk management plan to reduce vulnerability associated with climate risks	
Adaptation options are identified and prioritised	Range of potential adaptation options are identified	Signals consideration of different types of options, e.g. temporal, managerial, technical and compiling of required information to enable informed decision making	Process
	Assessments of adaptation options are undertaken	Signals evaluation of adaptation options against relevant criteria, e.g. efficient, effective, cost, and their ability to meet set objectives, e.g. within a risk management context or overall adaptation strategy, and enables prioritisation of options according to set criteria, e.g. urgency, practicality, synergies with other strategies or existing management plans	

Table A2.1. Continued

Adaptation objective	Indicator	Indicator context	Indicator type
Adaptation options are implemented	Implementation plan for adaptation actions Draft adaptation strategy Climate risk management plan	Signifies guidance along adaptation pathways, co-ordinated efforts and formalised roles and responsibilities towards implementing adaptation options	Process
Adaptation actions are evaluated	Monitoring system to ensure that adaptation actions, outcomes and outputs are moving towards established objectives	Ensures that actions are moving towards objectives established for implementation processes and outputs	Process
	Evaluation and review of adaptation strategy and whether or not objectives are being met	Assess suitability of strategy for meeting objectives	

The indicators' aim is to measure progress towards the adaptation objectives.

Table A2.2. Agriculture factsheet

Adaptation objective	Indicator	Indicator context	Indicator type
Stakeholders are engaged in the adaptation process	Consultation, communication and engagement plans in place to integrate relevant stakeholders in the adaptation process	Prepares the ground for effective and relevant stakeholder and community engagement, communication and education	Process
	Education and training schemes are in place to support future implementation of adaptation actions in the agriculture sector	Prepares the ground to facilitate building adaptive capacity and signifies that the relevant stakeholders can be engaged in a capacity-building process	
Current impacts and risks in the agricultural sector are understood	Number of projects to mitigate disease within the agriculture sector Assessments of current climate and weather risks for the agriculture sector have been undertaken Numbers of invasive terrestrial species are recorded	Signifies increasing understanding of the relevant baselines towards increasing adaptive capacity within the sector	Process
Future climate risks and vulnerabilities of the agriculture sector are understood	An adaptation strategy has been developed for the sector Assessments of climate change impacts and vulnerabilities in the agriculture sector have been undertaken	Signifies an increase in adaptive capacity through better understanding of climate change impacts and vulnerabilities	Process
	Futures risks have been identified	Signals that areas and stakeholders most at risk are the focus of early adaptation option identification and effort	
	Objectives for managing risks have been set	Signals increased chances of leading to specific outcomes as risk management objective ensures that uncertainty does not deflect from the overall goal of a risk management plan to reduce vulnerability associated with climate risks	
	Ongoing focus on research into the impacts of climate change on agriculture	Signals that new and emerging information in relevant research areas will become available to inform assessments, plans and objectives in relation to pests and diseases, drought effects, flooding, water logging and salinity	

Table A2.2. Continued

Adaptation objective	Indicator	Indicator context	Indicator type
Farms are actively engaged in climate risk management and adaptation measures	Supporting grants and financial schemes for adaptation assistance exist	Signals that the foundations are in place to assist implementation of sector-specific adaptation actions towards increased preparedness for climate change	Process
	Percentage uptake of supporting grants and financial schemes	Relates to assessment of provided assistance and support; signals towards level of undertaken climate risk management and engagement with adaptation measure	
	Cultivation phase shifts are undertaken	Signals that aspects of risk management have been undertaken and to what extent in relation to projected climate vulnerabilities of the sector in Ireland, such as pests and diseases, flooding, water logging and salinity	Output
	New varieties of crops are grown		
	Percentage increase in farmland covered by crop insurance		
	Percentage increase in livestock insured against extreme weather events		
	Number of risk management plans in place		
Increased water resilience in agriculture	Reduced total water demand for use in agriculture	Increased water security in agricultural sector signals towards increased resilience to impacts of climate change based on identified vulnerability of this sector to drought effects in Ireland	Outcome
	Percentage increase in water demand met by current supply levels		
	Increased reuse of treated wastewater		
	Number of additional irrigation schemes in place correspond to objectives for managing climate risks for the sector	Signals that implementation of climate risk management measures is taking place along adaptation pathways	Output
	Number of additional water management schemes in place correspond to objectives for managing climate risks for the sector		
Evaluation of adaptation actions in the agriculture sector	Percentage of livestock fed on grass	Higher levels of grass feeding reflects an uptake of benefit/opportunity from climate change and thus increased resilience and signifies that the sector is taking advantage of opportunities	Outcome
	Percentage change in total farm productivity (yield)	Relates to assessment of adaptation actions for suitability in relation to adaptation options and measures, which influence yield	
	Percentage uptake in crop diversification	Signals implementation of specific adaptation options and extent of the adaptation option	
Understanding change in vulnerability as a result of implemented adaptation actions and as new climate change information is becoming available	Repeated vulnerability assessments for the agriculture sector are undertaken	Relates to new and emerging information feeding into an adaptation process and signifies increasing adaptive capacity through a better understanding of climate change impacts and vulnerabilities, which also allows an assessment of whether or not adaptation actions undertaken are suitable	Process and outcome
	Sector-relevant climate projections are updated for sector-relevant plans	Signals that new and emerging information is feeding into an adaptation process and signifies increasing adaptive capacity through a better understanding of sector-relevant climate change projections	Process

