Adaptive Delta Management,

the Delta Program in a balancing act between traditional and adaptive approaches

Regional dilemmas for the Wadden region sub-program

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"*As soon as complexity is explicitly being considered in decision making, the feasibility and applicability of long-term planning will decline. The only question is whether to accept this complexity or not. In case complexity is not embraced in decision making processes, decision makers will turn out to become Don Quixote fighting windmills, they won't succeed*."

– Govert Geldof (2012)

Preface and Acknowledgements

Ever since I started working on my bachelor thesis research on the possibilities of structurally integrating adaptation to climate change into Dutch institutional planning frameworks, I observed obstacles in successfully turning adaptation theory and policies into practice. Especially local and regional governments seem to struggle with policy directives on how to create and implement more climate-proof and sustainable spatial strategies. The observation of this classical paradox of planning made me want to know more about the struggle of implementing long-term adaptation policies and find out about possibilities to overcome this apparent deadlock in the worldwide evolution of spatial adaptation policy. The *Delta Program* forms an ideal case for further exploring this phenomenon, as this Dutch governmental program has developed an *Adaptive Delta Management* approach that has been specially designed to cope with the uncertainties and complexities of managing policy development and implementation in the context of climate change. The fact that the Delta Program is made up of sub-programs gave me the opportunity to pick a regional sub-program and dive into the specific dilemmas it encounters in working with this new approach. A number of interviews within this national program and the sub-program Wadden region have opened up a whole new world of complex decision making for me, which made my job of writing a well-structured scientific thesis a great and in the end also satisfying challenge. I am really fulfilled with the final result and my graduation after a great study period at the Rijksuniversiteit Groningen.

I would like to like to use this opportunity to express my gratitude to the people who have taken the time and effort to contribute to the completion of this research. In the first place I would like to thank all interview respondents for their time and efforts in giving me more insight into the organizational struggles within current Dutch water management in general and in the Delta Program and Wadden region sub-program in particular. I would like to thank (in alphabetical order) Pieter den Besten, Pieter Bloemen, Kees van Es, Govert Geldof, Siep Groen, Floris Hammer, Rick Hoeksema and Kees de Jong. Further thanks go out to my supervisors Margo van den Brink and Terry van Dijk, who have played an invaluable role in the completion of this research. Their constructive criticism and further academic support have contributed in overcoming my personal struggles in writing this thesis. It has been a long and sometimes frustrating research process, but they have kept me on track for which I am very grateful. Finally I want to thank my girlfriend Maya for her understanding and patience over the last months, your moral support has definitely helped me trough. I also want to thank my sister and my parents for their interest and above all support during the five years of my studies and for giving me the opportunity to develop myself intellectually. It is unfortunate that my beloved grandmother could not live to see my graduation and it is to her I want to dedicate this undertaking.

Luitzen Jager

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Abstract

With the adverse effects of climate change increasingly starting to show, the need for spatial strategies to contest climate change is increasing. Obviously this means that, in spite of profound and partially irreducible uncertainties and complexities around climate change, still important policy decisions have to be made. This research takes a closer look at the contribution of adaptive management approaches in developing long-term adaptation strategies. Adaptive management, unlike traditional management approaches, allows complex processes to proceed despite structural uncertainty and aims at reducing this uncertainty through a systematic though flexible process for learning and adjustment in decision making processes. This research takes a closer look at the Delta Program, a Dutch governmental program that works on spatial adaptation strategies to prepare for long-term climate change effects. In this program the greatest challenge is to deal with the uncertainties and complexities in future climatic, economic and societal change, which led to the development of the Adaptive Delta Management concept, a policy tool meant to improve the ability to cope with these factors in adaptation processes and increase adaptive capacity, by using short-term measures that are in line with long-term objectives. The implementation of this concept takes place in a number of regional sub-programs, of which in this research a closer look is taken at the Wadden region sub-program that has to deal with specific long-term water safety tasks in a complex ecological system and fragmented regional decision making arena. Specific attention is paid to the dilemmas this sub-program runs into in setting up adaptive regional water safety strategies in a region with specific contextual dynamics. It turns out the Wadden region sub-program struggles with many dilemmas in linking up with regional ambitions, setting up adaptive governance structures and creating coherence within the program, which are mainly the result of prevailing traditional policy and decision making regimes that hamper the introduction of adaptiveness in this process. This research shows that the role of adaptiveness in complex decision making, based on the Adaptive Delta Management concept, requires serious contemplation in program organizations, regional decision making as well as institutional frameworks to increase its applicability in various regional contexts.

Key words: ***adaptive governance, adaptive management, adaptiveness, adaptive planning, climate change, complexity, flexible decision making, spatial planning, strategic decision making, uncertainty, water management***

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List of Abbreviations

ADM	Adaptive Delta Management
EL&I	Ministry of Economic Affairs, Agriculture & Innovation (in Dutch: Economische Zaken, Landbouw & Innovatie)
GHG	Greenhouse Gas
IPCC	International Panel on Climate Change
I&M	Ministry of Infrastructure & the Environment (in Dutch: Infrastructuur & Milieu)
KNMI	Royal Netherlands Meteorological Institute (in Dutch: Koninklijk Nederlands Meteorologisch Instituut)
MIRT	Multi-Year Program for Infrastructure, Spatial Planning and Transport (in Dutch: Meerjarenprogramma Infrastructuur, Ruimte & Transport)
NWP	National Water Plan (in Dutch: Nationaal Waterplan)
PKB	Key Planning Decision (in Dutch: Planologische Kernbeslissing)
VROM	Ministry of Housing, Spatial Planning & the Environment (in Dutch: Volkshuisvesting, Ruimtelijke Ordening & Milieu)
V&W	Ministry of Transport, Public Works & Water Management (in Dutch: Verkeer & Waterstaat)
WRO	Spatial Planning Act (in Dutch: Wet Ruimtelijke Ordening)
Wro	New Spatial Planning Act (in Dutch: Nieuwe Wet Ruimtelijke Ordening)

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Chapter 1 – **Introduction**

1.1 Difficulties in developing adaptation strategies

Ever since the effects of climate change have become dangerously apparent, international efforts have focused predominantly on *mitigation* initiatives, aimed at reducing greenhouse gas (GHG) emissions and thereby preventing further climate change from happening in the future (Burton *et al*., 2006). However, to be successful this approach requires active participation and cooperation of major GHG emitters worldwide and a strong sense of international awareness in order to achieve international objectives, since climate change is a phenomenon that is not restricted by administrative and national borders. Besides that, mitigation efforts will only become effective over very long time periods (Klein *et al*., 2007). The monitoring of the effectiveness of mitigation strategies has led to the recognition that despite all efforts, progress on the reduction of GHG emissions is not sufficient to prevent further climate change from happening in the near future and avoid devastating impacts of climate change in the coming century (Biesbroek *et al*., 2009a). From that moment on it was widely acknowledged that policies based on mitigation measures do not sufficiently reduce climate change related risks in time to avoid serious spatial consequences in countries prone to the effects of climatic change (see for example EC, 2009; IPCC, 2007), and so the search for new ways to deal more rapidly and effectively with the effects of climate change has increased.

As a result beyond, or in addition to mitigation efforts, incorporating *adaptation* initiatives into spatial planning practices and policies to deal with these inevitable effects of climate change becomes evident (Laukkonen *et al*., 2009), which Smith (1997: 252) expresses by stating that "*if climate change is inevitable, adaptation to its effects is also inevitable.*" It became clear that the next stage of the international climate effort must deal forthright with *adaptation*, since coping with potentially devastating impacts simply cannot be avoided (Burton *et al*., 2006). Adaptation in the context of climate change refers to any adjustment that takes place in natural or human systems in response to actual or expected impacts of climate change, aimed at reducing vulnerability to changing circumstances (IPCC, 2007). These measures can range from institutional, social, financial, organizational, to spatial interventions in order to be better able to cope with possible future effects of climate change. However, unlike mitigation, the potential of adaptation is often perceived to be limited for many systems, mainly since the effectiveness of adaptation to climate change depends on the accuracy of regional climate and impact projections, which are subject to substantial uncertainty and complexity (Füssel, 2007). As a result, adaptation is often referred to as a fuzzy policy problem that is unstructured and highly complex as it is rooted in different societal domains, takes place at a variety of levels and involves various actors in decision making with dissimilar perspectives, norms and values (Loorbach, 2010). All these factors displaying the characteristics of a *complex problem*, suggest that simple disciplinary solutions will not suffice in climate change adaptation.

Therefore, the process of mainstreaming adaptation into everyday planning and decision making, and developing long-term strategic adaptation policies appears to be easier said than done. It might sound

obvious that predictions based on climate projections simply call for a reduction of vulnerability and an increase of resilience to adapt to and cope with the dynamic future that lies ahead. But climatic changes are usually covered in great uncertainty, change and surprise which hinder detailed predictions of possible effects. This situation makes the development of strategic adaptation policies a highly complex challenge. The *traditional approach* of developing and managing spatial climate strategies consists of linear development paths towards normative, pre-set goals. This traditional model is based on the idea that strategies are implemented by a deliberate and intentional planning process (Wiechmann, 2007). However, in the face of the uncertainty and complexity of climate change, the use of such traditional management regimes may be questioned (see for example Tompkins & Adger, 2005; Jagers & Duus-Otterström, 2008; Charlesworth & Okereke, 2010). Besides practical problems using traditional management approaches in the complexity of adaptation decision making, these approaches do not seem to be satisfactory in addressing the uncertainty of potential long-term impacts of climate change (Davoudi *et al*., 2009; Biesbroek *et al*., 2009a). Nevertheless, adaptation has been recognized as a priority area for national and international policy initiatives as the Fourth Assessment Report of the *Intergovernmental Panel on Climate Change* (IPCC) (IPCC, 2007) has reemphasized the urgency of setting up adaptation policy frameworks to cope with climate change effects. Therefore, many countries worldwide are currently preparing or have yet established national adaptation strategies to structure long-term responses to climate change (Swart *et al*., 2009).

This situation has resulted in a paradox that emerged in planning and the process of setting up adaptation strategies. Spatial planning has acknowledged the need to think further ahead ever since the 1960s, the time in which thinking of possible future developments in terms of scenarios was introduced. However, over the years planning has also become a predominantly communicative undertaking in which long-term thinking seems to have faded into the background in favor of short-term interests (Voogd & De Roo, 2004). Besides this *communicative turn* in planning, *political rationality* is another phenomenon that contributes to this paradox in planning by placing short-term interests in short four or five year political terms in favor of long-term sustainable development. This *political rationality* is strongly conflicting with *scientific rationality*, as science generally prescribes to look further ahead for more sustainable developments in the face of climate change and will therefore hamper the introduction and the process of mainstreaming long-term adaptation strategies even further (Biesbroek *et al*., 2009b). In short, traditional planning approaches do not offer what climate change requires in terms of management characteristics. The use of these approaches leads to problems in covering the uncertainty that climate change entails and lacks the flexibility that is needed for addressing complex climate risks and insights in an effective and sustainable way. This poses a persistent paradox in modern days' strategic spatial planning in the face of uncertainty. Bulkeley (2006: 203) expresses this paradox in planning as "*spatial planning might seem to have both everything to do with climate protection … and at the same time little to offer in terms of pragmatic solutions.*" As a result, short-term action is usually omitted, which might confine chances for finding flexible and efficient solutions that ensure a better structural preparedness for long-term climate change.

In response, numerous concepts and management approaches have emerged, such as interactive network, process and governance approaches. However, dealing with persistent complexity in the long run will require an approach that gives special long-term attention to learning, interaction, integration and experimentation to sufficiently respond to the unpredictabilities of climate change (Loorbach, 2010). Therefore, flexible approaches are required that are able to adapt to both anticipated as well as to unanticipated conditions in which iterative processes of learning and continuous updating of policy initiatives and objectives remains possible. Such innovative approaches are often referred to as *adaptive management*, which differs from traditional management in that it allows management to proceed despite uncertainty regarding how best to achieve desired outcomes. Actually, adaptive management specifically embraces such uncertainty and complexity and provides learning processes characterized by using outcomes for management adjustment (Murray & Marmorek, 2003). In theory, adaptive approaches are meant to increase adaptive capacity and make spatial planning processes more flexible and therefore better able to cope with long-term complexity and uncertainty. The key challenge is to develop adaptive strategies that are useful in a changing and uncertain future, but at the same time also lead to decisive action (Wiechmann, 2007). However, it appears that many recent adaptation strategies are not fully taking advantage of the available options adaptive approaches have to offer and therefore usually not perform as intended, since many factors hamper their implementation and performance that can lead to complex dilemmas in adaptation strategy development and implementation. In scientific literature these obstructing factors are being referred to as *barriers* (see for example Biesbroek *et al*., 2009b; Biesbroek *et al*., 2011), *limits* (see for example Hulme *et al*., 2007; Adger *et al*., 2009), *constraints* (see for example Inderberg & Eikeland, 2009) or *challenges* (see for example Fünfgeld, 2010). Although these obstructing factors are very diverse by nature, they are all likely to lead to dilemmas in the development of long-term adaptation programs and strategies. Based on these two strongly differing approaches and the possible dilemmas in adaptation processes emerging from relying on either of the two, Wiechmann (2007) considers traditional planning and adaptive planning as the superior principal paradox of strategic spatial policy development. This paradox leads to a challenge for strategic spatial planning practice to strike a balance between the decisiveness of the traditional approach and the flexibility of the adaptive approach, while taking into account the context, content and process of a specific spatial setting.

1.2 Problem statement and central research objective

This research has a specific focus on the Netherlands, a country prone to the effects of climate change that is currently working on the development and implementation of the *Delta Program* (in Dutch: Deltaprogramma), an intergovernmental program working on sustainable long-term water safety, fresh water supply and spatial adaptation in the face of climate change. This program has been included as a case study for this research mainly since one of its primary objectives is to develop a long-term adaptation strategy for the Netherlands. Within the Delta Program a new management approach has been introduced that offers new perspectives on approaching uncertainties and complexities in managing the development of adaptation strategies in a more flexible way. This new management approach, as developed by the national Delta Program, has been titled *Adaptive Delta*

Management (hereafter ADM) and is based on, as the name suggests, principles from adaptive management theory. After the introduction of ADM, this adaptive approach was quickly hailed as an essential breakthrough in Dutch water management and long-term adaptation policy development in making sustainable progress in climate-proofing the Netherlands by dealing flexibly with uncertainties and changing predictions. It is this transition in water management from traditional planning approaches towards this new approach built on adaptiveness principles that is of main interest to this research as it might use some fundamental contemplation, since many obstructions appear in the process of adaptation strategy development which may be stagnant in the broad-scale implementation of this adaptive policy concept in long-term planning (Biesbroek *et al*., 2011).

Despite the theoretical advantages of adaptive management it is interesting to take a closer look at the practical value of ADM in regional decision making, especially because the transition from traditional to adaptive approaches in water management practice turns out to be a challenge of balancing between the aspects of both approaches in Dutch water safety planning and adaptive principles of ADM. Therefore this research will take a closer look at the way in which the nationally developed ADM approach is given form in practice and is being translated into the Wadden region sub-program, one of six regional Delta sub-programs working on a specific regional water safety strategy. The way in which the ADM concept is being applied in regional decision making processes will be studied to be able to comment on the actual role of adaptiveness in this process and the role of the principal paradox of strategic spatial policy development in guaranteeing both flexibility and decisiveness in policy development in the Delta Program. How adaptive is the ADM concept actually in practice, when set against the intended benefits at the national level? In this task, a closer look will be taken at the barriers and dilemmas the Wadden region struggles with after the introduction of this radically new adaptive policy concept in long-term water safety planning. This has led to the following central research question that forms the foundation of this research:

To what extent has the establishment of the Adaptive Delta Management concept contributed to the development of adaptation strategies in the Delta Program?

It will be clear this research has its focus on the way in which climate related risks are governed in the Netherlands based on Delta Program frameworks, concepts and insights. Because there seem to be many issues in implementing adaptive ideas into established spatial planning practice, this research focuses on the methodical discussion on the possible value of adaptive management at both the theoretical and empirical level. In this discussion, analyzing the ADM concept will be used to reflect on the adaptiveness of long-term planning and decision making in the Delta Program. The use of this policy management scope will be helpful to gain insight into current spatial planning practice and the ways in which the uncertainty and complexity inherently linked to climate change is being addressed in strategic policy making. Despite the fact that Dutch adaptation policy initiatives will be reviewed in a fairly detailed way, the research is not meant to be a prescription on how the adaptive management principle should be given substance in water management in different countries around the world or in

the Netherlands in particular. Instead the main research objective is to look for struggles in the implementation of ADM principles in addressing climate change in spatial planning in the Delta Program in general and in the Wadden region sub-program in particular, which might eventually contribute to the improvement and practical applicability of this approach.

1.3 Theoretical approach

In order to gain more insight into the current state of knowledge and to be able to make well-founded statements on the subject of using adaptive approaches in managing adaptation processes, the theoretical framework in **Chapter 2**, forms an important foundation for further argumentation in the empirical analysis section of this thesis reflecting on the Delta Program and the ADM concept. Thorough literature review has been done in both dated and more recent scientific work on firstly the characteristics of managing adaptation processes, secondly adaptive ways of managing complex policy issues and thirdly barriers that may lead to dilemmas in adaptation and therefore possibly obstruct these processes. It has been a deliberate decision to include these three main subjects in the theoretical framework as they will also form the essential conceptual underpinnings for three well-structured analytical chapters to study the way in which climate change responses have changed in the Netherlands over recent decades, how the Delta Program embraced the ideas of adaptiveness in the development of the ADM concept in the development of long-term adaptation strategies, how this concept is being translated into regional decision making processes and the dilemmas experienced in regional implementation, and finally to be able to comment on the role and value of adaptiveness in strategy development in the Delta Program in general.

The first subject included in the theoretical framework will elaborate the characteristics of the traditional process of managing adaptation, developing adaptation strategies and foremost the factors that influence and hinder this process. The uncertainties and complexities inherent to climate change, together with fragmented institutional and organizational structures can make the development of long-term adaptation policies a challenging and sometimes almost impossible task. Describing these factors in more detail is essential in setting the scheme for elaborating the establishment of ADM and the barriers and dilemmas later on in this research as these factors are the direct cause for the fact that so many barriers exist in setting up adaptation strategies. Latest scientific ideas on how to better cope with these specific factors are often based on adaptiveness principles in which flexibility and embracing uncertainty and complexity are playing a leading role. The second subject included in the theoretical framework therefore is an elaboration of the *adaptive management* and related *adaptive governance* concepts, the main characteristics of an adaptive process and its theoretical underpinnings. A successful implementation of these approaches is however difficult because of the great ambiguity of the approach as well as barriers that might undermine the theoretical benefits of flexible long-term processes in which uncertainties and complexities are embraced rather than avoided. Therefore the third and final theoretical subject is on the variety of barriers that may lead to dilemmas in the development and implementation of long-term adaptation strategies. This theoretical framework will be used as a main guideline and as point of departure for later empirical analyses of

Dutch water management practice, the introduction of the national Delta Program, the development of the ADM approach and the barriers and dilemmas encountered in the Delta sub-program Wadden region in using adaptiveness in setting up a water safety strategy.

