

Method selection in adaptation research: the case of the Delta Programme for the Dutch Wadden region

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Abstract Many methods are available to support adaptation planning. Yet there is little guidance on their selection. A recently developed diagnostic framework offers a structured set of criteria to choose research methods for specific adaptation questions. It has been derived from science-driven cases mostly. This paper offers the first application to a policy-driven case. Thus, it aims to (1) assess the descriptive quality of the framework for adaptation planning and (2) reflect on its value in supporting method selection. The paper focuses on the research commissioned for adaptation policymaking by the Dutch Delta Programme in the Wadden region. It compares the research methods used in the Delta Programme with those suggested by the diagnostic framework. It concludes that the selection of methods in the adaptation planning process can be described quite well by the decision trees of the diagnostic framework. Deviations occurred mostly for pragmatic reasons when the selection is informed by practical limitations of the policymaking process, such as available resources, time constraints and experience of the involved experts. It is recommended to enrich the

diagnostic framework with methods from adaptation practice and consult it in climate adaptation studies at an early stage.

Keywords Adaptation research · Method selection · Diagnostic framework · Dutch Wadden region · Delta Programme

Introduction

There is a demand for methods and tools to support adaptation planning. Decision-makers urgently demand reliable science-based information to help them respond to climate change impacts and opportunities for adaptation (Dessai et al. 2004). The linking of science with user needs is a multifaceted problem with no simple solutions (Cash et al. 2006; McNie 2007). Many different tools and methods exist to do problem-oriented adaptation research and provide decision support (e.g. Hallegatte et al. 2012; Ranger et al. 2013; Walker et al. 2012; Wise et al. 2014). Yet which approach is applicable in which situation? To help identify approaches suitable for specific adaptation challenges, the “Diagnostic framework for problem-oriented adaptation research” was developed (Hinkel and Bisaro 2014). The diagnostic framework consists of a series of decision trees and criteria that lead from framing adaptation challenges to possible research methods. Its intended users are researchers and policy analysts, who, confronted with concern about climate change adaptation, wish to select methods appropriate to address the adaptation challenge. The framework has been derived from a number of science-driven cases.

This paper offers the first application to a policy-driven case. Thus, we aim to evaluate the descriptive quality of

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the framework and its value in inspiring method selection in an adaptation policy process. We do so by comparing the adaptation policymaking process in the Dutch Delta Programme for the Wadden region and the decision trees of the diagnostic framework. The Delta Programme is currently elaborated to protect the Netherlands from flooding and to ensure adequate supplies of freshwater in the prospect of climate change (Delta Commissioner 2011). As an example of adaptation policymaking, it offers an attractive case to reflect on tools and methods used in practice. This paper focuses on the knowledge questions of the first 3 years of the policymaking process and the tools and methods used to address these. It will map the policymaking process using the leading questions and decision trees of the diagnostic framework and will reflect on reasons for agreeing with or diverting from the diagnostic framework. It should be stressed that, although methodologically we will follow the steps and decision trees of the diagnostic framework in this paper, the Delta Programme had no knowledge of the diagnostic framework during the policymaking process that we analyse.

Section “[Case description and method](#)” will describe the case study and the application of the diagnostic framework to the case. The analysis of the policymaking process will be presented in “[Results](#)”. Finally, this paper discusses lessons learned from the assessment and conclusions for the diagnostic framework and the adaptation research in the case study.

We observe that method selection in the adaptation planning process of the Dutch Delta Programme can be described quite well by the decision trees of the diagnostic framework. Diversions occur when selecting tools and research methods is motivated by practical limitations of the policymaking process, such as available resources and experience of the involved experts. Methodologically, the Dutch Delta Programme can gain from the diagnostic framework in the identification of adaptation measures.

Case description and method

The assessment in this paper focuses on adaptation policymaking in the Wadden region, as addressed in the Dutch Delta Programme. This section first introduces the Delta Programme, next the Wadden region and finally the research method.

The Delta Programme

In 2007, the Dutch government installed a committee with the request to formulate recommendations on protecting the coast and the low-lying part of the Netherlands against

the consequences of climate change (New Delta Committee 2008). Based upon their advice, an integral policy programme was designed: the Delta Programme. The objective of the Delta Programme is to protect the Netherlands from flooding and to ensure adequate supplies of freshwater for generations ahead (Delta Commissioner 2011). A Ministerial Steering Group chaired by the Prime Minister heads the implementation of the Delta Programme. The political responsibility and coordination of the Delta Programme is in the hands the Ministry of Infrastructure and the Environment. A Delta Commissioner is appointed to oversee the implementation of the Delta Programme. His main responsibility is to prepare an annual report that outlines progress and the steps that will be taken in the year ahead. The report is offered each year to the House of Representatives as part of next year’s national budget. This is the most important moment for parliamentary policymaking, as Members of Parliament can amend the budget to finance-specific plans.

The Delta Programme is organised in ten subprogrammes. Four of these are national subprogrammes, and six are regional subprogrammes. The national subprogramme ‘Delta Act’ started ahead of the other subprogrammes to provide the legal foundation for the Delta Programme, define the mandate of the Delta commissioner and set out the plan for financing the measures to be taken in the Delta Programme. Overseeing a subprogramme is commissioned to a high-level administrative controller, typically a Director General or a Department Director in the responsible Ministry. Together these administrative controllers form the Director General Counsel that prepares the Ministerial Steering Group. The controllers are also responsible for contracting an agent for the implementation, who is typically a civil servant from the national government.