The indicators' aim is to measure progress towards the sector's adaptation objectives.

Table A2.3. Marine and fisheries factsheet

Adaptation objective	Indicator	Indicator context	Indicator type
Key stakeholders engaged in adaptation planning	Consultation, communication and engagement plans in place to integrate relevant stakeholders in the adaptation process	Prepares the ground for effective and relevant stakeholder and community engagement, communication and education	Process
	Education and training schemes are in place for supporting adaptation actions	Preparing the ground to facilitate building adaptive capacity and signifies that the relevant stakeholders can be engaged in a capacity-building process	
Current impacts and risks in the marine and fisheries sector are understood	Assessments of current climate and weather risks for the marine and fisheries sector have been undertaken	Signifies increasing understanding of the relevant baselines towards increasing adaptive capacity within the sector	Process
	Monitoring of current threats and impacts to commercial fish and aquaculture species is undertaken		
	Current impacts to marine habitats and species are identified		
	Monitoring of marine ecosystems is undertaken		
	Number of and instances of marine invasive species		
Future climate risks and vulnerabilities of the marine and fisheries sector are understood	Assessments of climate change impacts and vulnerabilities for the marine and fisheries sector have been undertaken	Relates to increasing adaptive capacity through better understanding of climate change impacts and vulnerabilities	Process
	Futures risks have been identified	Signals that areas and stakeholders most at risk are the focus of early adaptation option identification and effort	
	Objectives for managing risks have been set	Signals increased chance of leading to specific outcomes as risk management objective ensures that uncertainty does not deflect from the overall goal of a risk management plan to reduce vulnerability associated with climate risks	
	Ongoing focus on research into the impacts of climate change in the marine and fisheries sector	Signals that new and emerging information in relevant research areas will become available to inform assessments, plans and objectives relevant to the sector, e.g. how changes in the distribution of marine species and invasive marine species, the frequency and intensity of storm surges and extreme weather events can affect commercial sector operation and the safety of people working in the marine environment	
Observed changes in fisheries and aquaculture data inform the development of adaptation actions	Changes in catch composition are monitored	Relates to building adaptive capacity as a growing amount of relevant information and better understanding of sector-specific impacts, vulnerabilities and opportunities in climate change adaptation will allow the development of more suitable adaptation actions and measures	Process
	Research into new commercial target species undertaken for the aquaculture and fisheries sector		
Stakeholders in the marine and fisheries sector are actively engaged in climate risk management and adaptation measures	Supporting grants and financial schemes for adaptation assistance are in place	Signals that foundations are in place to assist implementation of sector-specific adaptation actions towards increased preparedness for climate change	Process
	Uptake in grants and financial schemes	Relates to assessment of provided assistance and support; signals towards level of climate risk management undertaken and engagement with adaptation measure	
	Fisheries diversification schemes in place	Signals that sector-specific adaptation options and measures are considered and supported	