1.4 Research methods

This research will look at the development and subsequently at the implementation of the ADM concept in the Delta Program in general and in the Wadden region sub-program in particular. The choice of including a developed country like the Netherlands as a case study has been a deliberate one. Adaptation researches generally assumed lower vulnerability and greater adaptive capacity in developed countries than in developing countries and thus have focused more research in the latter. However, recent climatic crises have led to critical questioning of developed nations' capacity to adapt to the effects of climate change. The examination of developed nations' adaptive capacity and the persistent adaptation deficit in developing nations, has led to focused research on barriers to adaptation (Moser & Ekstrom, 2010). The Netherlands is considered to be among the forerunners in climate change adaptation research and policy and may therefore be considered as an instructive case study into barriers to adaptation action (Biesbroek *et al*., 2010). The Netherlands is considered to have high adaptive capacity (Haddad, 2005), with a great variety of measures and many options available to adapt, and broad historical experience in linking water management and spatial planning (Kabat *et al*., 2005; Biesbroek *et al*., 2011). Dutch water and delta technologies are renowned across the globe and it is the Delta Program that gives the Netherlands the possibility to confirm and extend this leading position by introducing renewing approaches such as the ADM concept. This research looks at Delta Program efforts of using adaptive principles in increasing the countries' adaptive capacity on the long-term.

Since science has not yet fully explored this field, besides a thorough literature review, empirical data is essential to see what exactly is going on in reality and to what extent barriers are actually context dependent. Empirical data has been gathered through careful analysis of policy documents, a presentation by Delta Program members and a total of eight interviews with a variety of experts in this field from within the national and regional program as well as outside the program. Their knowledge and expertise will be used to give insight into the current state of affairs, the considerations behind the ADM approach and the extent to which it is being applied and the barriers and dilemmas that are being experienced in the national Delta Program and the regional sub-program Wadden region. However, without going straight into this program, first of all a historical policy analysis is done on the development of water management and spatial planning practices in the Netherlands. This analysis shows a gradual paradigm shift in how climate change has been approached over the last decades. Having this contextual policy framework is essential in describing the developments towards the Delta Program, as it exposes the institutional structures under which this new policy program has to be implemented and how these contextual factors might contribute to or might create barriers that can obstruct the successful implementation of the ADM approach.

Secondly the focus shifts to the national Delta Program. In analyzing this governmental program special attention is given to the program approach and organization and to the characteristics and use of the ADM approach. One of the most important reasons why the implementation of adaptive management encounters so many difficulties is the lack of simple action plan on how to make management processes and strategic policies more adaptive. Since its definition is multi-interpretable, the ADM concept will be analyzed based on the theoretical underpinnings of adaptive management to see where the practical ADM variant differs from the theoretical concept. This analysis focuses not only on comparing the ADM concept to the theoretical underpinnings of adaptive management, but also on analyzing empirical evidence in order to identify barriers in its practical implementation. The analysis of ADM is also important in the search for possibilities to overcome such barriers in the future. The research is however not intended to give prescriptions and should not be used as a guideline on possible ways of how climate change adaptation will become a success. Instead it should be perceived as an exploratory study to look at current policy developments in order to implement adaptive policies, to draw up an inventory of the most striking dilemmas in the Wadden region sub-program, and what this could mean for possibilities to overcome them.

Finally the question is what the struggles are in the implementation of the ADM concept. The barriers and whether the potential benefits of using adaptive principles are reached only become apparent at the spatial scales at which this new concept is being applied, which in case of the Delta Program is the regional level. The Delta Program is subdivided into a number of generic and regional sub-programs that have the task of setting up a regional water safety strategy. In order to go more deeply into the barriers, one of these regional sub-programs, the Wadden region, has been included as a regional case. This regional case study will provide more insight into how the ADM concept is being translated from the national level and how regional efforts are geared towards regional contextual factors and to making regional adaptation efforts more responsive to uncertainty and complexity. The Wadden region is known as a strongly dynamic region in which high ecological, economic and social interests are at stake. The focus on a national and regional case will increase the understanding of barriers in developing adaptive strategies and therefore might also show potential options for improvement. The choice of including the Wadden region sub-program as a regional case in this research is mainly based on the fact that this region has specific complex water safety tasks and is not that well-known using and adaptive approach for its adaptation tasks. For this research it will therefore be interesting to analyze the added value of ADM in practice in a sub-program that could not be fully identified with this approach beforehand.

1.5 Academic and societal relevance

Incorporating climate change adaptation into spatial planning practice has gained increasing attention among both policy makers and researchers in recent years. Nevertheless, it is still largely unclear how to develop and implement successful long-term adaptation strategies (Bauer *et al.*, 2011). Only little systematic research has been done on actual adaptation policies and initiatives and even less on *how* these policies are or ought to be developed and implemented. With a few recent exceptions

(Biesbroek *et al*., 2010; Hulme *et al*., 2007; Keskitalo, 2010) the governance of climate change adaptation is still a blind spot in most scientific research (IPCC, 2007; Schipper & Burton, 2009). Although this scholarly gap may be due to the fact that "*the governance framework of adaptation is still largely in the making*" (Paavola, 2008: 652), it is problematic because not paying attention to the question on how to deliver adaptation policies through adequate governance approaches will inevitably hamper effective adaptation driven by public policies (Adger *et al*., 2007; Klein *et al*., 2007; Bauer *et al*., 2011). With the increasing acknowledgement that long-term planning goals should become more flexible and sustainable compared to what was the case by using traditional approaches, the need to act now and implement adaptive measures to avoid catastrophic impacts on the longer-term is growing. However, based on recent scientific publications, the transition towards *adaptive* approaches for complex spatial development issues appears to be problematic (see for example Nyberg, 1999; Van Der Brugge & Van Raak, 2007; Smith *et al*., 2009).

Most recently published researches based on this phenomenon are strongly focused on describing general lists of shortcomings and dilemmas in adaptation processes (see for example Runhaar *et al*., 2010; Biesbroek *et al*., 2011). In this research it is believed that many dilemmas and barriers encountered in adaptation policy development are strongly area-specific and cannot all be generalized and addressed in the same generic way. This research wants to contribute to the idea that regional contextual factors, whether physical, financial, institutional, political or organizational are decisive for the dilemmas a regional adaptation program runs into. This necessarily implies that, to make an adaptive process work, area-specific characteristics have to be taken into account more prominently in policy processes. The current scientific task is to further develop the usage of adaptive approaches in spatial planning and to further expand their potential benefit in reaching more sustainable planning outcomes, by taking contextual factors into consideration that are decisive for a successful adaptive process. This research might be helpful in contemplating on the role of adaptive management in the development of such strategic spatial policy initiatives.

The review of a national or regional climate adaptation strategy can be used to gain insight not only into a specific national or regional case, but might also draw lessons for other countries that are struggling with similar tasks of developing adaptation strategies. With a strong focus on monitoring, learning and evaluation in adaptive management processes, not only learning cycles within countries or regions, but also international exchange of ideas on how to organize and develop new climate-proof policies and how to deal with certain dilemmas in policy development can become of greater importance. This research intends to promote discussion on opportunities for further action research and on strategies for increasing awareness and information related to climate adaptation strategies. Besides that, adaptation to climate change will most likely become increasingly important into the future. In dynamic and uncertain times of political and financial crises, the climate change problem seems to fade more and more into the background. The new ADM approach potentially gives the right possibilities for integrating these tasks on the long-term political agenda. However, further optimization is needed to reach more sustainable outcomes. This research is aimed at contributing to this task.

1.6 Thesis outline and reading guide

To get a good overview of the main outline of this thesis, here a reading guide will be elaborated that indicates what subjects will be discussed in which chapter. Following, a reading advice will be given that might be useful for readers having a specific interest in particular parts of this research. First, the theoretical framework elaborated in **Chapter 2** can be read independently as a state of the scientific literature report, while at the same time it attempts to make a more interpretive contribution in synthesizing, as opposed to merely presenting, relevant scientific theory thus far. In this chapter three main theoretical concepts can be distinguished, which will later serve as a framing perspective for the empirical research on the case under study. The first theoretical concept, adaptation to climate change will be described and specifically the requirements for and limitations of managing adaptation processes in a context of uncertainty and complexity, as they differ strongly from traditional ways of doing. The shortcomings of managing adaptation processes leads to the introduction of adaptive management, the second concept, an approach that propagates flexibility and structured learning in decision making in the context of uncertainty and complexity. Since this new concept forms a radical shift away from traditional approaches, many limits and barriers exist in addressing adaptiveness in managing adaptation to climate change, which might ultimately form dilemmas in decision making processes. A categorization of these obstructing factors forms the third and final theoretical concept in this theoretical framework. Lastly, **Chapter 2** will contain the conceptual framework, which gives an overview of how the theoretical concepts will be positioned and used in the empirical part of this thesis. Following on from the theoretical framework, **Chapter 3** explains and justifies research methods and methodology into more detail and how they form an analytical strategy aimed at executing the empirical research based on the conceptual framework. In the following chapters, emphasis shifts to the case related empirical research, in which the Dutch Delta Program is examined in more detail. Each chapter is based on one of the theoretical concepts elaborated in the theoretical framework, visualized in the conceptual framework and expressed in the methodological strategy from **Chapter 3**. First of all, **Chapter 4** puts transitions and further developments in Dutch water management and spatial planning over the last decades in a broader historical perspective and places the Delta Program in the right policy context. It might be clear that this overview attempts to cover a lot of material and ground in a fairly limited amount of space. The struggle to do justice to a broad and complex field while also attempting to keep the argumentation of this research concise but informed enough to be both manageable and intelligible for readers not familiar with the Dutch policy context has not been easy. The goal is that this chapter is representative rather than exhaustive with a bias for general analytic rather than case oriented expositions. After having set out the policy transition towards a new governmental program and management approach for long-term water safety planning in **Chapter 4**, **Chapter 5** describes the national Delta Program, its organization and the newly developed ADM concept. What have been the considerations in developing this concept with the aim of being better able to deal with uncertainty in long-term decision making and how is its practical implementation being foreseen? Taking this analysis further, **Chapter 6** aims at the Wadden region Delta sub-program striving for more adaptiveness in their operation after the introduction of the ADM

concept. This sub-program will be elaborated quite extensively as well as its complex tasks and regional context in which strategic decision making has to take place. The dilemmas this program faces in improving long-term water safety though the development of a regional water safety strategy using the approach of adaptiveness form the primary subject of analysis. Finally **Chapter 7** starts off with a brief summary of the accumulated argumentation throughout the thesis and further contains the conclusion in which this argumentation will be used to answer the main research question addressed in **Chapter 1**. Besides that, a discussion of research outcomes, a reflection on research methods used, potential points of improvement and recommendations on possible follow-up research on this topic will be given as well as guidance for the Delta Program as a whole to rearrange their idea of adaptiveness, the use of ADM in improving water safety for the Netherlands and the fact that such an approach will inevitably lead to dilemmas in the complexity of regional decision making.

Reading advice: for those less interested in the theoretical and scientific backgrounds used in this research and rather willing to quickly obtain more practical research findings, **Chapters 2**, **3** and **4** can be ignored and the reader can instead skip to **Chapters 5**, **6** and **7** straight away, which subsequently highlight the current state of affairs in the Delta Program and the role of ADM in this governmental program, its regional application and dilemmas that are being experienced in the use of ADM and the conclusion that directly responds to the research objective introduced in this chapter. Throughout the thesis references to previous chapters and/or sections of chapters are included, in case additional theoretical or context related explanation is required.

Chapter 2 – **Theoretical Framework**

This chapter contains the theoretical underpinnings for this research and the conceptual perspectives from which this thesis is written. Consecutively three theoretical concepts will be covered in this theoretical chapter. Firstly uncertainty, complexity and organizational and institutional factors will be elaborated as they might form obstructing factors in the process of working on adaptation strategies. Subsequently the theoretical explanation of the adaptive management concept will be elaborated, a number of its key characteristics will be listed and its possible contribution in setting up adaptation policy as well as potential pitfalls will be discussed. Thirdly the explanation and characterization of barriers to adaptation will be covered as they are likely to lead to dilemmas in the development of adaptation strategies. Finally a conceptual framework is designed, with the conceptual structure for the remainder of this thesis and the way in which this theoretical chapter will be applied in further analysis.

2.1 Managing the development of adaptation strategies

Even though *mitigation* strategies are considered inadequate to fully accommodate the effects of climate change, they are usually way better defined in terms of action and goals than *adaptation* strategies are (Füssel, 2007). Mitigation goals and the ways in which they are to be achieved are usually clear, straight-forward and feasible for implementation at different governmental scales in different countries over the world. Adaptation interventions and especially objectives on the other hand, despite being considered more applicable these days, are a lot more ambiguous and vague, and adaptation processes require stronger adjustment to meet varying contextual conditions. From a management perspective Laukkonen *et al*. (2009: 288) describe the difference between both responses to climate change as "*mitigation aims to avoid the unmanageable and adaptation aims to manage the unavoidable."* However the unavoidable is also highly uncertain and complex, as exact predictions on timing, location and severity of climate change effects cannot be given, which is likely to pose serious obstacles in the process of managing the development of adaptation strategies to better cope with these effects. Adaptation strategies can be referred to as all anticipatory and planned adaptation policies, measures and options to manage the projected impacts of climate change, reduce vulnerability, enhance adaptive capacity, or benefit from opportunities (Swart *et al*., 2009). According to Swart *et al*., (2009) a national adaptation strategy is a national long-term vision or general plan of action for addressing the impacts of climate change. Moreover, as Burton *et al*. (2005: 186) argue, national adaptation strategies can include "*a mix of policies and measures with the overarching objective of reducing the country's vulnerability. Depending on the circumstances, the strategy can be comprehensive at a national level, addressing adaptation across sectors, regions and vulnerable populations, or it can be more limited, focusing on just one or two sectors or regions.*" Considering these trade-offs, setting up adaptation strategies can be seen as a highly complex task that requires serious contemplation.

Doing adaptation is more than just following a list of straight forward measures that need to be implemented one by one in order to reduce the impacts of climate change and achieve sustainable

outcomes (GLCA, 2009). In practice, adaptation actions tend to constitute on-going processes, reflecting many factors or stresses, rather than discrete measures to specifically address climate change (IPCC, 2007). Lists of adaptation options are ubiquitous, but there is little information about the climatic conditions for which they are expected to be effective, their potential benefits, resources needed to implement them, their institutional structures and processes to sustain them, potential spill-over effects and other factors that decision makers may wish to consider (Patwardhan *et al*., 2009). A distinction of adaptation initiatives can be made between those that involve the building *adaptive capacity* and those that involve the implementation of operational adaptation decisions (Adger *et al*., 2005). Adaptive capacity describes a society's ability to adapt to changing climatic conditions, whether by moderating potential damages, exploiting beneficial new opportunities, or coping with the consequences (IPCC, 2007). Operational adaptation decisions on the other hand are likely to be constrained and influenced by higher-level adaptation frameworks as well as by institutions that define other aspects of societal activity (Adger *et al*., 2005). This shows that operational adaptation decisions are in fact manifestations of and reflect adaptive capacity (Smit & Wandel, 2006). Where adaptation is described as "*adjustments in systems in response to actual or expected climatic stimuli or their effects in order to moderate harm or exploits beneficial opportunities*", the concept of adaptive capacity indicates "*the extent to which the system is able to apply these adjustments*" (IPCC, 2001: 365). However, the mere existence of adaptive capacity is not itself a guarantee that it will be actually used to do successful adaptation interventions (Burton *et al*., 2002). Adaptation depends not only upon the capacity of systems to adapt, but also on the will or intent to deploy adaptive capacity to reduce vulnerability. Adaptation only occurs when in addition to adaptive capacity there is also a political will and formal mechanisms that enable adaptation action (Levina, 2007). In setting up adaptation strategies it is important to consider what is perceived to be successful adaptation, as several authors have already suggested that creating high levels of adaptive capacity will not automatically translate into efficient and successful adaptation (Moser, 2009a).

Many obstructions appear along the way in giving adaptation a full-fledged place on the political agenda. In spite of the urgency and importance of adaptation responses and the increasing policy interest, societies often lack knowledge about, or are uncertain or skeptical about climate risks (Patwardhan *et al*., 2009). In practice, managing adaptation to climate change is clouded in uncertainty. Adaptation strategies require long-term horizons, which may not be popular with governmental and administrative systems, which rather prefer to focus on shorter time frames and quick-fixes. A focus on adaptation from within prevailing governmental structures may now be perceived as an acknowledgement of allocating scarce public resources to a threat that is not yet perceived as being imminent (Laukkonen *et al*., 2009). These practical dilemmas emphasize both the importance as well as the difficulties of developing adaptation strategies. This research exclusively focuses on the process of building adaptive capacity and resilience through setting-up national adaptation strategies, which puts the scope away from result-oriented goals and adaptation measures. In the next section the main obstructing factors inherent to managing adaptation processes will be discussed.