The subprogrammes are supported with guidelines and a general time schedule, offered by the Delta Commissioner and his central staff bureau. The guidelines are gradually becoming available. Beyond this, the subprogrammes operate relatively independent and can design their own subbodies and responsibilities for implementing as well as commissioning research. By November 2009, each subprogramme had prepared its instruction and had put it before the Director General Counsel for approval. National and regional governmental actors cooperate in developing the programme. The involvement of agents from civil society and business in particular is limited (Vreugdenhil and Wijermans 2012). An illustration of the governance architecture of the Delta Programme and its subprogrammes is given in the supplementary material (Figure s1) along with an overview of the terminology of the Delta Programme (Table s1).

The regional study for the Wadden region

The assessment in this paper is carried out for the Dutch Wadden region. The Wadden region is one of the regional subprogrammes of the Delta Programme (Fig. 1). Central in the Wadden region is the Wadden Sea, one of the world's largest tidal areas renowned for its mudflats. It has been on the UNESCO World Heritage List since 2009 for the integrity of the tidal mudflat ecosystem. The Wadden Sea is bordered by barrier islands in the north and the coast of the Dutch mainland in the south. Over 200 km of sea defences protect the islands and main land against the Wadden Sea. To the north of the islands is the North Sea. Here, the primary flood protection consists of dunes and sandy beaches, actively maintained by sand nourishments and dune protection. Recreation and tourism are the most important economic sectors on the islands. In the port areas Groningen Seaports, presently 20 % of energy in the Netherlands is produced. Other activities in the Wadden region are agriculture, fisheries, industry and shipping.

The central goal of the Delta Programme in the Wadden region is to ensure long-term coastal safety (2100) and to establish a monitoring programme for the impact of climate

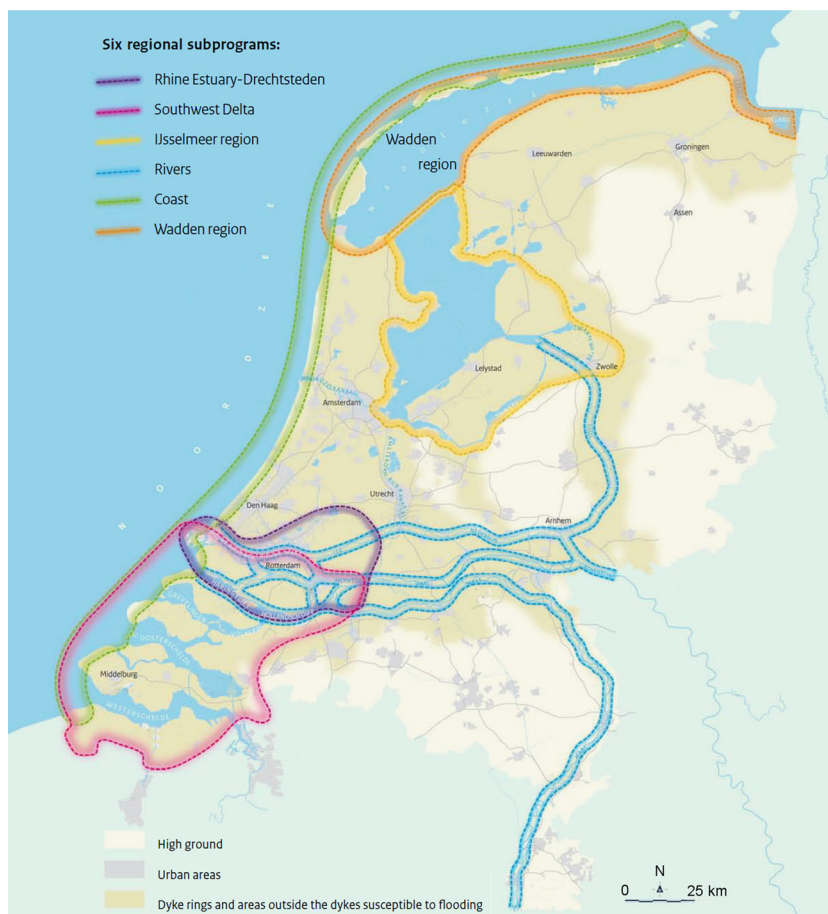
change on the Wadden Sea. Special attention goes out to adaptation strategies based on natural processes that can strengthen ecological resilience in the area and facilitate sustainable human use.

A substantial amount of studies have addressed the possible consequences of climate change for the Wadden area and the economic activities in the region. Regional baseline studies have been carried out for the Delta Programme (Oost et al. 2010), the Quality Status Report Wadden Sea (Oost et al. 2009) and the Wadden Academy (Kabat et al. 2009). The main climate pressures on the Wadden region are projected to be (1) temperature rise, (2) sea level rise, (3) changes in wind and wave climate, including heavier storm surges and wave set-up, and (4) precipitation increase in winter, decrease in summer, with increase in heavy rain showers (van den Hurk et al. 2006; KNMI 2009). Below, we summarise the impacts of climate change of particular relevance to the Delta Programme.