Table A3.3. Continued

Adaptation objective	Indicator	Indicator context	Indicator type
Stakeholders in the marine and fisheries sector are actively engaged in climate risk management and adaptation measures (continued)	Planning and delivery of all of the maritime services incorporates adaptation measures Policy development and implementation in relation to ports and shipping incorporates adaptation measures	Signals that sector-specific adaptation options and measures are implemented through co-ordinated efforts within sector-specific planning and policy development	
	Total Allowable Catches (TACs) set to increase resilience in target species Number of risk management projects in place in the marine and fisheries sector	Signals that aspects of risk management are undertaken in relation to projected climate change impacts for the sector in Ireland, considering, for example, changes in the distribution of marine species and invasive marine species, the frequency and intensity of storm surges and extreme weather events	Output
Evaluation of adaptation actions in the marine and fisheries sector	Number of new target species taken up in fisheries	Signals that specific adaptation options are implemented and to what extent	Outcome
	Percentage change in reported weather-related accidents and incidents in the marine and fisheries sector per official weather warning and/or alert	Relates to assessment of adaptation actions for suitability in terms of operational safety within the coastal and marine environment that may be impacted by weather, e.g. frequency and intensity of storm surges and extreme weather events	
	Percentage change in reported weather-related commercial damage in the marine and fisheries sector per official weather warning and/or alert	Relates to assessment of adaptation actions for suitability in terms of the potential commercial impact of the weather, e.g. frequency and intensity of storm surges and extreme weather events	
Understanding change in vulnerability as a result of implemented adaptation actions and as new climate change information is becoming available	Repeated vulnerability assessments in the marine and fisheries sector	Relates to new and emerging information feeding into an adaptation process and signifies increasing adaptive capacity through better understanding of climate change impacts and vulnerabilities, which also allows an assessment of whether or not adaptation actions undertaken are suitable	Process and outcome
	Sector-relevant climate projections are updated for sector-relevant plans	Signals that new and emerging information is feeding into an adaptation process and signifies increasing adaptive capacity through better understanding of sector-relevant climate change projections	Process

The indicators' aim is to measure progress towards the sector's adaptation objectives.

AN GHNÍOMHAIREACHT UM CHAOMHNÚ COMHSHAOIL
Tá an Ghníomhaireacht um Chaomhnú Comhshaoil (GCC) freagrach as an gcomhshaol a chaomhnú agus a fheabhsú mar shócmhainn luachmhar do mhuintir na hÉireann. Táimid tiomanta do dhaoine agus don chomhshaol a chosaint ó éifeachtaí díobhálacha na radaíochta agus an truaillithe.

Is féidir obair na Gníomhaireachta a roinnt ina trí phríomhréimse:

Rialú: *Déanaimid córais éifeachtacha rialaithe agus comhlíonta comhshaoil a chur i bhfeidhm chun torthaí maithe comhshaoil a sholáthar agus chun díriú orthu siúd nach gcloíonn leis na córais sin.*

Eolas: *Soláthraímid sonraí, faisnéis agus measúnú comhshaoil atá ar ardchaighdeán, spriocdhírithe agus tráthúil chun bonn eolais a chur faoin gcinnteoireacht ar gach leibhéal.*

Tacaíocht: *Bímid ag saothrú i gcomhar le grúpaí eile chun tacú le comhshaol atá glan, táirgiúil agus cosanta go maith, agus le hiompar a chuirfidh le comhshaol inbhuanaithe.*

Ár bhFreagrachtaí

Ceadúnú
Déanaimid na gníomhaíochtaí seo a leanas a rialú ionas nach ndéanann siad dochar do shláinte an phobail ná don chomhshaol:
- saoráidí dramhaíola *(m.sh. láithreáin líonta talún, loisceoirí, stáisiúin aistrithe dramhaíola)*;
- gníomhaíochtaí tionsclaíocha ar scála mór *(m.sh. déantúsaíocht cógaisíochta, déantúsaíocht stroighne, stáisiúin chumhachta)*;
- an diantalmhaíocht *(m.sh. muca, éanlaith)*;
- úsáid shrianta agus scaoileadh rialaithe Orgánach Géinmhodhnaithe *(OGM)*;
- foinsí radaíochta ianúcháin *(m.sh. trealamh x-gha agus radaiteiripe, foinsí tionsclaíocha)*;
- áiseanna móra stórála peitril;
- scardadh dramhuisce;
- gníomhaíochtaí dumpála ar farraige.