2.2 Obstructing factors in the development of adaptation strategies

Now it is clear that setting up adaptation policy not only poses significant analytical, but also serious policy challenges (Frankhauser *et al*., 1999). Adaptation strategies are sometimes understood as preventing all adverse impacts of climate change, but such a goal implicitly assumes a world that is perfectly adapted to current climate conditions, has perfect knowledge of future climate change and has abundant resources for adaptation (Füssel, 2007). However, despite efforts and attention for the adaptation task, a big gap remains between adaptation needs and current efforts to address them (Levina, 2007). Adapting to climate change is a wicked, complex and messy policy problem where traditional ways of acting no longer seem to suffice, since climate change cuts across traditional boundaries, existing institutional structures, routines, policy arenas, networks and jurisdictions (Lorenzoni *et al*., 2007a). Managing in the context of climate change is a challenging task for policymakers since adaptation is involved with unprecedented methodological challenges (Füssel, 2007). In these processes, policy- and decision makers are faced with the characteristics of:

- **Uncertainty and change**, which evolves out of the acknowledgement that science is incomplete, some understanding may be wrong, some changes are not foreseen and existing knowledge is not fully integrated. Thus far adaptation has been largely reactive and resources could be targeted to known risks. However in addressing risks in a more proactive way, uncertainties in the extent, timing and distribution of impacts make it harder to determine the appropriate level of investments, what strategies are needed and when (Burton *et al*., 2006). Uncertainty clouds the search for solutions and strategies, which leads to the question how to deal with this considerable uncertainty in managing adaptation related policy issues. This not only requires coping with various sources and types of uncertainty, but also with the ambiguity produced by the various ways in which uncertainty is interpreted and approached (Frankhauser *et al*., 1999). Even though some uncertainties may be resolved through the process of further research, research raises a crucial question whether society should delay taking action in anticipation of obtaining better information, or should accelerate taking action, as climate change might turn out to be more serious than expected (Ingham *et al*., 2006);

- **Complexity**, which originates from the intricate nature of system dynamics and differing spatial and temporal dimensions. The process of adaptation displays the characteristics of a complex policy problem. The management of such complex systems is inherently difficult as the prediction of their behavior is highly inexact (Wilson & Termeer, 2011). Climate change cannot be understood in terms of a simple cause-effect paradigm and causes multiple effects that cascade through systems in complex ways. These effects interact with each other and with local and regional changes in complex multi-dimensional patterns that are difficult to understand and even more difficult to predict (Patwardhan *et al*., 2009). Managing adaptation in this complex context is in turn difficult because adaptation comes through markets, civil society and government action and complex interactions between them (Adger & Vincent, 2004). Complex policy problems include large numbers of actors, each with their own norms,

beliefs, values, worldviews and interpretations of reality, who often have different objectives, goals, interests and expectations about the outcomes of policy games (Biesbroek *et al*., 2009b); and

- **Organizational and institutional fragmentation and fixation**, which characterizes the current governance landscape in which managing adaptation processes ought to take place, which is insufficiently linked and coordinated, in which centralization and decentralization of governance is often not appropriately balanced and in which important users and constituents are not included in the process. Not uncommonly the result is a fragmentation of actions among actors, sectors and levels. Because climate change potentially impacts upon a variety of physical and social systems that are strongly interconnected, governance systems that deal with the consequences of climate change are possibly even more fragmented than their counterparts in other policy domains. These domains are all related to different policy sectors, administrative levels and policy systems, which, in turn, are characterized by formal and informal rules, ambitions, problem-framing and resources. Furthermore, impacts of climate change provoke new interdependencies among these domains (Termeer *et al*., 2011).

These obstructing factors might lead to slow adoption of adaptation policies and might eventually even lead to lock-ins in which no adaptation action is taken at all (Burton, 2006). Yet initiatives for adaptation strategies are needed to prepare for future uncertainties. The strong normative character of successful adaptation has large impacts on managing the adaptation processes that many governments struggle to overcome. Management in the context of complexity means influencing the process of change of systems towards a desired state. Greater insight into the complex and uncertain dynamics of a system leads to improved insight into the feasibility of directing it (Rotmans & Loorbach, 2009). In order to do so, managing adaptation demands new and innovative insights into the organization of complex management processes (Loorbach, 2010). A more strategic approach is required to ensure timely and effective adaptation measures can be taken, ensuring coherence across different sectors and levels of governance (EC, 2009). Looking far into the future is crucial, but may not result in a fixed final image that is not receptive to further adjustment. The adjustment of policy designs must constantly remain possible in order to pursue optimal and sustainable adaptation outcomes (Frankhauser *et al*., 1999). In contrast to traditional management regimes, contemporary decision making in the field of adaptation is much more dynamic and complex, taking place through several networks of decision making in which continuous negotiate dependent actors through series of repetitive interactions about problems and solutions, strategies and objectives, and formal and informal rules (Scharpf, 1997). Within this governance perspective on decision making in the field of adaptation, stagnations and breakthroughs occur that influence and steer the outcome of policy games (Koppenjan & Klijn, 2004). The latest scientific insights show that the structural uncertainties surrounding climate developments necessitate more explorative, experimental and reflexive management approaches (Loorbach, 2010). To better deal with the emerging complexity of climate change, management approaches must be able to respond to complexity and change, and to anticipate associated uncertainties (Folke *et al*., 2005; Pahl-Wostl *et al*., 2007).

Clearly there is a strong tension between the need for adaptation policy progress, based on deliberate decision making and the need for flexibility and pragmatism in the face of uncertainty. Strong differences exist between the characteristics of traditional management regimes and adaptive management regimes that show more flexibility and pragmatism to emergent developments (see **Table 1**). The main difference between both approaches depends on the degree in which traditional planning is considered a qualified approach for strategy making in complex and dynamic settings. Wiechmann (2007: 11-12) states that "*the central challenge of strategic spatial planning is to strike a balance between the rationalistic approach of planners and the adaptive approach of incrementalists while taking into account the specific context, content and process of a spatial setting.*" A *management regime* is here referred to as the whole complex of technologies, institutions, environmental factors and paradigms that are highly interconnected and essential to the functioning of the management system that is targeted to fulfill a societal function. *Institutions* are referred to as formal and informal rules that structure behavior of society. Because of their high interconnectedness and internal logic, it is assumed that the individual elements of a regime cannot be exchanged arbitrarily (Pahl-Wostl *et al*., 2007).

Traditional Management	**Adaptive Management**
Centralized hierarchical top-down structure	Polycentric network structure
Centralized implementation	Decentralized gradual adjustment
Rational and informed	Pragmatic and intuitive
Plan conformance	Plan performance
Process progress	Process flexibility
Expert-based	Collective
Separate sectors	Cross-sectoral
Formal planning	Collective learning
Complete and explicit	Incomplete and implicit
Understanding fragmented by gaps in knowledge	Understanding by open and shared information
Prediction and control	Learning and self-organization
Quantitative variables	Qualitative indicators

Table 1 – Characteristics of traditional management versus adaptive management (based on Wiechmann, 2007; Pahl-Wostl *et al*., 2007; Pahl-Wostl, 2007; Van Der Brugge & Rotmans, 2007)

Unlike traditional approaches, often perceived to be insufficient to cope with the unavoidable long-term effects of climate change (Biesbroek *et al*., 2009b), adaptation requires ongoing flexible *process* structures that stimulate learning and have the ability to adapt to emerging information and to evolving experiences. An adaptation policy response should be anticipatory, not reactive and should as well be anchored in frameworks for economic growth and sustainable development. However, national governments often bear direct responsibility to develop and implement integrated policy programs that build resilience and reduce vulnerability, emphasize preventive local actions and manage risks associated with the impacts of climate change (GLCA, 2009). Recent efforts are increasingly geared

towards the use of *adaptive management* and -*governance* concepts in setting up adaptation strategies (Wilson & Termeer, 2011). This concept is a collaborative, flexible and learning-based management approach that can best be described as a shift away from the traditional idea of shaping and controlling society, towards acknowledging that society is dynamic and therefore in a constant state of flux (Biesbroek *et al*., 2011). By constantly evaluating goals, objectives and means, as new information and insights become available, adaptive management is more responsive to changing conditions and demands as compared with traditional approaches (Pahl-Wostl *et al*., 2007). Flexibility, learning and policy adjustment are key characteristics of this approach, of which the theoretical underpinnings will be introduced in the following part.

2.3 Adaptive management and adaptive governance

The origins of adaptive management date back to the 1970s, when ecologists Holling and Walters introduced a renewing management approach as a criticism of traditional practices that gave too little attention to the complexity and uncertainty of environmental processes (Lee, 1993). The adaptive approach was prescribed as a series of policy experiments intended to improve both management outcomes as well as the understanding of the functioning of ecosystems (Walters, 1986; Hatfield-Dodds *et al*., 2007). Even though adaptive management initially was conceived as a technical based model (e.g. Holling, 1978; Walters, 1986), it is now increasingly being implemented in the social domain as well (Lee, 1993; Allan, 2007; Van Der Brugge & Van Raak, 2007). It seems to have turned into a renewing approach to complex tasks that require creativity, curiosity and a strong commitment to learning (Murray & Marmorek, 2003). Some of the basic assumptions are widely accepted, but over the last decades a great variety of definitions and interpretations of adaptive management and the related *adaptive governance* concepts have been put forward in scientific literature as well as in policy practice. Without trying to come up with the best possible description here, the main goal is to emphasize their main purposes, basic principles and challenges for implementation in spatial planning practice.

Adaptive management can be described as a structured process for improving management by building knowledge and learning from the outcomes of implemented management strategies (Murray & Marmorek, 2003). This is an on-going process of developing improved management practices by use of continuous learning in order to systematically reduce uncertainty. Management actions and monitoring programs need to be carefully designed in order to generate reliable experimental feedback, improved understanding and clarify reasons underlying outcomes, based on which actions and objectives are subsequently being adjusted (Nyberg, 1999). Learning takes place through deliberately designing and carrying out management actions and systematically using the results of monitoring to learn how systems respond to interventions and to increase the level of certainty regarding how best to achieve improved interventions and desired outcomes (Walters 1986). This involves exploring alternative ways of meeting management objectives, predicting outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn what alternatives best comply with management objectives and using these results

to update knowledge and adjust management actions. Adaptive management in this sense goes beyond a *trial-and-error* approach and is much more than simply *adapting-on-the-go* (Murray & Marmorek, 2003). Adaptive management distinguishes itself by the structured and theoretically driven linkages among management objectives, system learning and adjusting based on what is learned in such a way that new knowledge can be incorporated systematically into future decision making (Arvai *et al*., 2003). In essence, adaptive management can be seen as *learning-by-doing* and adapting based on what is learned (U.S. DOI, 2009).

Adaptive management acknowledges that policies must satisfy objectives, but must always secure flexibility in order to modify for adaptation to uncertainties and complexities that might thwart this process. The adaptive management process includes effectiveness monitoring, evaluation of results and the use of obtained knowledge to adjust future actions (Murray & Marmorek, 2004). Such an approach requires a flexible framework for making good decisions in the face of uncertainties and a formal process for reducing uncertainties in a structured way so that management performance and effectiveness can improve over time (U.S. DOI, 2009). Although some learning occurs regardless of the management approach applied, the adaptive management process is structured to make learning more efficient (McLain & Lee 1996; Gunderson, 1999). Integral to the adaptive management process is a *structured decision making* component and a *learning* component. Structured decision making is an organized and transparent process approach for identifying and evaluating alternatives and justifying complex decisions (Allen *et al*., 2011). Adaptive management is framed within the context of structured decision making, with an emphasis on uncertainty about responses to management actions and the value of reducing uncertainty to improve management. Structured decision making is a term often confused with adaptive management, however structured decision making does not necessitate the iteration and consequential higher order learning inherent in an adaptive management approach (Allen *et al*., 2011). Even though learning plays a key role in adaptive management, it is seen as a means to an end, namely good management, rather than as an end in itself. The distinguishing features of adaptive management are its emphasis on sequential decision making in the face of uncertainty and the opportunity for improved management as learning about system processes accumulates over time (U.S. DOI, 2009).

Adaptive management aims to increase adaptive capacity and resilience by putting in place the right conditions needed for structured learning processes to take place. The ability to learn and adapt implies that a system can get better at pursuing a particular set of management objectives over time and at tackling new objectives in a changing context (Adger *et al*., 2005; Brooks *et al*., 2005; Folke *et al*., 2005; Lebel *et al*., 2006). A rigorous, deliberate approach to learning is an essential ingredient for adaptive management. If management actions are implemented in ways that significantly stray from the initial design, or if monitoring focuses on the wrong variables, learning anything meaningful will be difficult, if not impossible (Murray & Marmorek, 2004). Adaptive management involves ongoing, real-time learning and knowledge creation, both in a substantive sense as in terms of the adaptive process itself, or as Bormann *et al*. (1993: 1) states:

"Adaptive management is learning to manage by managing to learn."

Adaptive management is participatory, information-intensive and requires a process of active involvement, learning by all stakeholders throughout the process and ongoing improvement of management strategies by learning from the outcomes of policies (Geldof, 1995; Pahl-Wostl, 2007). The level of cooperation required to gather information needed for adaptive management indicates that many different stakeholders need to maintain a commitment to the learning process (Pahl-Wostl *et al*., 2007). In such a process it appears to be no longer enough to understand the complexity and uncertainty of just the subject itself, as it is equally important to understand what goes on in complex participatory processes between formal arenas of government, research, stakeholders and competent authorities (Henriksen *et al*., 2007). It is this emergence and broadening of involved actors in societal affairs beyond the institutions of formal government that has led to the broader notion of *governance* (Moser, 2009a). Governance can be defined as the set of structures and processes, by which actors determine a course of action, make decisions and share power (Lebel *et al*., 2006; Folke *et al*., 2005; Moser, 2009a). *Adaptive governance* is a form of governance that incorporates formal institutions, informal groups and networks, and individuals at multiple scales for purposes of collaborative management. Adaptive governance systems are understood as polycentric institutional arrangements constituted by nested, multi-actor, decision-making (see **Table 1**) (Ostrom 1996; Van Der Brugge & Van Raak, 2007) and refers to the ways in which institutional arrangements evolve to satisfy the changing needs and desires of society (Hatfield-Dodds *et al*., 2007). It helps to put flexibility in decision making, knowing that uncertainties exist and it provides the opportunity to change direction, will improve understanding of complex systems to achieve objectives and it is about taking action to improve progress towards desired outcomes. Bridging organizations, enabling legislation and government policies contribute to the success of an adaptive governance framework, whereby governance creates a vision and management actualizes it (Folke *et al*., 2005).

2.4 The adaptive management process

The process of adaptive management can be visualized as a cycle divided into two phases: a *set-up* phase in which key components are developed and an *iterative* phase in which all components are brought together in a cyclical decision making process. The set-up phase consists of structural elements, such as stakeholder involvement, defining management objectives and monitoring plans. However, to explicitly take uncertainties into account and to sustain the capacity for change, the process of adaptive policy development and implementation requires a number of steps that are part of an iterative learning cycle (Pahl-Wostl *et al*., 2007). This iterative process uses structural elements in an ongoing cycle in which structured decision making elements are combined with elements to stimulate learning about system structure and functioning and managing based on what is learned (U.S. DOI, 2009). Additional structure is incorporated into this sequence, by recognizing an embedded feedback loop of monitoring, evaluation and management adjustments that focuses specifically on learning from the impacts of management choices. Multiple iterations of this loop may occur within each repetition of the overall adaptive management cycle, accelerating learning about processes

within the more comprehensive cycle that includes learning about the adaptive process itself (U.S. DOI, 2009). Critical to this effort is the feedback of information between various steps of the cycle, which must all be coordinated and share information, not only to maximize the benefits on short-term actions, but also to carry the information learned from past experiences into future developments.

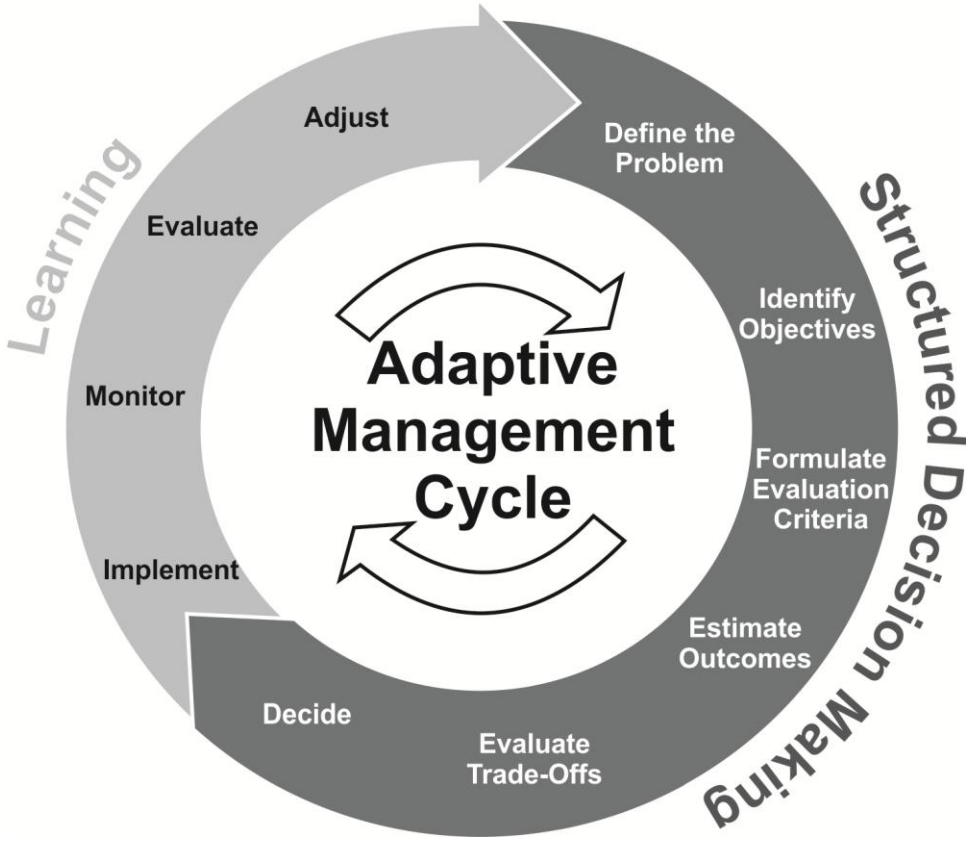

Figure 1 – The adaptive management cycle (based on Allen *et al.*, 2011; Murray & Marmorek, 2003)

Even though different interpretations of the adaptive management cycle exist throughout scientific literature and some terminology used here might not completely match with other terminology used in other scientific work, the ultimate goal of introducing the adaptive management cycle here is not to fully understand all of its consecutive steps, but rather to get a hold of its main characteristics and basic principles. Here this cycle will be described as a process in which a number of stages have to be run through (Murray & Marmorek, 2003). The adaptive management cycle as visualized in **Figure 1**, is based on work by Allen *et al*. (2011) and Murray & Marmorek (2003), and color is used in making a clear distinction between the *structured decision making* and the *learning* elements of the adaptive management cycle.

Although adaptive management is described here by a series of steps, it is important to recognize that adaptive management is a complex endeavor that entails much more than simply following a sequence of stages. The adaptive process requires continuous refinement and testing, exploring and development of new management options and making new predictions. All steps should be planned in advance, though it may be necessary to modify them later, as in practice some steps might overlap, some might have to be revisited and some might have to be done in more detail than others (Nyberg,

1999). All steps are essential to adaptive management in such a way that neglecting one or more will hamper the ability to learn from management actions. In this respect, adaptive management emphasizes the importance of the management process rather than focusing on goals, but without claiming the process is an end in itself. It explicitly recognizes that management strategies and goals may have to be adapted during the process as new information becomes available and that the quality of the process is essential for guaranteeing the quality of outcomes (Pahl-Wostl *et al*., 2007). This makes clear that adaptive management is more than just following a procedure and that it also requires curiosity, innovation, courage to admit uncertainty and a strong commitment to learning (Murray & Marmorek, 2003). But what is the adequacy of using the concept of adaptive management in setting up long-term adaptation strategies? The following part will go deeper into the challenges of using an adaptive approach in such complex decision making processes.