Potential climate change impacts on safety

Sea defences are certified to withstand extreme conditions with probabilities of 1/2000 up to 1/10,000 years

Fig. 1 Regional subprogrammes, including the Wadden region, as defined in the Dutch Delta Programme [source: Delta Commissioner (2011)]



(depending on the values at risk). Climate change is projected to change the probability of extreme events, which may cause dykes to fail flood protection standards. With sea level rise, the Wadden Sea will require more sediment (Kabat et al. 2009; Oost et al. 2009). This is expected to result in increased erosion of the islands and ebb-tidal deltas and additional requests for sand replenishment (Delta Commissioner 2010). In addition, the combination of projected sea level rise, storm occurrence and heavier storm surges can affect channel formation, undermine sea defences and compromise the safety of ports and industry in areas outside the sea defences. Soil subsidence adds to the relative sea level rise (Dobben and Slim 2012; Oost et al. 2010).

Potential climate change impacts on nature

Climate change adds a pressure to the coastal ecosystems that are already stressed by human interventions such as fisheries, nutrient enrichment, contamination and the introduction of non-native species. A key factor is whether natural sedimentation of the mudflats and tidal marshes will keep up with sea level rise or whether they will drown, significantly changing the character of the Wadden Sea. A contributing factor is that at many places, dykes, artificial dune rows and other human intervention limit autonomous adaptation such as sedimentation on the islands and a landward shift of the salt marshes (Dobben and Slim 2012; Oost et al. 2012).

Method: mapping method selection with the diagnostic framework

This study uses the “Diagnostic framework for problem-oriented adaptation research” (Hinkel and Bisaro 2014) to map the selection of research methods in implementing the Delta Programme for the Dutch Wadden region. The diagnostic framework provides decision trees and criteria that aim to guide to methods salient for case-specific adaptation research. In addition, it provides a coherent vocabulary to speak about methodological choices in problem-oriented adaptation research. The framework distinguishes between adaptation challenges researched, methods used and the criteria applied for choosing a particular method. In the operational use of the framework, adaptation challenges are studied by identifying and classifying the research questions that frame the research. Adaptation challenges are further classified according to whether private or public interests are involved and whether individual or collective action is sought for.

In line with the steps typically recognised in the adaptation process in the adaptation literature (e.g. Pahl-Wostl et al. 2007; Willows and Connell 2003), the framework

distinguishes between the three key types of adaptation challenges an actor may face:

1. Identifying adaptation needs;
2. Identifying adaptation measures;
3. Appraising adaptation options.

For each challenge, the framework offers a series of decision trees that map, based on empirical and theoretical criteria, types of adaptation challenges to appropriate research methods. Primarily, the diagnostic framework informs the selection of research methods. However, it does not wish to suggest that policymaking always needs research and, in cases where research is not applicable, the framework points to approaches of practice (e.g. ‘wait and observe’). The supplementary material provides an illustration of the decision trees for the three adaptation challenges (Figure s2). It focuses on the part of the decision trees found relevant for the analysis. For a detailed description of the diagnostic framework and the decision trees, we refer to Hinkel and Bisaro (2014). An interactive version of the diagnostic framework can be found at <http://www.pik-potsdam.de/~wrobel/mediation-platform>.

In this paper, we map research questions and method selection in the Delta Programme onto the decision trees of the diagnostic framework. The mapping is based on literature review of policy documents and background studies produced as part of the policy process, and the interaction with decision-makers and other stakeholder representatives in the context of the Delta Programme for the Wadden region. All authors participated in programme team meetings and consulted in the policy process. In the analysis, we use the English version of policy documents where available. We follow the annual cycle of the Delta Programme and analyse the work done in three consecutive years:

1. Year 1: end 2009–summer 2010. Research in preparation of Delta Programme 2011, which was presented September 2010
2. Year 2: 2010–summer 2011. Research in preparation of Delta Programme 2012, which was presented September 2011
3. Year 3: 2011–summer 2012. Research in preparation of Delta Programme 2013, which was presented September 2012

Note that due to the tight annual cycles, the programming and execution of research is carried out in parallel with decision-making based on the results of the previous year. For example, at the start of the research for Delta Programme 2013, civil servants were working on Delta Programme 2012. This complicates research programming and requires regular harmonisation of research and the decision-making process.

Results

Overview

Figure 2 provides an overview of the adaptation challenges addressed in the first 3 years in the Wadden region. Each step represents a year in the annual cycle of the development in the Delta Programme. The figure shows the evolution of the adaptation challenges to be researched as reported in the annual Delta Programme (Delta Commissioner 2010, 2011, 2012). Thus, it illustrates the stepwise interpretation and reframing of the adaptation challenges. The adaptation challenges evolve, and each year, new research is commissioned accordingly. The research methods selected in the different years are described in consecutive sections.

Step 1—Year 1 of adaptation planning in the Delta Programme

Year 1 focused on the adaptation challenge ‘*what are the effects of climate change on the Wadden Sea and how can the long-term safety of the Wadden region be safeguarded?*’ (Delta Commissioner 2010). Figure 3 illustrates the path through the decision tree in the first year, starting from

the adaptation challenge ‘*Identifying adaptation needs*’ (see also Figure s2).

Year 1 is characterised by scoping and background studies that summarise the available knowledge on the impacts and trends of climate change. This process yielded a long list of reported (potential) impacts (Oost et al. 2010). Faced with the breath of reported impacts in the background studies for the Delta Programme, the programme team felt more focus was needed for the policy process. The team decided to prioritise the impacts for closer study in the Delta Programme for the Wadden region. The prioritisation is based firstly on its direct impact on the central goals of the Delta Programme (here, safety and, to a lesser extent, nature conservation), next on the severity of the impact and its likeliness. The impacts on human use were considered beyond the main scope of the Delta Programme for the Wadden region and are as such not explicitly targeted by adaptation planning or support studies. However, adaptation measures that are considered in the programme are to be evaluated against producing co-benefits for sustainable human use and coping with impacts of climate change on economic sectors in the region. Thus, these sectors will play a role in the assessment in later years.