Forfheidhmiú Náisiúnta i leith Cúrsaí Comhshaoil
- Clár náisiúnta iniúchtaí agus cigireachtaí a dhéanamh gach bliain ar shaoráidí a bhfuil ceadúnas ón nGníomhaireacht acu.
- Maoirseacht a dhéanamh ar fhreagrachtaí cosanta comhshaoil na n-údarás áitiúil.
- Caighdeán an uisce óil, arna sholáthar ag soláthraithe uisce phoiblí, a mhaoirsiú.
- Obair le húdaráis áitiúla agus le gníomhaireachtaí eile chun dul i ngleic le coireanna comhshaoil trí chomhordú a dhéanamh ar líonra forfheidhmiúcháin náisiúnta, trí dhíriú ar chiontóirí, agus trí mhaoirsiú a dhéanamh ar leasúchán.
- Cur i bhfeidhm rialachán ar nós na Rialachán um Dhramhthrealamh Leictreach agus Leictreonach (DTLL), um Shrian ar Shubstaintí Guaiseacha agus na Rialachán um rialú ar shubstaintí a ídíonn an ciseal ózóin.
- An dlí a chur orthu siúd a bhriseann dlí an chomhshaoil agus a dhéanann dochar don chomhshaol.

Bainistíocht Uisce
- Monatóireacht agus tuairisciú a dhéanamh ar cháilíocht aibhneacha, lochanna, uiscí idirchriosacha agus cósta na hÉireann, agus screamhuiscí; leibhéil uisce agus sruthanna aibhneacha a thomhas.
- Comhordú náisiúnta agus maoirsiú a dhéanamh ar an gCreat-Treoir Uisce.
- Monatóireacht agus tuairisciú a dhéanamh ar Cháilíocht an Uisce Snámha.

Monatóireacht, Anailís agus Tuairisciú ar an gComhshaol
- Monatóireacht a dhéanamh ar cháilíocht an aeir agus Treoir an AE maidir le hAer Glan don Eoraip (CAFÉ) a chur chun feidhme.
- Tuairisciú neamhspleách le cabhrú le cinnteoireacht an rialtais náisiúnta agus na n-údarás áitiúil *(m.sh. tuairisciú tréimhsiúil ar staid Chomhshaol na hÉireann agus Tuarascálacha ar Tháscairí)*.

Rialú Astaíochtaí na nGás Ceaptha Teasa in Éirinn
- Fardail agus réamh-mheastacháin na hÉireann maidir le gáis cheaptha teasa a ullmhú.
- An Treoir maidir le Trádáil Astaíochtaí a chur chun feidhme i gcomhair breis agus 100 de na táirgeoirí dé-ocsaíde carbóin is mó in Éirinn.

Taighde agus Forbairt Comhshaoil
- Taighde comhshaoil a chistiú chun brúnna a shainaithint, bonn eolais a chur faoi bheartais, agus réitigh a sholáthar i réimsí na haeráide, an uisce agus na hinbhuanaitheachta.

Measúnacht Straitéiseach Timpeallachta
- Measúnacht a dhéanamh ar thionchar pleananna agus clár beartaithe ar an gcomhshaol in Éirinn *(m.sh. mórphleananna forbartha)*.

Cosaint Raideolaíoch
- Monatóireacht a dhéanamh ar leibhéil radaíochta, measúnacht a dhéanamh ar nochtadh mhuintir na hÉireann don radaíocht ianúcháin.
- Cabhrú le pleananna náisiúnta a fhorbairt le haghaidh éigeandálaí ag eascairt as taismí núicléacha.
- Monatóireacht a dhéanamh ar fhorbairtí thar lear a bhaineann le saoráidí núicléacha agus leis an tsábháilteacht raideolaíochta.
- Sainseirbhísí cosanta ar an radaíocht a sholáthar, nó maoirsiú a dhéanamh ar sholáthar na seirbhísí sin.