2.5 Challenges of using adaptive management in spatial planning

Despite the challenges in defining adaptive management, interest in the approach and its application is growing (Allen *et al*., 2011). The adaptive management concept might improve the conceptual and methodological basis for achieving more sustainable and integrated management practices in complex decision making processes. However, a limited understanding of how to successfully implement adaptive management is often blocking these processes (Pahl-Wostl *et al*., 2007). The challenge of implementing adaptive management stems from a lack of clarity in definition and approach, a paucity of success stories on which to build, paradigms that favor reactive rather than proactive approaches to managing complex tasks, failure to recognize the potential for shifting objectives and failure to acknowledge the social source of uncertainty, and hence increased risk of surprise (Allen *et al*., 2011). The process as visualized in the adaptive management cycle (**Figure 1**) is rarely being implemented in spatial planning, even though many planning documents and numerous development programs refer to it as being the basis of their approach. It is often thought that merely by monitoring and occasionally changing activities, one is doing adaptive management. In the absence of additional structure in decision making processes, monitoring a managed system does not instantly make an approach adaptive. Many systems are monitored in some manner, but in most cases the resulting data is not systematically being used for learning and policy improvement (U.S. DOI, 2009). Often the term adaptive management is misused to describe programs involving public participation. These misconceptions have led to dilution and confusion over what adaptive management really entails (Murray & Marmorek, 2004). Obviously, adaptive management carries unknown potential and irrevocable misunderstanding, a paradox that simultaneously explains the inherent interest and discomfort in its implementation (Allen *et al*., 2011). Adaptive management has yet to become more than rhetorically embedded into spatial planning culture.

Demystifying adaptive management is necessary to make it a genuine component in managing complexity (Allan, 2007). The conceptual underpinnings for adaptive management are simple; there will always be inherent uncertainty and unpredictability in the dynamics and behavior of complex systems. Yet despite these uncertainties, management decisions must still be made and whenever

possible, learning should be incorporated into management. Rather than ignore uncertainty, or use it to preclude management actions, the strength of adaptive management lies in the recognition and confrontation of such uncertainty as it can foster resilience and flexibility to cope with an uncertain future. Since its initial introduction, adaptive management has been hailed as a solution to endless *trial-and-error* approaches in complex management challenges. However, adaptive management does not produce easy answers and is appropriate in only a subset of management problems. Nonetheless, adaptive management has great potential when applied appropriately (Allen *et al*., 2011). Ironically, the confusion over the term adaptive management stems from the flexibility inherent in the approach, which has resulted in multiple interpretations of adaptive management. This inconsistency and even contradiction over the adaptive management concept have resulted in confusion and limited the ability to develop consistent and repeatable adaptive programs. Misunderstanding is largely based on the belief that adaptive management is what management has always been, a *trial-and-error* attempt to improve outcomes. However, unlike these approaches, adaptive management has explicit structure, including careful elucidation of goals, identification of alternative management objectives and hypotheses of causation, and procedures for the collection of data followed by evaluation and reiteration (Allen *et al*., 2011). It is often argued that the main reason for failure of adaptive management processes lies in stakeholders showing deplorable self-interest, seeing adaptive policy development as a threat to existing research programs and management regimes, rather than as an opportunity for improvement. This is why it is important to address the social dimension and contexts for adaptive governance in relation to complex system management, including processes of participation, collective action and learning (Folke *et al*., 2005). Another misconception is that while it is commonly believed that an adaptive approach can produce results quickly and at low cost, the opposite is more likely to be true. An initial investment of time and effort will increase the likelihood of better decision making, but patience, flexibility and support are needed throughout an adaptive process in order to reach sustainable outcomes (U.S. DOI, 2009).

It is important to acknowledge that not all decision making in the context of uncertainty and complexity is ideally suited for using an adaptive approach. In some cases there is no opportunity to apply learning, there is little uncertainty about what action to choose and there is no agreement on objectives. But often the concept of adaptive management is so intuitively appealing that it is being applied indiscriminately, with the result that many management applications fail to achieve the improvements expected from its implementation. In most cases this may have less to do with the approach itself but more with the inappropriate contexts within which it is purported to apply (U.S. DOI, 2009). Adaptive management is not a panacea for the navigation of many of the wicked problems, because it does not produce easy answers and is only appropriate in a subset of management problems in which not only *uncertainty* but also *controllability* are high (see **Figure 2**), which means the potential for learning is high and the system can be manipulated (Allen *et al*., 2011). Where uncertainty is high but controllability is low, developing and analyzing scenarios seems to be more appropriate. In fact adaptive management and using scenarios are complementary approaches to understanding complex systems. Likewise, if variable response is known, that is if uncertainty is low,

there is no reason for using adaptive management. Even in situations with low controllability, which for example can be the case with climate change, the use of adaptive management might be helpful in mitigating some impacts. But adaptive management is predicated on the idea that variables will respond to management and if there is little ability to increase control over the system through management, there is no reason to engage in adaptive management. So, adaptive management is appropriate if management can strongly influence the system but uncertainty about management impacts is high (U.S. DOI, 2009).

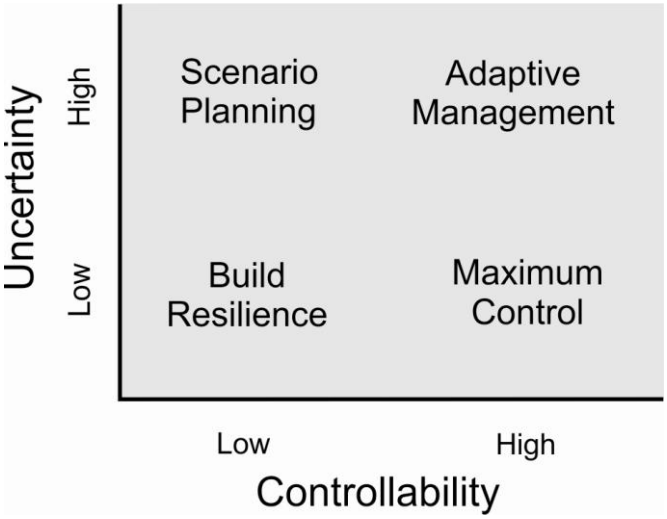

Figure 2 – Appropriateness of using the adaptive management approach (based on Allen *et al*., 2011)

Based on recent developments, adaptive management is considered to be appropriate for dealing with the emerging complexity and uncertainty of climate change. However, implementing this approach in the field of spatial planning comes with a number of practical challenges (Allen *et al*., 2011). It appears that a number of social and cultural issues constrain the ability to learn from management actions (Allan & Curtis, 2003; Allan & Curtis, 2005; Allan, 2004). These constraints include the general use of short-term time frames, inflexible and inappropriate institutional structures and an over-emphasis on action and competition over reflection and collaboration, which can in turn form disincentives for learning and the use of adaptive management (Allan, 2007). Political time spans for example rarely extend more than five years, which makes long-term monitoring a quite rare phenomenon (Allen *et al*., 2011). Rather than dwelling on constraints here it is more constructive to flag some issues that should be considered when attempting to embed adaptive management into the future development of adaptation strategies. For adaptive management to achieve its promise it should be recognized as a radical departure from established traditional ways of managing complex problems, which requires new ways of thinking about management, new organizational structures, new implementation processes and tools (Allan, 2007). It is often stated that the key to adaptive management rests on overcoming the tendency to defer difficult decisions and radical departures from existing policies until more information is available. Such an institution would foster long-term consistency and help translate varying experiences into new policy recommendations (Arvai *et al*., 2003).

Even though the need for flexible planning is widely acknowledged, practical developments to set up new planning practices and overcome obstructions to increase adaptive capacity is generally lagging behind (Folke *et al*., 2002). There is an emerging discourse of obstructions in setting up adaptation strategies that are traditionally analyzed as a set of immutable thresholds (Adger *et al*., 2009). Present understanding of processes of adaptation to climate change suggests that actions occur when risks are known and when resources are available to minimize risks or reduce vulnerabilities (Hulme *et al*., 2007). As the need to adapt to changing climatic conditions is increasingly being recognized, societies will need to address and overcome various barriers and limits to adaptation (Jones, 2010). The next section will take a deeper look into barriers and limits that might lead to dilemmas in adaptation policy development.

2.6 Barriers and limits in developing adaptation strategies

In scientific literature the concepts of *barriers* and *limits* to adaptation are often used interchangeably, whereas sometimes – although the line between them may be blurry – a clear distinction is made (Hulme *et al*., 2007). In this research the distinction between both concepts is consistent with the definition by the IPCC (2007) in which limits are described as obstacles that tend to be absolute in a real sense and therefore constitute critical thresholds of change beyond which systems may not be able to adapt without radically altering their functional state and system integrity. In some cases socio-ecological or physical limits may be stretched by technological innovations, but beyond such limits looms irreversible system change and the adjustment to living with that change (Adger *et al*., 2009). Human and resource-based limits relate to knowledge, technological and economical restrictions, such as various spatial and temporal uncertainties associated with forecasting, low levels of awareness and information amongst policy-makers, as well as a lack of financial resources and assistance to facilitate adaptation interventions (Adger *et al*., 2009). Barriers on the other hand are described in scientific literature as those seeming limits that can be overcome. Barriers are defined as political, social, or behavioral conditions that tend to delay, divert or temporarily block adaptation processes because of the way in which society is organized or because of the values it propagates (Ekstrom *et al*., 2011). As Adger *et al*. (2009) argue many seeming limits are in fact malleable barriers which can be overcome with concerted effort, sufficient political will, institutional change, creative management, change of thinking, prioritization, social support, sufficient resources and so on. Research emphasizes the significance of barriers in adaptation processes which are endogenous to society. Social factors such as ethics, knowledge, behavioral attitudes to risks, institutional elements and cultural values which hamper adaptation are important components that are often neglected in wider adaptation debates (Jones, 2010) and should definitely to be considered in decision-making processes.

The IPCC (2007) notes that, to date, social limits and barriers to adaptation are not well researched and recognized in adaptation policy development and that climate adaptation literature primarily relates to barriers in the implementation of adaptation strategies rather than in developing them. Most studies have focused on socio-economic conditions (Adger, 2003; Smit & Wandel, 2006), such as time, finances and knowledge as preconditions for successful and effective adaptation. But before

adaptation strategies are being implemented, they go through complex processes of decision making in which barriers can occur that constrain the adaptation strategy from being developed in the first place. Barriers in developing adaptation strategies – such as strategic and institutional uncertainty – are hardly addressed in scientific literature (Biesbroek *et al*., 2009b). Some of the obstructing factors that might lead to limits and barriers in setting up adaptation strategies are *material* and can pose major limits in decision making, such as physical-ecological, technological or economic factors (Adger *et al.*, 2007). These limits constitute absolute thresholds of change beyond which irreversible change might occur. *Social* factors on the other hand might cause barriers to adaptation, which can be explained as the outcome of the interactions of intentional actors. This division of material and social factors influencing adaptation processes and their relations are displayed in **Figure 3** (Biesbroek *et al*., 2009b). Social factors influencing the adaptation process can be subdivided into *actor-specific* and *institutional* factors. Actor-specific factors are those barriers that prevent actors from deploying their strategies and achieving their goals in the policy game. Institutional factors can result in barriers when they constrain actors in achieving or pursuing their goals. Here, institutions are referred to as the structuring and more enduring features in social life that are persistent through time and difficult to change. They are contrived of prevailing formal and informal rules, shared norms and values, and common held beliefs (Scott, 2008). Material and social factors are likely to interact and are likely to constitute complex limits and barriers that might pose serious pressure on successful adaptation. The same possible interrelation applies to institutional and actor-specific factors. This interrelatedness once more shows the complexity and fragmentation of governance systems that are designed to cope with the complexities of adaptation to climate change. As a result of this interrelatedness, identifying where real barriers lie in setting up adaptation policy can be a complex challenge.

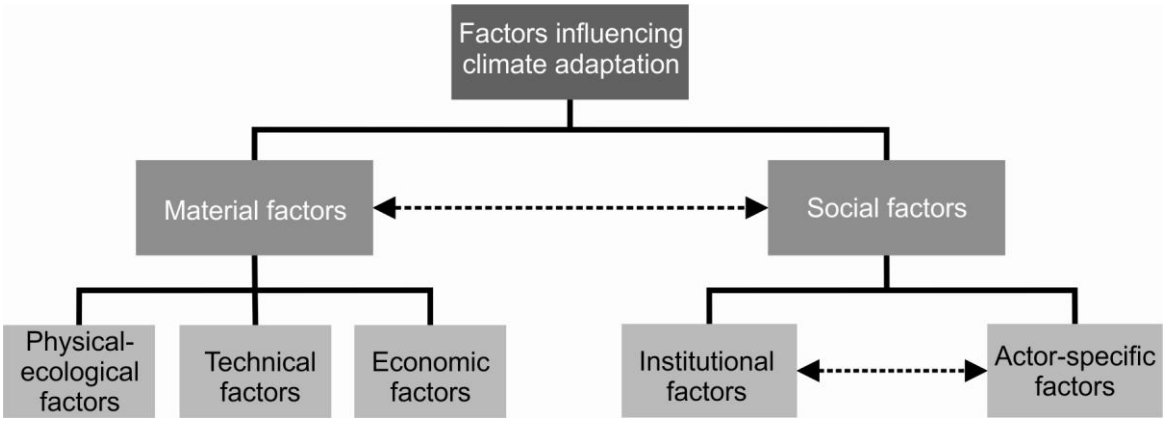

Figure 3 – Categorization of factors influencing adaptation processes (Biesbroek *et al.*, 2009b)

Literature on adaptation to climate change refers to a great variety of barriers to adaptation, but not all of them are unique solely to the issue of climate change. Rather, many are inherently linked to complex decision making in general (Adger *et al.*, 2009). Mainstream literature refers to topical issues like uncertainty, scales of action, responsibility, social capital, time horizons and the willingness to act, as important factors that present barriers for policy makers in developing and implementing adaptation strategies. There is however little theoretical understanding how these factors actually influence

decision making processes. With an increasing scientific attention to climate change from different epistemic perspectives, more theories and perspectives are becoming available to address obstructing factors in relation to policy processes. Biesbroek *et al*. (2009b) for example, link barriers in adaptation processes to theories in public administration to explore interesting overlaps that could be beneficial for understanding institutional governance barriers for the development of adaptation strategies. Most studies present barriers that are inherent to any complex policy problem. In order to explain why certain adaptation strategies strand in decision making, theories from public administration sciences could be very useful and can help to understand the causes for stagnating policy processes (Biesbroek *et al*., 2009b). Variables inherent to any complex policy issue, such as the slow-turning wheels of government bureaucracy, wait-and-see-attitudes of politicians, other competing interests and concerns, and hidden agendas of politicians, can form important barriers in adaptation processes. Many of these non-climate barriers have not explicitly been addressed by other studies on adaptation, although their influence on policy processes are known from studies of public administration and political science (Biesbroek *et al*., 2011). In order to get a better understanding of barriers in setting up adaptation strategies, this research includes both climatic as well as non-climatic factors.

2.7 Categorizing barriers to adaptation

A great variety of barriers can be identified in recent literature on adaptation to climate change, as well as in literature on complex policy issues (Biesbroek *et al*., 2011). To reduce and manage this large number of barriers and combine different streams of literature, seven categories of barriers to adaptation, based on research by Biesbroek *et al*. (2009b) and Biesbroek *et al*. (2011), will be introduced and used here: *uncertainty*, *fragmentation*, *institutional void and institutional crowdedness*, *conflicting timescales*, *motives and willingness to act*, *lack of awareness and communication*, and *resources*. It is important to keep in mind that many of these barriers are interdependent, which means that the clear distinction between different barriers in theory might not be that uncomplicated in practice. In the following section each of these groups of barriers will be briefly elaborated in order to get a better understanding of their individual meaning and their possible mutual relationships.

Uncertainty

Central to any discussion on developing and implementing adaptation strategies is the notion of uncertainty that can pose significant barriers (Dessai & Hulme, 2004). Traditional responses suggested in the literature to deal with these uncertainties, are to diminish epistemic uncertainty by conducting more research, increase computational power, communicate the range of uncertainties through scenarios and quantify degrees of uncertainties. As Sarewitz (2004) argues, uncertainty is not only about lack of scientific understanding, but also about the missing coherence between scientific understanding and the political, cultural and institutional context in which policy processes take place. Certainty is never an attainable state in strategic decision making, as uncertainty is an inherent attribute of any prospect. Decision making depends not only on the mathematical calculation of uncertainty, uncertain knowledge or irreducible ignorance, but also about the uncertainties caused by the strategies of actors and institutions involved in decision making processes (Biesbroek *et al*.,

2009b). Koppenjan & Klijn (2004) define three types of uncertainty that can lead to stagnations in policy processes. *Substantive* uncertainty refers to the complex nature of policy problems like climate change and the availability, accessibility, quality and quantity of information that is used in decision-making, to understand the problem and to design solutions (Biesbroek *et al*., 2009b). *Strategic* uncertainty refers to uncertainty about which strategies are to be used to reach strategic goals. Finally *institutional* uncertainty refers to the processes of decision making that take place at several policy arenas simultaneously and at different levels of governance.

Fragmentation

Fragmentation refers to the large number of actors involved in climate change responses at different levels of governance and widely dispersed material and human resources. Fragmentized decision making processes are characterized by a lack of connection and coordination among institutions, organizations, individuals and policies at different levels (Urwin & Jordan, 2008; Adger, 2003; Adger *et al.*, 2005; Dessai & Hulme, 2004). Because varying perceptions, strategies and objectives exist at all levels in decision making processes, adaptation requires a multi-level and multi-sector approach, in which fragmentation might lead to barriers in setting up adaptation strategies (Biesbroek *et al*., 2011). Multi-level governance is a challenge for policy makers in that they have to combine hierarchically and centrally governed political structures on the one hand with local aims and objectives, social capital, values and norms about what is desirable and socially acceptable in specific contexts on the other hand (Adger *et al.*, 2009). Fragmentation becomes visible in decision making and governance arrangements, the increasing self-organizing capacity of actors, their independence and specialization, and the increasing role of private actors in decision making. Moreover, policy processes do not take place in a policy vacuum as multiple policy processes are being played at the same time that might influence outcomes (Biesbroek *et al*., 2009b). Fragmentation can also emerge in knowledge being diffuse or only partly accessible, responsibility about adaptation being divided across different organizations, or decisions being made at different levels with decisions on one level having negative consequences for decisions on other levels (Biesbroek *et al*., 2011). Resources in adaptation policy processes, such as financial, technological, physical resources, and legislation, knowledge, information and time, are also often fragmentized in adaptation processes as not all resources are distributed equally throughout society (Swart *et al.*, 2009). It is the availability and accessibility of resources that is essential in successfully developing and implementing adaption strategies (Biesbroek *et al*., 2009b). Besides that, much of the essential information needed in setting up adaptation strategies is highly fragmentized within and between actors, organizations and different administrative levels, context specific or difficult to access (Swart *et al.*, 2009).