Methodologically, Year 1 was dominated by literature review and seeking expert opinion. We use the term expert

Fig. 2 Main steps and adaptation challenges researched in the Wadden case study

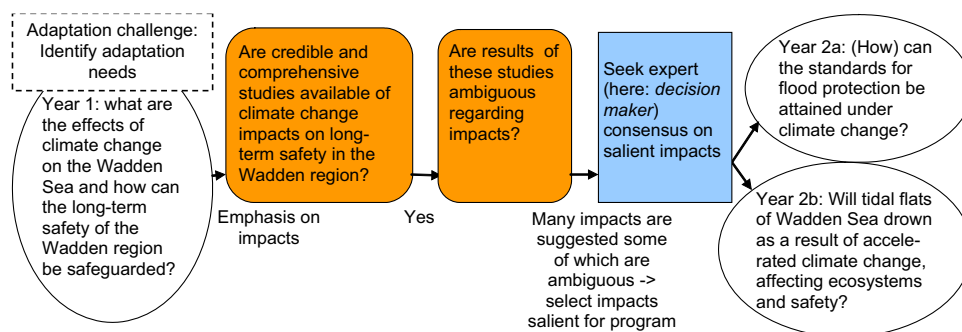
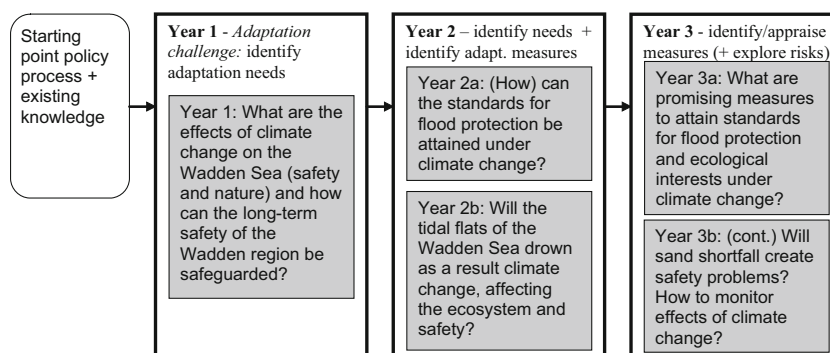


Fig. 3 Analysis of the research undertaken in the first year of the Wadden case study (step 1), following the diagnostic framework. White ellipses indicate adaptation challenges, blue rectangles indicate

methods and approaches, and orange boxes indicate questions that lead from adaptation challenge to methods (colour figure online)

here for individuals who were consulted by the programme team in an advisory role. They can be affiliated with research institutes as well as NGOs or other civil organisations. Traditionally, Dutch ministries had their own in-house knowledge departments. These departments have developed into independent knowledge institutes over the last decades. Yet links remain strong, maintained at least partly by earmarked research budgets. With respect to knowledge development, we observe that the ministries still strongly rely on their ‘own’ institutes and epistemic communities. The members of the programme team predominantly have a background in water- and land-use planning. Few, if any, social scientists are actively involved in the research of the first year, and little social sciences research is commissioned (Werners et al. 2009). This notwithstanding, the Wadden programme team commissioned a stakeholder analysis in Year 1 and discussed the involvement of other parties in the coming years.

Although the Delta Programme deals with long-term climate change adaptation, already the pressure of the annual implementation cycle was felt. The results of the first year include prioritised impacts and a more focussed problem definition for the next year. An important development in the first year was the initiative of the central staff bureau of the Delta Programme to start the co-development of various guidance documents, most significantly on the central values and criteria for the evaluation of adaptation options, on the assessment of adaptation tipping points (te Linde and Jeuken 2011), and on adaptive delta management (van Rhee 2012). Although these guidance documents only became available in the second and third year of the Delta Programme, the guidance and interaction organised by the staff bureau increasingly helped to focus the work towards adaptation policymaking.

Step 2—Year 2 of adaptation planning in the Delta Programme

Shortly after the first Delta Programme report was delivered (at the end of Year 1), the Government Commissioner Kuijken said (Kuijken 2010):

“One of the biggest challenges is dealing with uncertainties in the future climate, but also in population, economy and society. This requires a new way of planning, which we call adaptive delta planning. It seeks to maximise flexibility; keeping options open and avoiding ‘lock-in’. In the meantime, we prepare the so-called delta decisions about the measures to take if our current water system reaches its limits.”

This quote signifies two things: (1) recognition that a new planning approach had to be developed and adopted,

(2) a new framing of the adaptation challenge, focussing on the finitude of the current water management system under climate change. After the first year, the Delta Programme even more clearly saw the need to define its own niche and scope and encouraged the subprogrammes to assess how much longer current policies and management practices were expected to suffice and when adjustments would be required. This relates to the recognition that climate change will become salient for practitioners if it threatens management objectives or results in conditions that society perceives as unacceptable. It presumes that adaptation becomes relevant only if the amount of change is unacceptable or interest can be realised more effectively by alternative management options (Werners et al. 2015).