Treoir, Faisnéis Inrochtana agus Oideachas
- Comhairle agus treoir a chur ar fáil d'earnáil na tionsclaíochta agus don phobal maidir le hábhair a bhaineann le caomhnú an chomhshaoil agus leis an gcosaint raideolaíoch.
- Faisnéis thráthúil ar an gcomhshaol ar a bhfuil fáil éasca a chur ar fáil chun rannpháirtíocht an phobail a spreagadh sa chinnteoireacht i ndáil leis an gcomhshaol *(m.sh. Timpeall an Tí, léarscáileanna radóin)*.
- Comhairle a chur ar fáil don Rialtas maidir le hábhair a bhaineann leis an tsábháilteacht raideolaíoch agus le cúrsaí práinnfhreagartha.
- Plean Náisiúnta Bainistíochta Dramhaíola Guaisí a fhorbairt chun dramhaíl ghuaiseach a chosc agus a bhainistiú.

Múscailt Feasachta agus Athrú Iompraíochta
- Feasacht chomhshaoil níos fearr a ghiniúint agus dul i bhfeidhm ar athrú iompraíochta dearfach trí thacú le gnóthais, le pobail agus le teaghlaigh a bheith níos éifeachtúla ar acmhainní.
- Tástáil le haghaidh radóin a chur chun cinn i dtithe agus in ionaid oibre, agus gníomhartha leasúcháin a spreagadh nuair is gá.

Bainistíocht agus struchtúr na Gníomhaireachta um Chaomhnú Comhshaoil
Tá an ghníomhaíocht á bainistiú ag Bord lánaimseartha, ar a bhfuil Ard-Stiúrthóir agus cúigear Stiúrthóirí. Déantar an obair ar fud cúig cinn d'Oifigí:
- An Oifig um Inmharthanacht Comhshaoil
- An Oifig Forfheidhmithe i leith cúrsaí Comhshaoil
- An Oifig um Fianaise is Measúnú
- Oifig um Chosaint Radaíochta agus Monatóireachta Comhshaoil
- An Oifig Cumarsáide agus Seirbhísí Corparáideacha

Tá Coiste Comhairleach ag an nGníomhaireacht le cabhrú léi. Tá dáréag comhaltaí air agus tagann siad le chéile go rialta le plé a dhéanamh ar ábhair imní agus le comhairle a chur ar an mBord.

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Reflecting on Adaptation to Climate Change: International Best Practice Review and National MRE and Indicator Development Requirements

Authors: Kathrin Kopke, Evanna Lyons, Ellen MacMahon, Barry O'Dwyer and Jeremy Gault

Identifying Pressures

Preparing human and managed natural systems for the physical impacts of climate change will pose a substantial challenge at sectoral and local levels in Ireland. In particular, vulnerable coastal, fluvial and urban areas must take substantive measures to adapt to an anticipated amplification of climatic extremes, as must key sectors involved in the management, use or distribution of water or natural resources. These challenges provide a clear impetus to develop indicators that can measure adaptation performance, to facilitate the development of robust and resilient adaptation plans and measures. However, perhaps an even greater impetus to do so is provided by global and European moves toward ever-more rigorous monitoring, evaluation and reporting of adaptation progress.

Informing Policy

Member States are at various stages of a process to bring their adaptation processes and reporting procedures into line with those adopted at EU level. Accordingly, adaptation policy in Ireland is moving towards alignment with that advocated at EU level. Developing Irish indicators that can measure the progress of national adaptation processes is supporting EU and UNFCCC requirements for monitoring, evaluation and reporting. This study introduces a draft monitoring, reporting and evaluation (MRE) framework to develop indicators that can measure progress towards adaptation objectives and draws on best practice and guidance from relevant international bodies and EU Member States to identify a set of criteria to facilitate the development of nationally relevant indicators.

Developing Solutions

A suite of draft adaptation indicators was developed based on best practice, nested within the proposed MRE framework, linking to international and national adaption objectives and incorporating sector-specific climate change vulnerabilities. Draft adaptation indicator development concentrated on local authorities and the agriculture and marine and fisheries sectors, which resulted in the identification of 70 draft adaptation indicators. An additional 197 indicators are proposed for other sectors of interest, which are housed within a Microsoft Excel document, the "Draft Adaptation Indicators" table. The table outlines adaptation objectives, indicator type, organisations that may hold relevant data, available data and data gaps, how individual indicators relate to the European scoreboard and how indicators can be aggregated for national-level reporting.

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