Institutional void and institutional crowdedness

Adaptation policies often lack commonly accepted formal institutions, rules, laws and norms according to which policy processes are taking place (Swart *et al.*, 2009). Many of the institutional factors mentioned as barriers to adaptation result from this absence of clear adaptation institutions (Inderberg & Eikeland, 2009). This lack of legal guidelines enabling, facilitating, or stimulating adaptation is often

referred to as the *institutional void* and can form a major barrier in policy processes for the development and implementation of adaptation strategies (Hajer, 2003). The institutional void can complicate communication and can lead to a situation in which there is no shared understanding of what adaptation strategies should comprise, there are no legal mechanisms or instruments for adaptation and a shared sense of urgency is missing (Biesbroek *et al.*, 2011). In most cases no coercive mechanisms are available to force or encourage the development of long-term adaptation strategies (Füssel, 2007). For example, formal arrangements to finance the development and implementation of adaptation strategies and a clear division of responsibilities, which are generally not present in institutional frameworks, would better safeguard long-term investments and process structure and progress (Bouwer & Aerts, 2006; Stern, 2006; Adger *et al.*, 2009; O'Brien *et al.*, 2006; Thynne, 2008). Decision-making becomes even more challenging assuming that the essence of adaptation strategies is to mainstream adaptation into existing institutional arrangements and climate related policy domains (Kok & De Coninck, 2007). New policy problems are emerging parallel to existing institutional orders and need to claim a position within prevailing formal and informal rules, norms and values. An institutional void therefore does not mean that there are no institutions in place, but rather that there are no institutions that address the issue in particular (Hajer, 2003). Without the availability of specific institutions, decision making is challenging, especially for the legitimacy and efficacy of decisions. According to Hajer (2003), many policy decisions "*align with traditional governance arrangements and existing ways of doing to justify the course of action.*" Therefore, adaptation decisions not only need to be taken in an institutional void but also have to align to norms and values of existing institutional arrangements, which poses the challenge of institutional change to include rules, norms and values about adaptation in existing institutional structures. Barriers might also develop as a result of a surplus of institutions, or *institutional crowdedness*. Old institutions competing with new institutions can be the cause of confusion about tasks and responsibilities, unclear or conflicting goals and divergent perceptions about the problem and possible approaches (Biesbroek *et al.*, 2011).

Conflicting timescales

The incongruence between long-term processes of climate change and short-time horizons of politicians and policies can also form an important barrier to adaptation (Biesbroek *et al.*, 2009b). The inertia of the climate system causes long time lags between the human causes of climate change and its consequences (IPCC, 2007). Therefore adaptation strategies need short-term development and implementation to respond to long-term changes and prevent disastrous future events. Even though the focus of adaptation should be on the long-term, time horizons used by politicians are significantly shorter. This political rationality forces politicians to perform well during a term to increase chances for re-election (Biesbroek *et al.*, 2009b). As a result of this rationality, the political agenda is almost exclusively influenced by pressing issues and public opinion, for which convenient solutions can be implemented within a political term and for which immediate credits will be received. The credits for anticipatory adaptation to long-term changes are difficult to identify and will only become clear in the long run. Traditional planning horizons do not look much further than five years into the future,

because well before then, society has already changed and other striking issues might need more attention. Therefore, most policy strategies are revised every five to ten years to better match societal dynamics and to use new obtained understanding of these pressing issues. Because adaptation links to such dynamics, it generally does not travel well in time and space. What is said to be necessary today might not be that urgent tomorrow (Biesbroek *et al*., 2009b). Conflicting timescales make it difficult to mainstream adaptation into new and existing policies and practices, even though adaptation may require immediate attention. Long-term changes in the climate system and the rate of projected and observed impacts are difficult to relate to the dynamics of societal change and short-termism in decision-making and policies (Biesbroek *et al*., 2011). This incongruence in time complicates decision making processes particularly because contemporary governance arrangements and policy strategies are not sufficiently equipped to deal with such time lags (Biesbroek *et al*., 2009b).

Motives and willingness to act

Without the right motives and willingness to start adapting, barriers can emerge in adaptation processes at different governance levels (Tompkins *et al.*, 2009). Factors such as attitudes, ethical beliefs, norms and values can be reasons to engage in adaptation, while a lack of these factors can constrain these processes (Biesbroek *et al*., 2011). The right motives and willingness to act are essential in developing and implementing successful adaptation strategies, but there is little understanding what exactly motivates and what discourages actors, politicians and policy makers to start adaptation. Scientific work on this topic refers to two types of motivational factors, *actor-specific* or *intrinsic* motives and *institutional* or *external* motives to start adapting (Lorenzoni *et al*., 2007b; Swim *et al.*, 2009). A better understanding of these factors would enable the development of stimulating mechanisms and instruments for adaptation or to change existing institutional and governance arrangements to stimulate actors to start adaptation (Biesbroek *et al*., 2009b). Lorenzoni *et al*., (2007b) state that factors such as a lack of understanding, uncertainty and skepticism about climate change, perceiving climate change as distant threat, a missing sense of urgency, fatalism, reluctance to change lifestyles and externalizing responsibility and blame are important barriers to individual action. If intrinsic motives are absent, policy makers feel disempowerment, despair, no sense of urgency and disbelief, which subsequently leads to low willingness to start adapting. Institutions on the other hand can also be used to motivate actors to start adapting, although actors might not be intrinsically motivated. Such external motivation is the result of tangible rewards or pressures to achieve certain goals, like financial gains and coercive tools (Biesbroek *et al*., 2009b).

Lack of awareness and communication

A lack of awareness and a lack of good communication can also create barriers in the process of developing and implementing adaptation strategies. Communication is important to increase public and political consciousness about the impacts of climate change, the levels of vulnerability and the need to start adapting (Moser, 2010). Without communication public society remains uninformed about its role and the collective or governmental efforts on adaptation. Besides communication, social and political awareness is considered to be an important condition in literature on climate change

adaptation. The public level of awareness is influenced through various media, which at times can be negative and might influence public opinion on the relevance of climate change tasks. A lack of communication between science, policy and society on climate change adaptation can result in a low level of awareness, skepticism, overconfidence or denial of the problem (Biesbroek *et al*., 2011).

Resources

The presence or absence of resources also forms an important enabling or obstructing factor in the process of adapting to climate change. According to scientific studies, a lack of resources, or the inaccessibility of resources, can form a profound barrier to climate change adaptation (Amundsen *et al*., 2010). Important tangible and intangible resources include *human resources* in setting up adaptation strategies, such as staff availability, time to become informed, managerial support and skillful and qualified individuals, *financial resources*, such as process finance and finance for implementing adaptation measures, *information resources*, such as fundamental and applied research on adaptation, tacit and local knowledge, data availability and credibility and legitimacy of information, *physical resources*, such as technological measures and *natural resources*, such as the availability of land for spatial measures. Therefore resources are often considered to be key components in the development of adaptive capacity (Füssel, 2007).

2.8 From barriers to dilemmas in the development of adaptation strategies

Systematically identifying barriers to adaptation can contribute to an advanced understanding of the adaptation process and may assist in complex decision-making processes (Moser & Ekstrom, 2010). As a result, a growing body of literature has emerged that specifically addresses questions about the existence and nature of barriers to adaptation as well as the ability to transcend them (Adger *et al*., 2009; Burton, 2009; Moser *et al*., 2008; Pielke *et al*., 2007). It is important to note that in fact it frequently is the effort of overcoming barriers that becomes the primary target and focus of the initial adaptation effort (Ekstrom *et al*., 2011). This process of overcoming limits and barriers can potentially lead to *dilemmas* for decision makers that may have significant impact on the development and implementation of adaptation strategies (Rayner & Jordan, 2010). These dilemmas pose fundamental questions for policy makers on how to set up or implement adaptation strategies, centralized or decentralized, emphasizing short- or long-term, using linear or flexible process structures, sector-oriented or integrated and so on. The answer to such dilemmas and the kinds of policy measures that flow from it depend on the overall framing of the adaptation problem (Jordan *et al*., 2009). A refined ability to identify the most challenging barriers, may allow governments, businesses and organizations to improve their understanding of adaptive capacity and strategically design processes to overcome potential dilemmas in working on adaptation strategies (Ekstrom *et al*., 2011).

According to Ekstrom *et al*. (2011) overcoming barriers should not be seen as a normative must, rather barriers should be approached descriptively as impediments that simply can stop, delay, or divert adaptation processes. Moreover, overcoming all barriers does not necessarily lead to a successful adaptation process. Not even the best run process should be expected to be free of

barriers and outcomes may still require adjustment (Moser & Ekstrom, 2010; Ekstrom *et al*., 2011). In practice, the presence and severity of barriers needs to be carefully assessed in order to determine how the process of adaptation is taking place, as well as the relative importance of each barrier in this process (Biesbroek *et al*., 2011). Barriers may frequently appear as factual limits and not questioning their changeability may in itself be an obstacle to sufficient adaptation progress (Moser & Ekstrom, 2010; Ekstrom *et al*., 2011). But successful adaptation is not solely limited by exogenous forces outside society's control (Adger *et al*., 2009). Cultural norms, values and institutions are largely responsible for the creation and preservation of most barriers. Successful adaptation will only occur if these restrictions are recognized, influenced and overcome (Jones, 2010). Social values translate into action because they frame how societies develop rules and institutions to govern risk, social change and the allocation of resources. Therefore, whether or not barriers should be seen as *limits* to adaptation depends on goals, values, risks and social choice (Hulme *et al*., 2007). Social values are likely to vary within and between societies and are likely to change over time, so what may be a barrier in one society or at one particular moment in time may not be in another, depending on the ethical standpoint, the emphasis placed on projections and the risk perception of society (Adger *et al*., 2009).

A better understanding of barriers in decision making, their underlying mechanisms and strategies to overcome them could facilitate effective and innovative future adaptation strategies (Biesbroek *et al*., 2011; Adger *et al*., 2009). Based on improved understanding, innovative strategies need to be developed to overcome barriers or else barriers are likely to subsist and continue to impede the development and implementation of adaptation strategies. In scientific literature governance emerges as the art of navigating and overcoming the barriers that stand in the way of developing appropriate strategies and policies; as well as finding the necessary human, social, technical and financial resources to enable and implement them (Moser, 2009b). Leadership, strategic thinking, resourcefulness, creativity, collaboration and effective communication are required in circumventing, removing, or lowering barriers. Ultimately, this chapter is coming to its conclusion by elaborating the role of this theoretical framework in the remainder of this research in the conceptual framework.

2.9 Conceptual framework

Based on the problem description and research objective described in **Chapter 1**, and the theoretical concepts elaborated in this chapter, a conceptual framework has been set up that will be used to structure the remainder of this thesis. By linking research objectives, theory and case studies, the framework clearly positions the main concepts of interest to this research as well as their mutual relationships (**Figure 4**) in eventually drawing conclusions. To structure the following chapters of this research, the case study will be analyzed based on three research steps, which are subsequently based on the main theoretical concepts elaborated in **Chapter 2**. Together these concept-based research steps will constitute a logical and straight-forward argumentation between on the one hand the theoretical underpinnings and the empirical findings on the other hand. The steps are meant to come up with a well-founded answer to the research question and draw a well-motivated and clear conclusion in the final chapter.

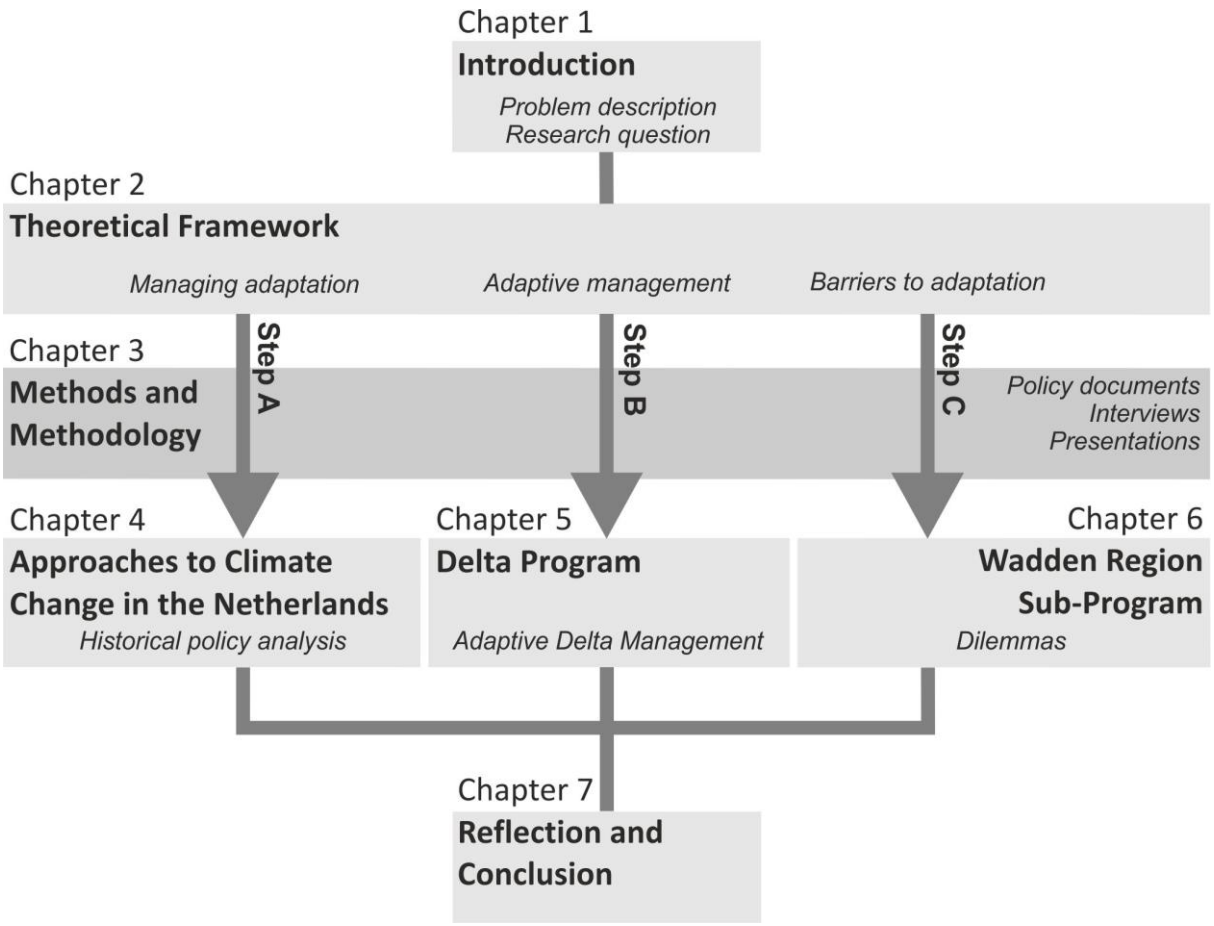

Figure 4 – Conceptual framework with schematic research structure

The transition from the theoretical framework to the chapters containing the case study analyses takes place through three research steps (A, B and C), which are based on the concepts discussed in the theoretical framework in **Chapter 2** and will be addressed in the exact same order in **Chapters 4**, **5** and **6**. Here, all three research steps will be shortly elaborated and the link between theoretical concepts from **Chapter 2** and empirical analyses in **Chapters 4**, **5** and **6**, as well as their mutual relationships will be explained. The research steps have been based on the translation of the ADM concept from the national to the regional level, of which the findings will be used to reflect on the actual adaptiveness of the concept when set against the intended benefits. First of all, Step A originates from the obstructing factors inherent to managing the development of adaptation strategies as elaborated in **Chapters 2.1** and **2.2**, which over the years have led to gradual paradigm shifts in the fields of water management and spatial planning. In this research step, a closer look will be taken at this particular paradigm shift in the Netherlands in **Chapter 4**.

Step A – Approaches to Climate Change in the Netherlands

The complexity and uncertainty in managing adaptation might be a reason to structurally change prevailing policy discourses and switch to alternative approaches in developing adaptation policy. For the Netherlands the historical transition of water management and spatial planning approaches has played a crucial role in developments towards present policy and institutional frameworks. The

theoretical concept of obstructing factors to managing adaptation responses, *uncertainty and change*, *complexity*, and *organizational and institutional fragmentation and fixations* elaborated in **Chapter 2.1** and **2.2**, will form a useful starting point for discussing policy evolution in Dutch water management and spatial planning and how governance responses changed accordingly. In this transition a clear switch can be recognized from a traditional towards an approach more based on adaptive principles. To give the fullest possible insight into policy developments and initiatives that have been taken over the years to improve spatial responses to climate change, **Chapter 4** will start off with these initiatives and developments that have eventually led to the establishment of the Delta Program.

In response to traditional technical-rational approaches that have long been mainstream in developing climate policy, a variety of factors has led to the development of more adaptive approaches that are expected to be better able to deal with the uncertainties and complexities of climate change. Step B therefore will take a closer look at the national Delta Program and especially at the ADM approach that has especially been developed in this national government program to attain more sustainable adaptation initiatives in a context of uncertainty, complexity and administrative fragmentation.

Step B – Delta Program

The ADM concept, as developed by the national Delta Program will be discussed and analyzed in **Chapter 5**. Besides this concept, the Delta Program organization and time planning will be discussed as these contain many important factors essential to the applicability of ADM. The theoretical basis of the adaptive management concept and its process approach as elaborated in **Chapters 2.3** and **2.4** will be used as a heuristic frame of reference for analyzing the value of the ADM concept in striving for flexible decision making. The ambiguity of the theoretical terminology of adaptive management as elaborated in **Chapter 2.5** makes judging the practical value of the ADM approach, which is based on these principles a nearly impossible task. Nevertheless, these limitations will be taken into account as the basic conceptual principles of an adaptive process, such as the iterative and flexible character will be used to give general analytical feedback on the ADM concept.