This focus can directly be seen in the questions for Year 2 in the Wadden Delta Programme: (1) *Can the standards for flood protection be attained under climate change?* and (2) *Will the tidal flats of the Wadden Sea drown over time as a result of accelerated climate change, and what will be the consequences for the ecosystem and safety?* Figure 4 illustrates the path through the decision trees in the second year. Note: The English version of the Delta Programme 2011 uses the term ‘sandbanks’. We consider tidal flats a more helpful translation. We will therefore use the latter term in this paper.

In terms of the decision trees (Hinkel and Bisaro 2014), the Delta Programme in Year 2 started with another cycle of research at the adaptation challenge ‘*Identifying adaptation needs*’. The same decision tree was followed. What was new is that at this stage, there was more focus in the research questions as well as in the guidance provided by the central staff bureau. Quick scans were carried out for eight core themes to assess available knowledge and knowledge gaps to be addressed in decision support studies. Significantly, the delta scenarios had become available (Bruggeman et al. 2011), which changed the situation compared to the previous year as it facilitated agreement on the range of future impacts to be considered.

In the second year, the programme team of the Wadden region intensified the work on adaptation measures. Adaptation measures had been addressed in general terms before, yet only in the second year were they explicitly researched. This is in line with the diagnostic framework and the suggested progress to the second and third adaptation challenge ‘*Identify adaptation measures*’ and ‘*Appraise adaptation options*’. The Delta Programme focuses mostly on collective public action of national and regional authorities. It is the objective of the Delta Programme to consider a number of strategic alternatives and make decisions at a more strategic level. It will leave detailed implementation to the regular water management policy process. The options that were identified in the second year therefore are broad alternatives, rather than specific

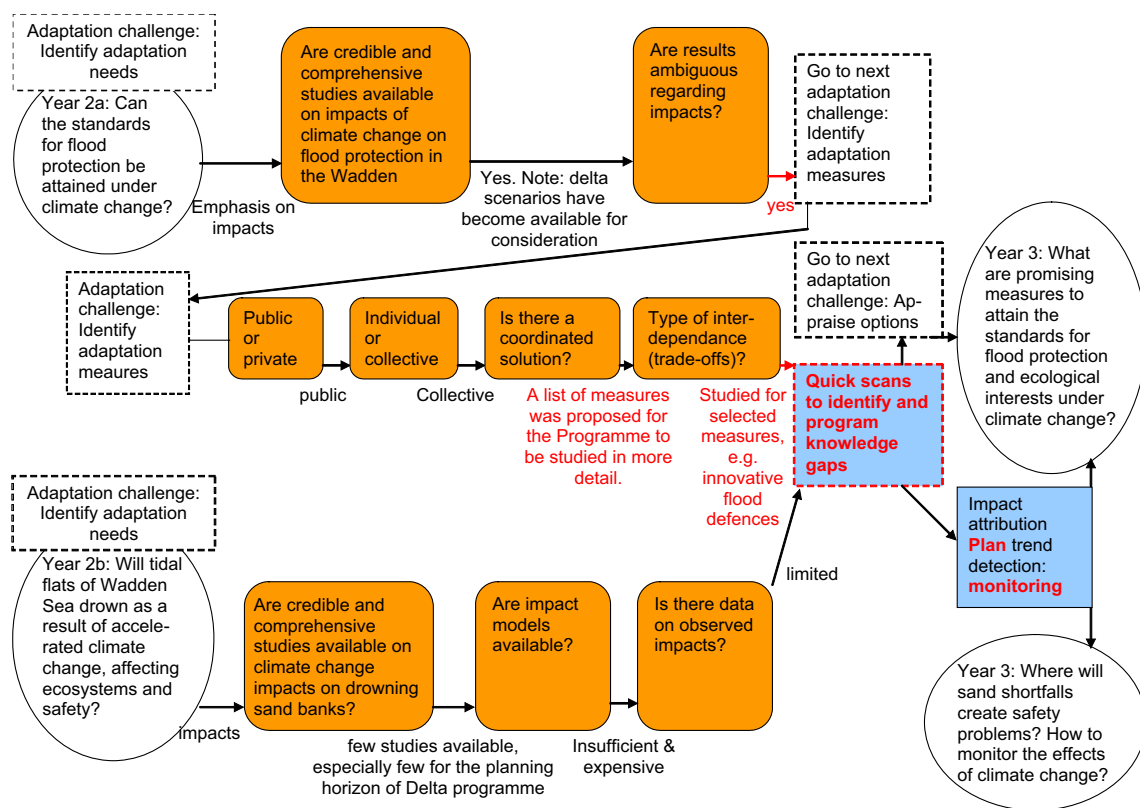


Fig. 4 Analysis of the research undertaken in the second year of the Wadden case study (step 2), following the diagnostic framework. White ellipses indicate adaptation challenges, blue rectangles indicate

methods and approaches, and orange boxes indicate questions that lead from adaptation challenge to methods. Red text indicates a derivation from the framework (colour figure online)

measures. For example, ‘innovative flood defences’ were identified as possible adaptation measure for the Wadden area (see Table s1 for terminology). The potential of this measure was to be studied in coming years.