Eventually the ADM concept, as developed by the national Delta Program in The Hague, has to be implemented in a wide variety of regional and local contexts. At the regional level, where actual adaptation strategies have to be developed, dilemmas in using ADM might emerge that were not considered while developing the concept at the national level. It is this translation, implementation and practical applicability of the ADM concept that the final research step specifically focuses on. Step C therefore aims at the particular dilemmas that are being encountered in the Wadden region sub-program as a result of the application of the adaptive principles behind the ADM concept.

Step C – Wadden Region Sub-Program

The Wadden region sub-program case in **Chapter 6** will specifically focus on the question if and how barriers play a role and lead to dilemmas in working on adaptation strategies in this regional sub-program. Besides elaborating barriers and dilemmas, gaining more insight into the specific physical, administrative and institutional context of the Wadden region is of great importance as this might to a large extent clarify the presence of particular dilemmas. To gain insight into dilemmas that are being

encountered in this region, the same classification of barriers will be used as in **Chapter 2.7**. This structured list will be used as a heuristic framework for analyzing and structuring the findings on the situation in the Wadden region sub-program case, in order to draw well considered conclusions.

Finally a synthesis of outcomes from these three research steps will constitute well-founded input for answering the research question and reflecting on the research outcomes in **Chapter 7**. The conclusion will form a general reflection on current Dutch water management as well as a more specific reflection on the Delta Program in general and the struggle of the Wadden region sub-program in using ADM in particular. This chapter will also contain a discussion of research outcomes, a broad research reflection and recommendations for possible future research and improving the applicability of the ADM concept.

Chapter 3 – **Methods and Methodology**

This chapter will elaborate the research methods and methodological strategy used in finding the answers to the research objectives and research question described in Chapter 1. In order to do so, multiple information sources will be deployed so that besides a thorough theoretical framework, a comprehensive empirical analysis of the case under study will deliver a legitimate scientific basis for drawing conclusions in this thesis. Specific research methods will be targeted towards the research steps as described in the conceptual framework. In this way a methodological strategy per research step can be designed, of which all steps together will pool a broad set of theory, policy, expertise and experiences in finding well-grounded and therefore legitimate answers.

3.1 Research methods

Due to the fact that this research is not describing an unambiguous and fixed situation, the role of giving meaning to various perceptions involved in the Delta Program is of great importance in order to draw legitimate conclusions. As a result, an important quality criterion in the methods used for this research is *triangulation*, the use of multiple perspectives from multiple information sources to base scientific argumentation on. The starting point of this research is to explicitly put a broad base of viewpoints and experiences on the table, within the feasibility framework that consists of available time, labor and other resources. In this research, triangulation of information from policy documents, presentations and interviews are used to stress the tensions and describe the struggle that the Delta Program is currently in. Working documents, official policy documents and policy presentations have definitely contributed to an improved understanding of the progress in the process of introducing ADM in Dutch water management practice and at the aspects that are accentuated most in this process and especially why. All policy documents related to Delta Program activities are freely available online at *Pleio* (Deltaweb, 2012), a government-wide information platform across organizational borders for improving collaboration, disseminating knowledge and creating new facilities. Yet, policy documents are still nothing more than just words on paper and usually have little value as soon as more emphasis is placed on the analysis of issues such as dilemmas in developing long-term adaptation strategies. Therefore personal experiences and expertise has been of vital importance to gain sufficient insight into the factors the Delta Program struggles with.

Therefore, a total of eight interviews were conducted with respondents from both within and outside the Delta Program. The total of seven respondents from within the Delta Program can be separated into two groups, two respondents from the national Delta Program and five respondents from the Wadden region sub-program. The respondents from the national Delta Program have been selected based on their responsibilities and expertise in the program. These two respondents, Pieter Bloemen and Floris Hammer, staff members of the national Delta Program in The Hague, are responsible for *Strategy and Knowledge* and therefore are directly involved in the development of the ADM concept. A presentation by these two staff members on the general ideas behind and intended benefits of the ADM concept was attended at the Radboud University of Nijmegen, followed by a more in-depth

interview on the exact philosophy behind this concept and obstructing aspects the national program runs into. Regional respondents were selected based on the organization of the Wadden region sub-program, which is made up of three program task clusters that together encompass all activities the sub-program deals with (see **Figure 9**). For this research, all cluster leaders have been interviewed as well as the sub-program manager and his representative to get a good insight into the role of adaptive decision making throughout the program organization. All these respondents are delegated to this sub-program by the national or a regional government. The five interview respondents from the sub-program Wadden region are Pieter den Besten (representative program manager and initiator trilateral cooperation Wadden region, Ministry of *Infrastructure & Environment*, The Hague), Kees van Es (program manager, Ministry of *Economic affairs, Agriculture & Innovation* (EL&I), Leeuwarden), Siep Groen (cluster safety strategies, Ministry of EL&I, Leeuwarden), Rick Hoeksema (cluster system knowledge and monitoring, Rijkswaterstaat, Leeuwarden) and Kees de Jong (cluster safety tasks, Water board Noorderzijlvest, Groningen). The last interview respondent from outside the Delta Program is expert consultant Govert Geldof, who has a specific expertise on complex decision making in the fields of water management and spatial planning, and has done intensive research into the use of adaptive management approaches in these field (see Geldof 1995; Geldof, 2004). This respondent has been selected to reinforce the discussion of research outcomes, the adaptive management concept and its practical applicability. The appendix contains the full list of interviewees, their position within the research field as well as relevant side information.

No generic interview guide has been used throughout the interviews with national and regional program respondents. This deliberate methodological choice has led to semi-structured interviews that could be formulated as informal conversations, since especially the struggle a regional sub-program has to cope with is often very fuzzy and cannot be blamed on one single barrier. This methodological approach has been chosen to avoid preconceptions and biased interviews as much as possible. The national Delta Program interview topics were focused on subjects such as the theoretical and methodological principles behind the ADM concept, expected limitations of this approach at the national level and the anticipated struggle of its regional implementation. The interviews at the regional sub-program level have especially contributed to mapping out dilemmas as they are experienced in the process of using the principles of flexibility and learning processes in setting up adaptation strategies in a specific regional context. Finally, a semi-structured interview with expert consultant Govert Geldof was meant to place the findings from the Delta Program interviews into a broader perspective. This interview mainly concentrated on the paradoxes between current water management policies on paper and the dilemmas of their practical implementation, the confusion over basic water management and adaptive management concepts, and some general points of improvement for ADM. The methodological strategy per research step will be shown in the following part.

3.2 Methodological strategy per research step

To structure the scientific efforts in working on well-founded answers to research objectives while at the same time advocate the approach developed in the conceptual framework, a specific

methodological strategy per research step has been created. Each of the three research steps (A, B and C) comes with its own specific methodological strategy, which together will constitute a well-balanced and straight-forward argumentation in which a sufficient variety of information sources are used. The research methods per research step will be illustrated in the following section as well as how they relate to each other and constitute a legitimate methodological research strategy.

Step A – Approaches to Climate Change in the Netherlands

The policy analysis in the first step is an attempt to put the following research steps in an administrative and political context. Policy documents and secondary literature in which policy developments in Dutch water management are analyzed are central in mapping out the development towards the present policy framework that constitutes the point of departure for this research. A number of *shock-events* over the last decades have created *windows of opportunity* for radical policy change such as the establishment of the Delta Program. These changes together with developments in the field of spatial planning have created viable conditions to take a radically different approach in developing sustainable adaptation strategies. This policy analysis is essential in understanding the shift away from the traditional approach, which has been typical to Dutch water management for decades, towards a more adaptive approach.

As already stated before, step A puts the efforts of the Delta Program, which are covered in Steps B and C, in the right context. This policy framework will act as point of departure for the various interviews, since initiatives and decisions taken by the Delta Program are bounded by both opportunities and restrictions this framework offers.

Step B – Delta Program

Policy documents and secondary literature focused on the Delta Program and related policy and institutional frameworks play an important role in the second research step mapping out the organization of the Delta Program and the ADM concept. However, in describing the main principles of and the idea behind ADM, the information from presentations and interviews at the national level prove to be truly essential, as these really stress the potential benefits and the struggle experienced at the national level in developing and implementing this concept. Both interviews at the Delta Program level are used to gain more insight into the considerations at the national level that have led to particular decisions in designing the ADM concept and how it is ought to be implemented in sub-programs.

The findings from Step B have deliberately been used in interviews at the regional level. Using quotes and interview findings from the national Delta Program in interviews at the regional level exposed tensions and conceptual confusion around the ADM approach between the national and the regional level and varying insights on how or even whether it should be used at all.

Step C – Wadden Region Sub-Program

Compared to the national Delta Program, substantially different dynamics are at stake at the regional level where adaptation strategies are to be developed that need to cope with the dynamic regional long-term effects of climate change. Besides policy documents and working documents that have

been used to analyze the complex tasking and organization of the Wadden region sub-program, the five interviews played a crucial role in this final research step as well in order to find out more about what particular dilemmas are being experienced throughout the sub-program organization and about expectations on future developments in the use and applicability of ADM.

In this way the order in which Delta Program interviews were conducted is deliberately based on the main research lay-out that looks at the way how the ADM concept is being translated from the national program to the regional sub-program level, as elaborated in **Chapter 1** and displayed in the conceptual framework in **Figure 4**, by subsequently looking at its intended effect at the national level and its practical limitations at the regional level. By submitting considerations and findings from the interviews and presentations at the national Delta Program level to the regional sub-program organization, dilemmas in using this ADM approach come to the fore, which result from the intended benefits at the national and the actual limitations of the concept at the regional level. In the conclusion the findings of the interview with Govert Geldof are combined with remarkable findings from other interviews so that legitimate conclusions can be drawn about the current situation in the Delta Program and put these findings into a broader perspective by reflecting on the contemporary water management discourse in the Netherlands and its main concepts. In the final chapter all efforts from the three research steps are brought together and are overlooked to give a broad based overview of the influence of adaptive decision making within the Delta Program and the share of adaptiveness in its regional application.

Chapter 4 – **Approaches to Climate Change in the Netherlands**

This chapter will elaborate the historical transition of Dutch spatial planning and water management policy frameworks in the context of climate change. By describing the establishment of national adaptation strategies and the role transitions in water management and spatial policy have played in this process, this historical overview is essential in putting policy developments towards the Delta Program in the right perspective, as institutional structures are known to form the basis on which new policy developments are being initiated. The focus will be on uncertainty and change, complexity, and organizational and institutional fragmentation and fixations in describing the policy shift from a traditional central technical-rational approach towards a more adaptive and decentralized approach in water management. The changing approaches to climate change in the Netherlands elaborated in this chapter will form a valuable background in describing the institutional framework on which the Delta Program is build, the approaches used in this program and how they work out in the Wadden region.

4.1 A paradigm switch in Dutch responses to climate change

The Netherlands is often portrayed as one of the major victims of climate change and is renowned for its battle against water that has already been taking place for several centuries (Davoudi *et al*., 2009). The Netherlands is a relatively small and densely populated country with over sixteen and a half million inhabitants, which is home to the sixteenth largest economy of the world (CBS, 2012). The country is located within the deltas and flood plains of the rivers Scheldt, Meuse, Rhine and Eems. Almost one-third of the country's territory is located below current average sea level, while another third has to be protected by dikes and storm surge barriers from flooding in periods of high river discharge (Swart *et al*., 2009). Besides that, the Netherlands has to deal with soil subsidence as a result of gas extraction, peat oxidation caused by ground water level control and geological processes. Ten million people live in these flood prone areas and 65 percent of the Dutch GNP is being generated there (Kabat *et al*., 2005), which makes its population and economy extremely vulnerable to the potential effects of climate change through the water dimension (Veraart & Bakker, 2009). With most economic activity situated in Europe's largest delta region, climate change impacts could turn out to be disastrous for Dutch society and economy. After a large flood disaster in 1953, with economic losses estimated at €1 billion and 2,000 lives lost, the now famous *Delta Plan* was designed. This plan, a comprehensive system of highly visible policies and large infrastructural interventions like dikes and surge barriers, was implemented over the following decades (Kabat *et al*., 2005; Swart *et al*., 2009). Even though the establishment of the Delta Plan has led to flood defense standards which are known to be the highest in the world (Kabat *et al*., 2005), the increasing threat of flooding – which will only be exacerbated by climate change – makes the Netherlands one of the most vulnerable countries in Europe (EEA, 2008; VROM, 2007). This declares why water management is the core issue of climate change adaptation policy in the Netherlands (Davoudi *et al*., 2009). The effects of climate change however will not only lead to increased river discharge and sea level rise, but are also likely to create longer periods of droughts, increase the urban heat island effect and the probability of urban flooding due to increased precipitation (Kabat *et al*., 2005; Swart *et al*., 2009). This

chapter and the remainder of this research will exclusively focus on the water safety dimension of climate change adaptation in the Netherlands.

Due to a long tradition of strong governmental responsibility, protecting the Netherlands against flooding is being enshrined in the Dutch constitution, which means that political support for protective water safety measures is almost self-evident (De Vries, 2006). This resulted in Dutch society generally having great faith in its central government to ensure sufficient water safety, which is a direct consequence of the traditional water management paradigm, which was dominantly aimed at pursuing unambiguous water safety throughout the country for many decades. This paradigm can be described as an approach in which predefined generic flood risks norms form the starting point for water safety tasks. Another key characteristic of this traditional water safety paradigm concerns the central style of policy making, which is heavily influenced by a strong reliance on scientific research and a strong engineering ethos. During this era most water management initiatives were based on fixed targets, end states, strict timetables and a command-and-control approach which suit water engineers well (Davoudi *et al*., 2009). At the national level the *Ministry of Infrastructure & Environment* (I&M), formerly the *Ministry of Transport, Public Works & Water Management* (V&W) and its policy implementing agency *Rijkswaterstaat* traditionally form the main players in Dutch water management. Their central role in protecting the country from flooding combined with their status as strong unified state institutions have turned them into powerful actors (Faludi, 2005). Taking the potential threats of climate change into consideration, the Dutch have been forced to become skilled water engineers, a management aspect that over the years has become cultivated in water management and spatial planning (Dutch Water Sector, 2012).

However, while this traditional water safety approach suggests a high degree of precision, it has a tendency of neglecting uncertainties (Davoudi *et al*., 2009). The idea that engineering and research can with a great amount of certainty determine the chance of flooding was increasingly being questioned, as uncertainty is a fundamental aspect of risk. Not only do more uncertainties exist, uncertainties are also likely to increase as a result of climate change (Davoudi *et al*., 2009). The public debate about how to cope with an increased flood-risk as a result of climate change was accelerated by two near floods in the Rhine river basin in 1993 and 1995 (Kabat *et al*., 2005). These events shocked the comforting idea that everything was under control. The first government reaction – according to the traditional paradigm – was the draft of a *new Delta Plan* with many planned large scale infrastructural protective measures (Wiering & Driessen, 2001; Davoudi *et al*., 2009). At the same time however new alarming climate change predictions were published. The fact that the existing situation did not provide the desired safety levels, combined with the fact that future developments would make things even worse, formed an important *window of opportunity* for structural policy change (Wolsink, 2006; Wiering & Immink, 2006; Davoudi *et al*., 2009). Questions were raised to whether the traditional technological-engineering approach would be sufficient to successfully counter the effects of climate change in the long run and bring about sustainable water safety in the Netherlands (Kabat *et al*., 2005; De Vries, 2006; Voogd, 2006; Werners *et al*., 2009).

It is increasingly being acknowledged that spatial planning processes that ignore the risk of flooding are generally considered not viable in the long run (Davoudi *et al*., 2009). Even though water was considered to be a threat, a nuisance, or at least a waste of space in spatial development throughout the 20th century, more recently the idea started to gain support that spatial planning strategies should be more oriented and better attuned to the crucial role of water in the Netherlands (Davoudi *et al*., 2009). Based on these insights and the increasing awareness that the traditional approach was not appropriate to bring about sustainable water safety, a new adaptive discourse of *accommodating water* or *living with water* has first emerged in the *Water management 21st century policy* report, which later became the incentive for policy directives such as *Room for the River* and the *Delta Program* (Wiering & Immink, 2006; Swart *et al*., 2009). This policy report had the goal of spatializing water management by reconsidering the relationship between water management and spatial planning as the key to sustainable climate policy and spatial development (CW21, 2000; De Vries, 2006). Where the traditional paradigm was based on resistance to extreme conditions, the new adaptive discourse is based on the concept that flexibility is necessary and a focus on creating system resilience and adaptive capacity are needed. An important outcome of the adaptive discourse was that the dominant perception of climate change as a risk that needs to be reduced or managed has been complemented by a view of climate change as an opportunity for creativity and innovation in the search for adaptation interventions (Sedee & Pijnappels, 2010). This adaptive policy discourse argues that extreme climatic events have to be accommodated rather than fought, by using spatial measures that seek not only to increase safety levels, but also integrate social, environmental and economic aspects (Werners *et al*., 2009). Therefore the water system should proactively structure spatial planning and not the other way around (Voogd, 2006). The next section will elaborate the transition towards this renewed interaction between spatial planning and climate policy in the Netherlands.

4.2 Climate-proofing Dutch spatial planning

Because the Netherlands has to accommodate a wide variety of spatial functions onto a relatively small surface area of land, while at the same time maintain or improve spatial quality, the evolving problem of climate change has given a strong impetus to reconsider the relationship between water management and spatial planning. The way to use available space as effectively as possible is to look at all functions and features as an integrated whole together with the additional water safety demands in decision making (Satijn & Ten Brinke, 2011). In fulfilling this task, the Dutch government is committed to making its spatial lay-out *climate-proof*, a challenge in which spatial planning has a leading role (Kabat *et al*., 2005). Climate-proof in this context means that spatial plans should be able to accommodate both predictable as well as unpredictable impacts of climate change and are aimed at increasing adaptive capacity (**Chapter 2.1**) (VROM, 2007). The transition towards preparing water management and spatial planning to the effects of climate change requires changes in many different aspects of policy making. Since water management and spatial planning are strongly embedded in existing institutional and policy structures, changing existing practice is not only a matter of policy change, but more importantly a matter of institutional change (Davoudi *et al*., 2009). Such institutional change calls for approaches that do not belong to current repertoires of knowledge and practice. A full

integration of spatial planning and water management requires much organizational learning and institutional change at all levels, including new forms of governance (Howe & White, 2004). It is increasingly acknowledged that planning in the face of uncertainty requires flexible governance structures, whereas traditional institutions, as Davoudi *et al.* (2009) state it, mainly serve the defensive status quo. This governance transition can be clearly distinguished in Dutch spatial planning and has contributed to improved adaptive approaches to climate change related water management tasking.

In mainlines, Dutch spatial planning practice is based on the 2006 *National Spatial Strategy* (in Dutch: Nota Ruimte) and its successor the *Structural Vision Infrastructure & Space* (in Dutch: Structuurvisie Infrastructuur en Ruimte) that replaced the former in 2012 (I&M, 2012). These governmental strategies are long-term visions on spatial developments and corresponding objectives of national interest (Government of the Netherlands, 2012). Simultaneously with the National Spatial Strategy, the legal spatial planning framework was updated pretty drastically by the *new spatial planning act* (in Dutch: Nieuwe Wet Ruimtelijke Ordening) (Wro) that was adopted in 2008 and replaced the *spatial planning act* (in Dutch: Wet Ruimtelijke Ordening) (WRO). The Wro introduced new responsibilities and rules concerning spatial planning that strongly contrast with its predecessor. Traditionally, central steering was based on programmatic and generic policy, expected to be applicable in any situation, in which lower governments were nothing more than executive bodies (Voogd & De Roo, 2004). With the Wro, each government level has access to basically the same legal instruments and is responsible for its own spatial policy, taking into account tasks and responsibilities of higher level governments, which means the national government no longer interferes with each decision making process and instead aims to guide more strategically on mainlines (Van Doorn & Pietermaat-Kros, 2008). Instead of the reactive attitude in the WRO, national and provincial governments now take a more proactive stance and provide decentralized governments with strategic spatial policy in the form of *structural visions* earlier on in the process (Van Der Vlist & Van Dijk, 2009). Since adaptation to climate change can be included in both national and lower level visions, these themes will affect decision making at underlying government levels (Jeuken & Morsselt, 2008), which creates space for development on the principle to take up as much as possible at a decentralized level and only centralize those issues that require strong guidance. Based on this principle of *decentralization*, emphasis in Dutch spatial planning has shifted from a traditional idea of setting spatial restrictions at the central level, to stimulating desired developments at the regional and local level (VROM, 2006), based on the principle of *subsidiarity* that implies the deferral of responsibilities and tasks to the lowest possible scale level where they can be executed.

It is especially the approach of governance and guidance, rather than the policy content that has changed drastically in this new legal framework. Fewer central government rules and regulations, more scope for local and regional considerations, more development planning and less development control are some of the intended improvements. Decentralization is and never will be a goal in itself, but instead is a means of realizing goals set by governments at lower spatial scales, whether or not together with other parties. This approach leads to the situation in which responsibilities between and within governments are constantly subject to change, which subsequently leads to changes in the

prospect of the approach of spatial planning. With current tendencies of combining different strategies and sector-oriented interests, climate policy – formerly centrally managed – unfolds more and more as a renewed decentralized governance policy issue in which adaptation tasks and tailor-made approaches that suit a specific spatial context can both be included (Wiering & Immink, 2009). The transition to the decentralization of policy responsibilities therefore can also be characterized by a shift from goal-orientation towards optimization of the spatial decision making process (Voogd & De Roo, 2004). This spatial planning framework offers great opportunities for a more adaptive approach of adaptation tasking in the Netherlands in setting up a sustainable and climate-proof spatial lay-out.

Still climate-proofing the Netherlands is considered to be one of the greatest spatial challenges of the 21st century. With taking into account the possible short and long-term effects of climate change, this task should increasingly become a catalyst for strategic decision making in spatial planning (VROM, 2007). The administrative task of adapting to climate change comprises the development of a coherent vision at different scale levels, adjusting sector-oriented interests from different policy fields and finding the right direction to realizing this coherence and alignment. This task comprises a number of vital considerations that are decisive for the way in which it will be dealt with over the coming decades. Even though adapting to the effects of climate change is essential for Dutch society, decentralized governments usually are not able to fully integrate adaptation into short-term plans, since these authorities do not have sufficient knowledge, skills and capacity to estimate long-term effects of climate change and to integrate these into long-term spatial developments. Therefore the need for applied knowledge at the local and regional levels is increasing. Strong cooperation between governments, the business community, civil society organizations and science is crucial in achieving intersectoral and integrated solutions for Dutch spatial planning, and at the same time increasing society's awareness and legal readiness. The long period in which the traditional control paradigm was leading, has stagnated the development of specific and practical knowledge, which now forms a serious barrier for creative and innovative solutions that are needed in preparing the Netherland for future climate change (Davoudi *et al*., 2009). In order to give more attention to the possible long-term effects of climate change at these governmental levels, further integration of scientific knowledge and its practical applicability is needed. Hence Dutch governments have initiated an intergovernmental research program in 2006 with the task of developing an adaptation strategy to further embed adaptation into policy, regulations and governance structures.

4.3 Working on a National Adaptation Strategy

As the need for stronger cooperation between the scientific and governmental worlds in setting up adaptation strategies is increasing, it should come as no surprise that several research programs and policy strategies have been developed and implemented over the last decade to gain a better intersectoral understanding of climate change and its impacts. From 2001 onwards, the national government has argued for more research on climate change adaptation, particularly through the field of spatial planning. This effort resulted in a number of national research programs that have been initiated and take climate change impacts and adaptation as their main research focus. The most

influential programs are *Habiforum*, *Deltares*, *Living with Water* (in Dutch: Leven met Water) (2004-2010) and the two largest national research programs with a focus on climate change impacts, vulnerability and adaptation *Climate for Space* (in Dutch: Klimaat voor Ruimte) (2005-2011) and *Knowledge for Climate* (in Dutch: Kennis voor Klimaat) (2008-2014). Most of these research programs are (partly) financed through the national research stimulation fund *Bsik* that aims to create the right conditions and lay the foundation for a high-quality knowledge economy in climate-proofing the Netherlands (Swart *et al*., 2009).

In response to a number of IPCC reports in which adaptation was added to the existing mitigation agenda, several Dutch policy reports were issued which directly related to increasing vulnerabilities to climate change. While the Dutch national white paper on spatial development (*National Spatial Strategy*) was discussed in Parliament, the outcomes of these IPCC reports led to critical questions about what response would be appropriate to cope with climate change related effects (Davoudi *et al*., 2009). It might sound somewhat surprising that although it had been known for a long time that climate change will most likely have great impacts, the development of a formal adaptation strategy has only started well after the turn of the century. An important inducement that marked the start of the political process of developing a Dutch adaptation strategy was a motion by Member of Parliament Lemstra in 2005, who stated that strategic spatial planning was based on a too short time span and did not pay enough attention to the potential long-term effects of climate change (ARK, 2012). In order to set up an unambiguous adaptation strategy, in 2006 the ministries of (at that time) *Spatial Planning, Housing and the Environment* (VROM), *Transport, Public Works and Water Management* (V&W), *Agriculture, Nature and Food Quality* (LNV) and *Economic Affairs* (EZ) together with provinces, municipalities and water boards established the comprehensive national program *Adaptation, Space and Climate* (ARK) with the objective to include adaptation into spatial developments and spatial programs and by doing so giving spatial planning practice a key role in climate-proofing the country (ARK, 2012). ARK was several times larger than former research programs on this topic, in both size and scope. It was targeted to develop a comprehensive agenda that deals with climate change across several sectors of society, through partnerships between policy makers, researchers and other stakeholders (Kabat *et al*., 2005). The ARK program was initiated to coherently develop a formal strategy that would be useful in structuring the mainstreaming of adaptation into spatial decision making (Swart *et al*., 2009).

In 2007 the Dutch government officially formulated a national strategy in which climate change had to become a catalyst in strategic spatial decision making (Van Buuren, 2009). The ARK program was based on a multi-disciplinary approach as it was assumed that making spatial adjustments based on changing climatic conditions was the responsibility of a wide variety of parties (VROM, 2007). The program strategy was aimed at an innovative and intersectoral cooperation between governments, governmental organizations, scientific knowledge institutes, social organizations and the business community. The ARK program can be characterized by a strong strategic character and had a particular focus at raising awareness on the potential impacts of climate change on spatial planning, a task for which adaptation and multiple-use-of-space were propagated as sustainable ways of spatial planning (VROM, 2007). The ARK program tried to convey authorities involved that climate-proofing

Dutch spatial planning is not just another burden in complex decision making, but in the end might also offer chances for innovative solutions that are well worth the consideration. It was acknowledged that adapting to climate change requires a change in the way of thinking as well as in the way of acting. However such a transition process takes a lot of time and effort (VROM, 2007). According to the governmental parties involved, the ARK program could not perform well and reach goals without taking away part of the uncertainties inherent to climate change by doing more thorough scientific research and make quick-scans of existing knowledge about emerging problems and to identify gaps in knowledge and eventually provide input for future policy developments (Veraart *et al*., 2006). In this scientific trajectory, research programs teamed up in developing insight into the uncertainty in present knowledge about climate change and its consequences, as well as uncertainties surrounding socio-economic developments which complicated the playing field for decision making (Davoudi *et al*., 2009). However, the implementation of this strategy was eventually casted aside as the ARK program and its efforts got overtaken by the development of the Delta Program (Werners *et al*., 2009).

4.4 Towards a Delta Program

In 2007 a *Delta Commission* was installed, following the commission formed after the 1953 floods, with a broad mandate to evaluate the potential effects of climate change in the Netherlands and develop an integral perspective on making the Netherlands more climate-proof for at least up to 2100, while keeping its main characteristics intact (Kabat *et al*., 2005; Delta Commission, 2008). In their ambitious *Delta Advice*, which was submitted to the national government in 2008, the Delta Commission emphasized it was doubtful whether Dutch water management and spatial planning were sufficiently equipped for the possible long-term effects of climate change (Delta Commission, 2008). This advice had no direct links to the adaptation strategy and its recommendations that were developed just years before. Instead, the political impact of the Delta Advice has shifted its focus from primarily spatial planning at the time of the ARK program, to more emphasis on *integrated water management*. According to the Delta Commission, the imperative for action was not immediately acute, but indeed was urgent. The commission concluded the Delta Advice by stating that "c*limate change is now forcing itself upon us, a new reality that cannot be ignored*" (Delta Commission, 2008: 5). Trying to cash in on this, the Delta Commission formulated a list of radical recommendations such as raising flood protection levels in diked areas by a factor ten (Delta Commission, 2008; Werners *et al*., 2009).

The primary goal of the Delta Commission in their advice was the development of a national vision on how the Netherlands could be able to guarantee sufficient water safety and on ways in which the effects of climate change could be taken care of in the long-term (Delta Commissie, 2008). Once more, emphasis was placed on the fact that future challenges were not exclusively threatening, but did also offer good opportunities for integrating water safety with economic development, spatial planning and ecological development. Here, the commission builds on previous findings from the ARK program (VROM, 2007) and water management policy as developed in the *Room for the River* program (V&W, 2000). Another goal of the Delta Commission was to transfer a sense of urgency to society in general and to policy makers in particular. Without this urgency and a lack of problem awareness, the

Netherlands would now be considered safe and taking measures now would not be seen as immediately necessary. However, to prepare the Netherlands to climate change in a sustainable way, required measures would have to be taken as soon as possible that do not just guarantee safety on the short-term, but especially on the long-term as well. The Delta Commission wanted to stress this urgency in order to be able to start working as soon as possible and avoid the passing of eventual future problems on to next generations as much as possible (Delta Commission, 2008).

To operationalize these substantial recommendations, the Delta Commission proposed the establishment of a comprehensive *Delta Program* in which adaptation tasks are worked out jointly, a *Delta Law* in which tasks and responsibilities are legally registered, a *Delta Commissioner* with the responsibility of coordinating and facilitating the execution of the program and a *Delta Fund* to guarantee sufficient financial resources for long-term implementation of adaptation interventions (Delta Commission, 2008; Swart *et al*., 2009). It was in 2010 that the Dutch government officially launched the Delta Program to ensure long-term water safety for the Netherlands and sufficient fresh water supply for at least the century to come (Dutch Water Sector, 2012). Until then, most initiatives for adaptation policies were mainly targeted at placing the issue on the political agenda and raising public awareness. However, besides raising political and public awareness, the Delta Program has a specific focus on the actual implementation of adaptation into practice. The adaptation strategies to be developed in the Delta Program will contribute to the realization of the policy set down in the first *National Water Plan* (2009-2015) (NWP), which forms the legal policy framework for the Delta Program (NWP, 2009). Protecting the Netherlands from water and ensuring a sufficient supply of fresh water are no short-term issues, but are matters for which long-term attention will be required (Delta Commissioner, 2012). Together with the transition towards a new adaptive paradigm that can be recognized in Dutch water management, the long-term aspect and flexibility in the policy approach have been given an explicit role in the Delta Program by the development of an innovative approach to complex water management tasks, which has been titled *Adaptive Delta Management* (ADM). The next chapter will take a deeper look into the national Delta Program and will further elaborate this ADM concept that will form the new basis for developing long-term water safety strategies.

Chapter 5 – **Delta Program**

As described in the previous chapter, recent reactions to alarming climate change predictions have led to the establishment of the Delta Program that can be regarded as the Dutch adaptation strategy following up on previous work done by the ARK program. This comprehensive governmental program will form the basis for structured and deliberate approaches in setting up long-term adaptation strategies for climate-proofing the Netherlands. In this chapter a closer look will be taken at the organizational structures and goals of the Delta Program and at how a new management philosophy called Adaptive Delta Management is gaining influence in complex long-term adaptation and water management tasking. This new management approach, as developed by the Delta Program, is a radical shift away from the traditional technocratic and expert-based management approach that has been mainstream in Dutch water management for a long time and instead is based on adaptive management principles. A closer look will be taken at the development of this Adaptive Delta Management concept, its intended benefits and how it relates to the theoretical underpinnings of adaptive management.

5.1 The national Delta Program

As advised by the second Delta Commission in 2008, the Delta Program was officially adopted by Dutch government in 2010. This national governmental program is being executed under the responsibility of the Ministries of *Infrastructure and the Environment* (I&M) and *Economic Affairs, Agriculture and Innovation* (EL&I), and can be described as a coherent and comprehensive package of strategic investments to ensure the Netherlands can absorb the long-term effects of climate change up to 2050, with a forward view to 2100 (DP2012, 2011a). The program comprises plans and provisions that will be necessary over the coming years to guarantee flood safety and a sufficient supply of fresh water, and besides that will provide a forward view into measures that will be necessary for the decades following this initial period (Government of the Netherlands, 2012). The government has appointed a *Delta Commissioner*, who makes proposals for the development of Delta Program reports and guides this process. These annual Delta Program progress reports are submitted as part of the formal annual State budget framework. All plans for necessary measures, developments and provisions form the primary part of these progress reports in which the national government, regions, social organizations and business community are involved. The first Delta Program report published in 2010, which was titled *Working on the delta, Delta Program 2011, Investing in a safe and attractive Netherlands, now and in the future*, dealt with the possible approaches for work to be carried out in the period up to 2015 (DP2011, 2010). The resulting findings and conclusions made up the core of the second Delta Program report, which was published in 2011 and is titled *Working on the delta, Delta Program 2012, Acting today, preparing for tomorrow* (DP2012, 2011a). In these reports the progress of a wide variety of water management tasks the Delta Program deals with are brought together to eventually come up with coherent and comprehensive adaptation strategies and structuring policy decisions aimed at climate-proofing the Netherlands.

The Delta Program can be characterized by an integral design in which national government, provinces, water boards and municipalities work together with actively involved social organizations, business communities and knowledge institutions in order to expand the present knowledge base and set up sustainable long-term adaptation strategies to anticipate future developments (Government of the Netherlands, 2012). The Delta Program is based on a coherent approach in looking for strategic adaptation solutions, since complex water safety tasks and intended interventions to tackle them show a strong interdependency (DP, 2012a). Up to 2015, alongside ongoing programs and projects, the emphasis of the Delta Program will be on the preparation of a number of Delta Decisions. Since water tasks cannot be separated from social, economic and ecological developments, these Delta Decisions will be considered in an integral area-based fashion, in which the possibilities of linking up with other specific regional developments and ambitions will be examined (DP, 2012a). These policy frameworks will play a key role in determining future water management in the Netherlands, structure main Delta Program tasks and provide promising directions for work from 2015 onwards (DP2012, 2011a).

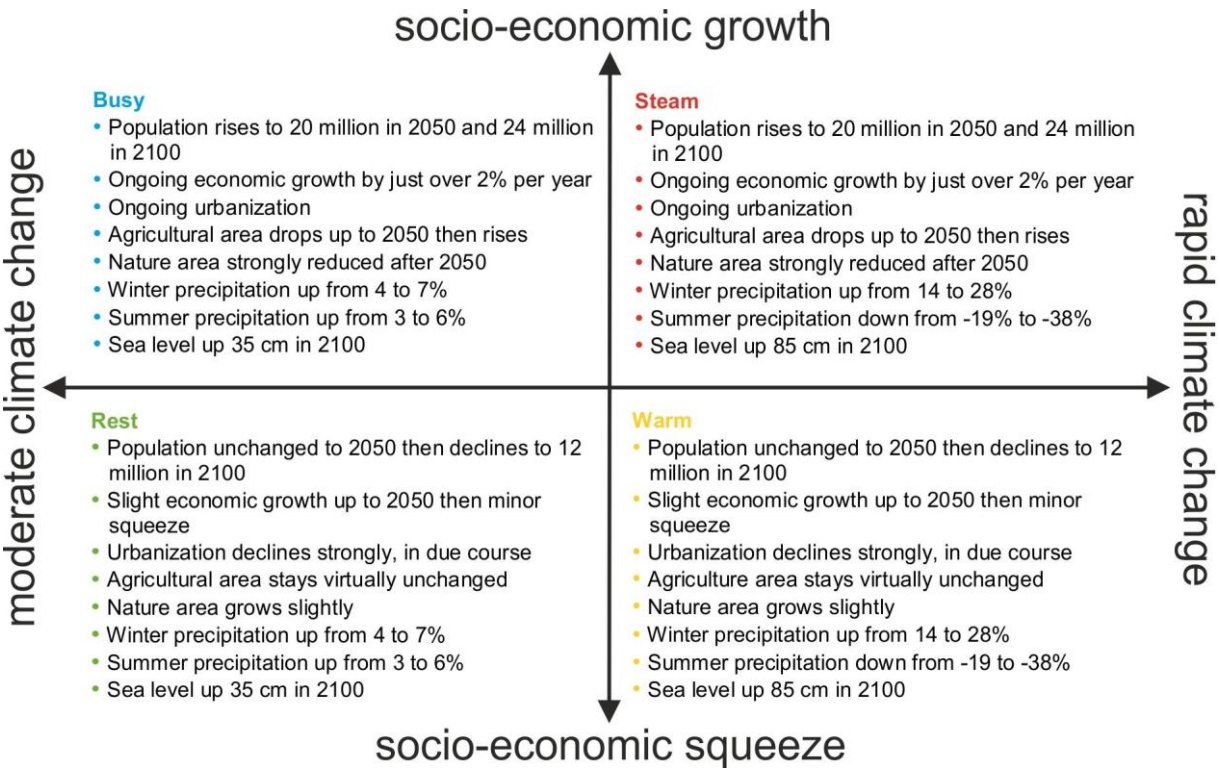

Figure 5 – The four Delta scenarios (DP2012, 2011a)

To get a better grip on the complexities and uncertainties that characterize these tasks, efforts of the Delta Program are strongly based on the development and sharing of scientific knowledge (DP2012, 2011a). This strong emphasis on knowledge is not just on technical-engineering expertise, but on the development of corresponding socio-cultural, administrative and financial knowledge as well. Due to the fact that there is a great deal of uncertainty in the complex task of forecasting climate change and its potential effects as well as in socio-economic developments, the Delta Program explicitly acknowledges that each consideration is surrounded by great uncertainty. Therefore a generous program methodology has been developed based on the use of uniform so called *Delta Instruments*

and *Delta Scenarios*, which together constitute the basis for most studies conducted and decisions taken within the Delta Program (Government of the Netherlands, 2012). The Delta Scenarios for the Netherlands are a combination of the KNMI-2006 climate scenarios created by the *Royal Netherlands Meteorological Institute* and the 2006 socio-economic scenarios created by the collaborating planning bureaus (see **Figure 5**) (CPB *et al*., 2006). These two sets of scenarios comprise the main playing field of plausible future developments that is considered to be relevant for uniform operation in future water tasking and research to be conducted in the Delta Program. The most important Delta Instrument that forms the computing heart of much of current and future water management analyses in the Delta Program is the *Delta Model*, a comprehensive model instrument, aimed at the main water system that can be used for hydraulic calculations and the underpinning of long-term policy decisions. This model is based on the Delta Scenarios which point out a bandwidth of plausible future climatological, socio-economic and demographic developments. This approach allows making well-considered comparisons between possible Delta Program measures, in a hydrological, societal and financial sense (Delta Model, 2010). The fact that knowledge in this context of complexity and uncertainty will never really be perceived objective or certain will be interpreted differently by parties involved, which only further strengthens the need for intelligent knowledge management. Approaches for developing contextual knowledge based on climate models to be applied at the regional and local scales are essential in improving its applicability. In this way emphasis is placed, besides on fundamental climate research, on applied climate research that is more efficient and sustainable for local and regional application (DP2012, 2011a).