The second year saw increased involvement of the central staff, encouraging coordination and harmonisation across subprogrammes. Involvement ranges from comparison of research agendas, the development of guidance documents (e.g. te Linde and Jeuken 2011), the harmonisation of terminology and providing central facilities for hydrological model calculations and cost assessments. In addition, knowledge-sharing systems were tested to improve transparency and credibility of the work. Finally, in parallel with studying alternatives, the central staff bureau facilitated the development of criteria for comparison of alternatives.

Although the assessments in Year 1 and 2 showed that climate change is expected to compromise current policy objectives and stakes in the Wadden region in the coming century, the seriousness and timing of impacts remained largely uncertain. Therefore, the Delta Programme has decided at an early stage to augment possible adaptation options with setting up a monitoring programme with the specific objective of early warning of impacts of climate

change and impacts thresholds in particular. Monitoring is seen as an appropriate intermediate adaptation strategy given both the uncertainties and the potential severity of impacts.

For the monitoring programme and to improve system understanding, cooperation was sought with the other Wadden States Germany and Denmark. This required the Wadden region Delta Programme to build in sufficient flexibility to react on new insights. An example is the finding in the second year that the ebb-tidal deltas could erode and compromise the sustainability of the barrier islands and perhaps the tidal flats. This sparked discussions on the necessity and piloting of large-scale sand nourishments in the deltas.

The pressure of the annual implementation cycle was felt even stronger than in the first year. This influenced method selection. For example, more fundamental studies of system behaviour that would take several years were rejected. Interaction with the steering group of the subprogramme as well as the staff of the Delta Commissioner co-determined the pace and emphasis of the research questions. In particular, the Wadden region steering group commented that more attention should be paid to the social and economic consequences (also at a national level) of a failure in energy

production and distribution in the northern part of the Netherlands in the case of flooding. Secondly, when assessments showed different flood patterns than the region so far expected, these calculations had to be rechecked.

A re-routing of the diagnostic framework's decision trees in the Wadden region was eight quick scans to tap into available knowledge, to share ideas and define knowledge gaps. The results of the quick scans were reviewed by an independent academic body [the Wadden Academy of the Royal Netherlands Academy of Arts and Sciences (KNAW)]. The quick scans can be seen as an exploratory extra loop through the decision trees to detail the adaptation challenge and research questions based on available knowledge and actor inputs.

A diversion of the decision trees was the lack of use of methods to identify and co-develop measures. A list of measures was proposed by the programme team, mostly based on existing information. More in general, the involvement of stakeholders deteriorated. As tasks and responsibilities were not clearly defined, parties retreated. In Year 2, the programme was in effect coordinated by governmental organisations (i.e. state, provinces, municipalities and water boards) who occasionally consulted other parties.

Step 3—Year 3 of adaptation planning in the Delta Programme

The guidance on adaptive delta management that had been announced in the second year became progressively clear in Year 3 (van Rhee 2012). This provided a comprehensive, yet unbinding, timeline for the subprogrammes (see Fig. 1 in van Rhee (2012) or Figure s3 in the supplementary material for an English version) and guiding principles for policymaking (Delta Commissioner 2012; van Rhee 2012):

- Linking short-term decisions with long-term planning around flood risk management and freshwater, taking into account uncertainties in climate and socio-economic scenarios;
- Working with adaptation pathways that consist of multiple strategies that can be alternated between, actively timing decisions and using windows of opportunity;
- Identify and appraise flexibility in adaptation options and pathways, e.g. possibilities for speeding up/slowing down or stepwise implementation of an option depending on observed change and new information;
- Actively investigate and appraise opportunities to link investment agendas of public and private parties to capitalise on synergies and innovative investment schemes.

For the Wadden region, the implications of these key points are a renewed interest in involving private parties in Year 3.

In line with Figure s3, the questions to be addressed in the Wadden Delta Programme in Year 3 are: *What are promising measures to attain the standards for flood protection and ecological interests under climate change? Where will sand shortfalls create safety problems? How to monitor effects of climate change?* Figure 5 illustrates the path through the decision trees in the third year.

Year 3 focussed on detailing and appraising adaptation measures and strategies. At the same time, discussions on system knowledge and the appreciation of the current safety challenge continued. The programme team reorganised the research agenda, making research on options one of the three research clusters to be addressed (next to 'safety task' and 'system knowledge and monitoring').

Adaptation measures were clustered to yield strategic alternatives to be progressively implemented, depending on the speed of climate change and in particular sea level rise. This resulted in four possible strategies for the Wadden region (Delta Commissioner 2012):

1. *Continuing the current strategy* sand replenishments and improving dykes and hydraulic structures;
2. *Prevention plus* linking the current prevention strategy to ecological and other objectives and ambitions (e.g. by developing innovative flood defences and using natural processes);
3. *System interventions* large-scale interventions, such as additional sand replenishments along the North Sea coast if the current or prevention plus strategy does not sufficiently counter the 'drowning' of mudflats in the Wadden Sea;
4. *Investments in spatial organisation and disaster management (multi-layer safety)*. Preventing casualties and damage in the case of a flood.

Adaptation strategy 4 was reintroduced on the adaptation agenda at the explicit request of the Delta Commissioner. Within each strategy, different adaptation measures were studied in more detail, often accompanied by stakeholder consultation. A prominent example is the research on innovative flood defences.

To assess the potential of innovative flood defence as an adaptation measure, the Delta Programme Wadden Sea initiated in Year 3 an explorative study. This study first made an overview of existing and potential embankment concepts in the Netherlands. Next, promising options were identified per location in close collaboration with the water boards. Examples are over-topping-resistant broad dykes and dykes combined with salt marshes (van Loon-Steensma et al. 2014). As a follow-up of the explorative study, in Year 3 (continuing in Year 4), a detailed study of the

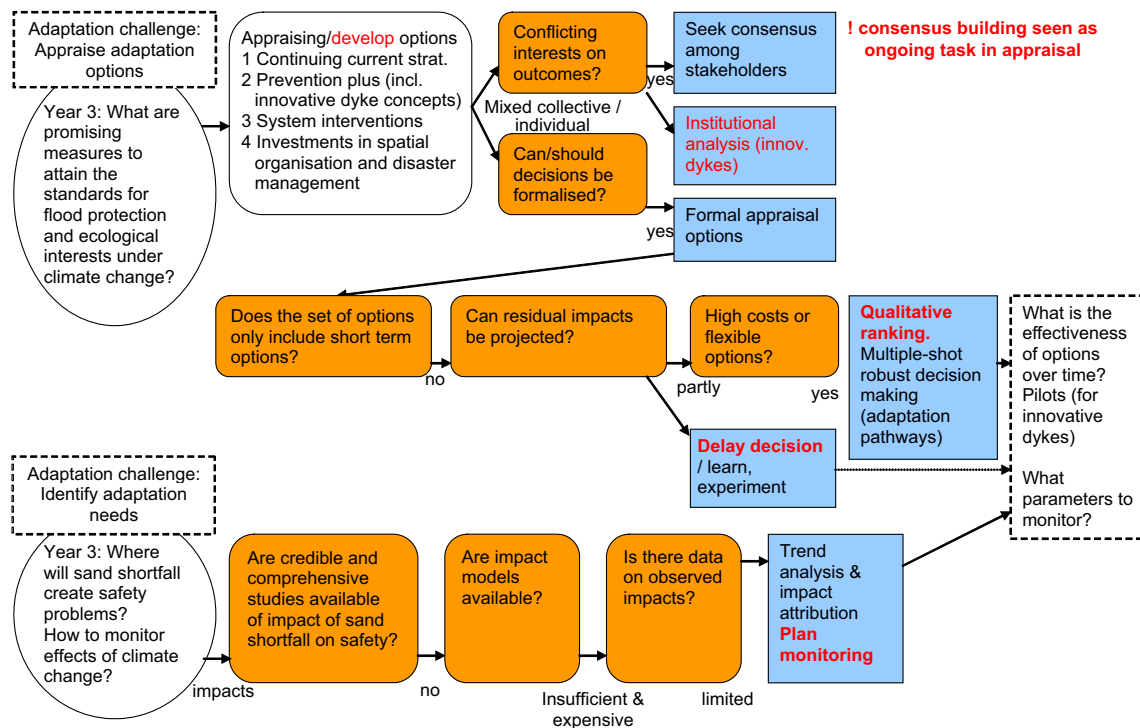


Fig. 5 Analysis of the research undertaken in the third year of the Wadden case study (step 3), following the diagnostic framework. White ellipses indicate adaptation challenges, blue rectangles indicate

methods and approaches, and orange boxes indicate questions that lead from adaptation challenge to methods. Red text indicates a derivation from the framework (colour figure online)

potential of innovative flood defence was made for two pilot locations (Lauwersoog and along the Dollard). The aim of these pilot studies was to get more insight into chances and constraints to contribute to (inter)national agreed targets, local aspirations, and into new opportunities for combining functions. In cooperation with local stakeholders, criteria were selected, making use of the assessment framework provided by the Delta Programme. The broad criteria are safety, opportunities for other values and functions, costs, feasibility and trade-offs. Potential flood defence options were assessed against these criteria resulting in the identification of a subset of promising dyke concepts to be included in the decision-making process. The pilots delivered qualitative information about site specific nature, landscape or economic values and views of local stakeholders, along with quantitative modelling studies of safety performance and spatial consequences of different dyke concepts (Schelfhout et al. 2012; Smale and Hoonhout 2012). This quantitative information was felt a prerequisite for cost-benefit or a multi-criteria analysis.

Reflecting on the methods suggested by the diagnostic framework, we observe that consensus building was not addressed explicitly but considered an implicit result of the appraisal process. In the appraisal, the criteria provided by the central Delta Programme were used (including costs). Felt missing from the diagnostic framework are methods

for the identification of criteria that are specific for climate change adaptation, such as flexibility and robustness. The largest deviation from the decision trees is that the strategies were mostly appraised qualitatively rather than quantitatively. Time and financial restrictions played a major role in the selection of methods.

Discussion

In this paper, we compared the adaptation policymaking process of the Dutch Delta Programme for the Wadden region and the decision trees of the diagnostic framework (Hinkel and Bisaro 2014). Here, we discuss our results by reflecting firstly on the descriptive quality of the diagnostic framework, secondly on its value for inspiring method selection and thirdly on the lessons learned from the analysis.

Descriptive quality of the diagnostic framework

We observe that the decision trees of the diagnostic framework match quite well the selection of methods in the Dutch Delta Programme in the Wadden region. Contributing to this is that both the Delta Programme and the diagnostic framework are organised along the

characteristic steps in adaptation planning (e.g. Pahl-Wostl et al. 2007; Walker et al. 2012; Willows and Connell 2003).

Deviations occur firstly where the Delta Programme uses methods that do not appear in the diagnostic framework. As the diagnostic framework is work in progress and as such open to including new methods, these deviations are in principle not limiting for the descriptive quality.

Secondly deviations occur for pragmatic reasons, such as availability of resources, time pressure and experience of the involved experts. Also, strategies were found to be dropped at an early stage for political reasons rather than formal appraisal criteria. Similarly, strategies can be reintroduced on the adaptation agenda at the explicit intervention of actors. The decision trees do not account for 'power play'. Also, the timing of methods and results can be a crucial factor in the outcome of the decision-making process that is not recognised in the diagnostic framework. Both tactics of delay and time pressure resulting from the Delta Programme agenda were observed. So far, the developers of the diagnostic framework choose to exclude pragmatic criteria for method selection. This is found to limit the descriptive quality of the diagnostic framework yet may be conducive for inspiring method selection.

Value for inspiring method selection

Comparing the Delta Programme and the diagnostic framework, we observe deviations where the use of the diagnostic framework in method selection could have inspired the Delta Programme. For example, the diagnostic framework puts consensus building earlier in the process. This could have been beneficial for the Delta Programme as the stakeholders in the Delta Programme differ from those involved in the regular water management process in the Netherlands. Also, the diagnostic framework supports method selection for the identification of measures, which could have enriched the Delta Programme.

The Delta Programme clearly experienced that adaptation required new methods to be developed. Procedural methods in particular were felt to be missing. An overarching planning method (adaptive delta management) was proposed that outlines the planning process and relies on identifying strategic alternatives, innovation and adaptation pathways, rather than detailed measures. Such overarching approaches are currently missing from the diagnostic framework. In addition, some more specific methods that the Delta Programme required cannot be found in the diagnostic framework. Examples are methods to organise the governance architecture, to develop a research agenda, select goals and define criteria across different entities in the planning process. The value of the diagnostic framework to inspire method selection could be strengthened by

including selection criteria and methods that address the planning of the adaptation process itself.

Lessons from the analysis for the diagnostic framework

The analysis identified methods used in the Delta Programme that could be included in the diagnostic framework. These include:

- Pilot studies and projects that champion location-specific adaptation options. Pilots recognise that the applicability and effects of many more-innovative adaptation options are largely uncertain. Pilot studies proved particularly successful in capturing the interest of regional parties.
- Identification of the mandate of a policymaking process in terms of potential failure of existing policy due to climate change.
- More gradual appraisal of adaptation alternatives, zooming in from potential to promising measures, and next to preferred alternatives in the course of a number of years, before final selection.
- Early stakeholder analysis to inform the architecture of the planning process.

In addition, the application of the diagnostic framework to a policy-driven case yields more procedural insights that the framework could benefit from. Firstly, what we see is that often, an adaptation challenge requires several iterations of research and refinement before sufficient progress is made to move to another adaptation challenges, e.g. before risks are understood and shared sufficiently to be able to start the identification of measures. Contested information, which is overstepped, can be used by parties to block the policy-making process in a later stage. Whether existing studies satisfy the requirements of the policymaking process could be made more explicit in the framework, for example, by asking whether outcomes are perceived credible, legitimate, actionable, and salient (c.f. Cash et al. 2006; Lempert 2013). The iterations could also be conducive to align frames (c.f. Vink et al. 2013), a process which the diagnostic framework could aim to call attention to.

What we also see is that research results were used in other policy processes. Regional parties in particular are keen to understand the relative importance of the many policy processes that they are involved in. The importance of links to other policy processes may suggest that the diagnostic framework could benefit from early explicit consideration of the existing policy structure within which adaptation has to play out. This includes a reorientation on the impacts of climate change on existing (water) management objectives. This conforms recent studies that have suggested that adaptation research should start from the

adaptation problem in its decision context of socio-economic challenges in order to satisfy information needs of policymakers in the face of long-term planning under uncertainty (Kwadijk et al. 2010; Ranger et al. 2013; Reeder and Ranger 2011). A reorientation would also be useful in cases where adaptation is to be integrated in existing policies.

Finally, the question *who* will be asked to carry out research could be addressed in the diagnostic framework. In the commissioning of research for the Delta Programme for the Wadden region, familiar knowledge institutes and experts dominate. In other policy implementation processes, open tenders for decision support research have resulted in a new interdisciplinary research community and the creation of new evidence for innovative water safety alternatives (e.g. Werners et al. 2010).

Summarising, we feel that addressing in the diagnostic framework, whether outcomes of research methods satisfy the requirements and dynamics of the policymaking process could help navigate trade-offs between acting as a research protocol and delivering adaptation action on the ground.

Conclusions

We observe that the use of methods in the adaptation planning process of the Delta Programme for the Wadden region can be described quite well by the decision trees of the diagnostic framework. Deviations occurred mostly for pragmatic reasons when the selection of tools is informed by practical limitations of the decision-making process, such as available resources and experience of the involved experts.

The diagnostic framework has been derived from science-driven cases. This paper offers the first application to a policy-driven case. The experience is promising and offers opportunities for mutual learning. Methods to be included in the diagnostic framework are pilot studies and methods to organise the governance of adaptation. It is felt that the Delta Programme for the Wadden region would have benefited from using the decision trees in the diagnostic framework had they been available at the start of the Delta Programme. For example, in case of the Delta Programme, application of the diagnostic framework would have broadened the identification of measures and encouraged consensus building. It is recommended for climate adaptation studies to consult the diagnostic framework at an early stage.

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