5.2 Organization and approach of the Delta Program

The effects of climate change force the Delta Program to look far into the future and to anticipate complex developments in order to be optimally prepared. Probably the most important consideration on which the Delta Program approach is based is the question how the issue of water safety can be properly linked to other regional ambitions such as economic, ecological and spatial goals to reach sustainable outcomes (Government of the Netherlands, 2012). Based on the interconnectivity in the water system, the choice is made for a cohesive integrated approach to finding solutions. In their task of climate-proofing the Netherlands, the Delta Program defines three basic values in decision making, which are *Solidarity*, *Sustainability* and *Flexibility* (DP2012, 2011a). These basic values form the shared values of the organization of the Delta Program that are meant to bind all parties involved and act as a beacon for important decisions to be made. *Solidarity* refers to a minimal passing on to future generations and to other regions, a prioritization of measures within the Delta Program as a whole and national financing of measures of national interest. *Flexibility* refers to the need to keep substantial as well as process adjustments possible at any given time in the process. *Sustainability* refers to the components *people*, *planet* and *profit* that need to be taken into account in strategic decision making (Werners *et al*., 2009; DP2012, 2011a). The Delta Program further uses three basic principles of decision making, which are *Integrality*, *Consistency* and *Transparency*. Defining basic principles in the approach of the Delta Program will contribute to its efficiency and recognition. *Integrality* is of importance because of the physical, temporal and financial coherence in decision making processes.

Consistency refers to substantial factors, such as the use of data and models, as well as process factors, such as an unambiguous and uniform organization and process structure for all sub-programs. Finally *transparency* refers to openness in program structure, decision making and progress (Werners *et al*., 2009).

Figure 6 – The nine Delta sub-programs (based on DP2012, 2011a)

The recent policy shifts in spatial planning and water management, elaborated in **Chapter 4**, have been essential in setting up the organizational structure and in defining the approach of the Delta Program. The most important developments in this process of establishing the Delta Program were the *decentralization* and *deregulation* of water management and spatial policy. According to the 2012 Delta Program report, the organizational configuration of the program offers a firm basis to link national and regional sides around water management tasking while at the same time utilizing the strength of collaboration as much as possible (DP2012, 2011a). On the one hand the Delta Program consists of pending programs that are already working on water safety tasks in the Netherlands, such as the *Room for the River*, *Afsluitdijk* and *Sand Suppletion* programs, that are included in the Delta Program and keep their own organization and financing. On the other hand the Delta Program is working on long-term objectives that require a more specific strategic approach. For the exploration of these specific strategic goals a total of nine sub-programs have been established. These sub-programs add specific topical and regional flavor to the Delta Program and explicitly link short- and longer-term water management objectives (DP2012, 2011a). The national Delta Program is made up of a total of nine, of which three generic and six regional sub-programs (see **Figure 6**). Among the generic sub-programs doing research and developing national frameworks that can lead to generic policy statements like the Delta Decisions, plays a leading role. The regional sub-programs on the other hand are aimed at developing and implementing specific regional adaptation strategies that will function as starting point for long-term regional water management tasks, linking up with regional ambitions and other contextual factors.

The political responsibility for the national program and sub-programs lies with the Ministries of *Infrastructure and the Environment* (I&M) and *Economic Affairs, Agriculture and Innovation* (EL&I) (Werners *et al*., 2009). Other participating governments in the sub-programs are provinces, municipalities and water boards that collaborate with the national government in the elaboration and implementation of sub-programs. The Ministry of I&M is responsible for the following generic and regional sub-programs (see **Figure 6**) (Government of the Netherlands, 2012):

Safety	*generic*	What protection levels should be used in order to protect the Netherlands against flooding
Fresh water	*generic*	How to secure the long-term supply of fresh water
New urban developments and restructuring	*generic*	What rules and regulations are needed to include climate change into the planning of new urban developments and the restructuring of built-up areas
Rhine Estuary-Drechtsteden	*regional*	How the *Rijnmond* and *Drechtsteden* area can remain safe and livable with a rising sea level, higher river discharge and increasing summer droughts
IJsselmeer region	*regional*	The possibilities of using flexible water level management for the IJsselmeer in order to increase water safety and the potential role of this body of water in fresh water supply

Rivers	*regional*	How the main rivers can discharge increasing amounts of water from upstream in a safe and efficient way
Coast	*regional*	How the Netherlands can be protected against long-term sea level rise

The Ministry of EL&I is responsible for the following regional sub-programs (see **Figure 6**) (Government of the Netherlands, 2012):

Southwest delta	*regional*	How the Southwest delta area can remain safe and livable with rising sea levels and higher river discharge
Wadden region	*regional*	What measures need to be taken to guarantee safety in the Wadden region with an eye on rising sea levels

Each sub-program has its own program organization, run by a program director and staffed by employees of central and regional governments. In order to further link the central government with the provinces and connect regional and national issues, steering groups have been set up within all sub-programs. The members of those steering groups are delegates from the national and provincial authorities who can provide program organizations with valuable advice. Administrative consultation on the tasking of the three generic sub-programs takes place in a national consultation body or national steering group, while the six regional sub-programs are discussed in regional steering groups and consultation bodies. The proposals developed by all nine sub-programs together are discussed in the national Delta Program steering group, which is made up of ministers and other administrators. Beyond this, sub-programs operate relatively independent and can design their own sub-bodies and responsibilities for strategy development and implementation (Government of the Netherlands, 2012).

With this program design consisting of nine sub-programs and a variety of consultation bodies and involved interest groups, it is decisive for the Delta Program to guarantee a certain degree of coherence, not just within the overarching national program, but in and between sub-programs as well. All regional sub-programs of the Delta Program show a strong mutual coherence and dependency at the national level as can be made up from **Figure 6**. Choices made in one region are likely to affect the implementation of water safety strategies in other regions. The outcomes of generic sub-programs on the other hand might also have consequences for regional sub-programs and vice versa (DP2011, 2010). The three generic sub-programs need tangible experiences and outcomes from both other generic as well as regional sub-programs to know what is needed concerning generic topics such as spatial adaptation and water safety. The outcomes of other sub-programs are used as input for the development of generic policy frameworks on for example the actualization of generic protection standards and the extent to which spatial planning frameworks should be adjusted or developed to be better able to cope with the effects of climate change (DP, 2012b). As a result of the integrated program approach, the Delta Program also pursues coherence of stakeholders, involved organizations and strategies within sub-programs (Werners *et al*., 2009). Therefore, besides apparently coherence in the water system, coherence in time and in decision making also plays a leading role. Finally the

search for coherence with other regional developments whether in policy or spatial development is an area of priority in the Delta Program (DP, 2010).

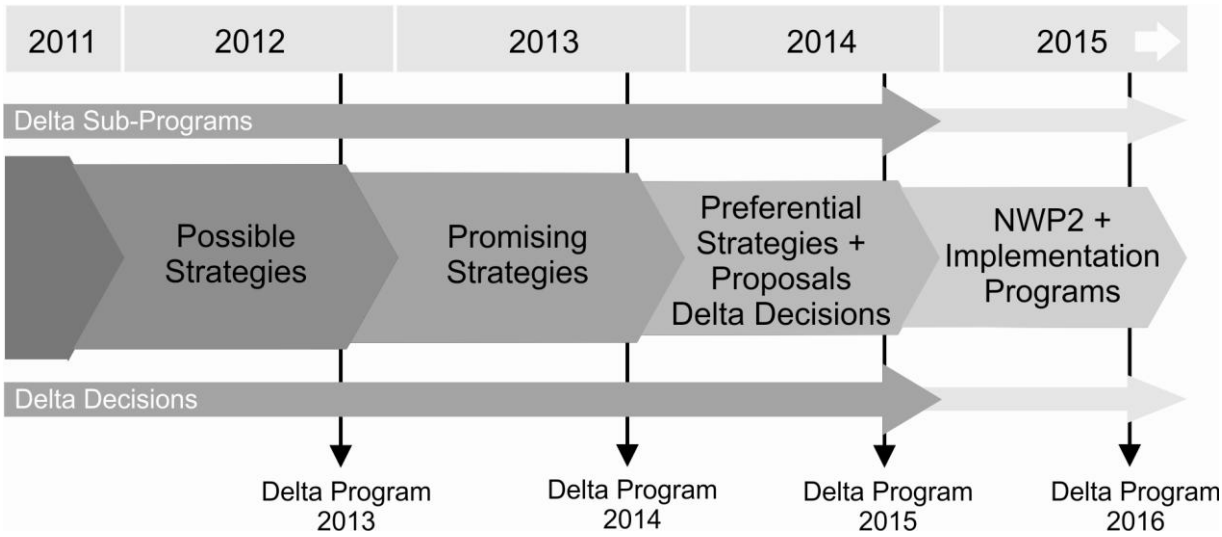

Figure 7 – Schematic outline of the Delta Program decision making trajectory up to 2015 (based on DP2012, 2011a)

All nine sub-programs are provided with a generic framework consisting of strong guidelines and a general time planning framework enforced from the national program, which puts all the activities of sub-programs in a strong phased time frame (see **Figure 7**). Administrative agendas are synchronized based on this iterative process trajectory that creates moments in decision making where joint steps are to be taken at both the national and regional level in getting a better view of the bigger picture in climate-proofing the Netherlands. In iteration rounds the Delta Program will become more detailed and will taper towards preferential strategies and Delta Decisions for the sub-programs in order to further detail future water safety tasks. In each round the problem analysis will be further strengthened and over three years' time, this trajectory tapers from *possible*, to *promising* and finally towards *preferential adaptation strategies* and proposals for Delta Decisions. This funneling process has started with the 2011 report that elaborated action plans for all sub-programs for the period up to 2015 (DP, 2011c). In the 2012 report, a variety of problem analyses are made for all sub-programs, which are then be used in the 2013 report to explore possible directions for strategies, without making final decisions. In the 2014 Delta Program possible directions will be further explored and will be brought down to a number of promising future strategies (DP, 2011d). Promising strategies are strategies that will achieve goals at good cost-efficiency, have positive effects on other functions and will create regional support (DP, 2012b). Further development will eventually lead to proposals for a preferential strategy for each sub-program in the 2015 Delta Program, which is expected to contain the best approach to guarantee water safety and fresh water supply for each sub-program (DP, 2011d) and will turn into a coherent proposal for the Delta Decisions (DP, 2011c; DP, 2012b) and as input for the policy laid down in the second *National Water Plan* (NWP) (DP2012, 2011a). This does however not mean that work of the Delta Program and its sub-programs will be done by 2015 as work on safeguarding long-term water safety in the Netherlands will be ongoing.

Another essential factor in the organization and approach of the Delta Program is the availability of financial resources (DP2012, 2011a). The availability of financial resources differs substantially between generic and regional sub-programs, as generic sub-programs usually have more resources available for example in supporting research than regional sub- programs have. Regional sub-programs mostly rely on finances made available by the national government for the implementation of water safety measures (Werners *et al*., 2009). Since the Delta Program seeks to achieve its objectives at acceptable costs, with measures that can count on maximum social support (DP2012, 2011a), economic analyses play an important role in developing and assessing adaptation strategies. The *Multi-Year Program for Infrastructure, Spatial Planning and Transport* (in Dutch: Meerjarenprogramma Infrastructuur, Ruimte en Transport) (MIRT) and the procedures for more efficient decision-making as proposed by the *Faster & Better* or *Elverding Committee* (in Dutch: Sneller & Beter or Commissie Elverding) constitute important policy frameworks for the Delta Program with regard to the development and implementation of large water management investment projects (Government of the Netherlands, 2012). The MIRT program is a national investment program to bring about consistency in large scale infrastructure projects and programs in the spatial domain, in which the national government is directly financially involved. The MIRT program consists of specific payments from the national government to decentralized governments with location specific performance agreements and the main aim of realizing better aligned, substantially consistent and improved coherence between investments in the spatial domain (Government of the Netherlands, 2012), in which regional partners and other parties are actively involved (DP2012, 2011a). In the search for sustainable outcomes all large scale investments within the Delta Program are included in the MIRT program (MIRT, 2012). Since the rules of the MIRT program specify the main process steps for long-term projects and programs to qualify for government funding (Government of the Netherlands, 2012), these rules form the main systematic that guide the implementation of the Delta Program and therefore are the reason behind the strict schematic outline of the Delta Program decision making trajectory in **Figure 7**.

Following on from this, the guidelines for the Delta Program follow the national program *Faster & Better* with the goal of speeding up decision-making by exploring strategic alternatives and selecting development directions in early stages of the decision making process. Such early strategic guidance differs from the prevailing Dutch planning practice that typically postpones decision making until several alternatives have been developed and appraised in greater detail (Werners *et al*., 2009). Within the *Faster & Better* program, the national government is working on structurally improving the preparations, decision making and implementation of large scale projects, in order to combat slow decision-making and indecision. The *Faster & Better* approach aims to make rules and regulations more flexible and to offer more scope for local and regional administrative considerations and offering more possibilities for an area-based trade-off of national standards. In a nutshell, *Faster & Better* seeks to contribute to wider administrative room to maneuver. There is clarity on timing of decisions, participation is broad-based and works progress from broad to fine, within clear decision making trajectories. Again most aspects of this policy program can be found in the Delta Program time planning up to 2015 in **Figure 7** (DP2012, 2011a).

The uncertainties and complexities, which are indispensable elements of dealing with climate change, makes managing the development of adaptation strategies and Delta Decisions within the regional sub-programs a challenging task. In an interview national Delta Program staff member Pieter Bloemen (2012) emphasized that "*the first association was that the Delta Program was going to become a linear path towards reaching pre-set goals. However later in the process the role of uncertainty was more espoused.*" In order to prepare well for the future, the national Delta Program had to develop a radically new approach in which the basic values and basic principles are strongly reflected in dealing with the indispensable complexity and uncertainty of climate change. An increase in flexibility and robustness, quick response to unexpected events and keeping multiple options open are key characteristics essential to delay the necessity to take drastic measures. The time gained can be used to learn more about climate change, its potential effects and develop innovative solutions. This new management approach developed within the Delta Program is called *Adaptive Delta Management* (ADM), a flexible management approach that according to the 2012 Delta Program report (2011a: 9), "*offers a wide range of chances for innovative solutions.*" Bloemen (2012) describes ADM as:

"…[A]n approach designed to give an explicit role to uncertainty around future developments in long-term decision making and policy development. The approach combines existing insights into working with several potential strategies and appraising flexibility around these strategies."

The use of the ADM concept will lead to new insights which can have an added value in preparing for strategic decision making. The added value of ADM lies in the link between long-term tasking and short-term decision making, which means that consciously dealing with uncertainties, establishing relationships between decisions, looking ahead and at the same time becoming tangible are vital parts in contributing to long-term decision making in the Delta Program (DP2012, 2011a). It maps uncertainties and traces chances outside of the direct scope of the problem, which in theory is a challenging and enriching, but however not an easy task (DP2012, 2011b). The next chapter will elaborate the concept behind the ADM approach and its methodical underpinnings in more detail.

5.3 Characterizing the Adaptive Delta Management concept

The ADM concept prescribes the development and implementation of adaptation strategies and measures that can be adjusted to new insights and changing developments. As described earlier, the Delta Program acknowledges an adaptive approach goes together with openness to learning and obtaining new knowledge, the courage to experiment and the ability to deal with the unexpected (DP2012, 2011a). Therefore options should be kept open for measures which are not yet needed and strategies should be operated that offer chances to switch to alternative strategies or to carry out measures in such a way as to enable later expansion or adjustment. In the 2012 Delta Program report (2011a: 8) the ADM approach is described as:

"Adaptive Delta Management is about doing what is necessary; neither too much nor too little, without ruling out future options."

The adaptive reasoning leads to the exploration of different adaptation measures and options, even before the necessity of implementation becomes necessary. Given the fact that the way in which changes might develop is anything but certain, flexibility in decision making is an important element of ADM (Delta Commissioner, 2012). It would be both unwise and unnecessary to take measures now that anticipate changes that might unfold at the very long-term. Rather, a stepwise approach is followed in which steps are sufficiently large to be well enough prepared for changes in the near future. However care needs to be taken that these steps do not block, but instead facilitate additional measures that might need to be taken in the long run. Making the right connection from one step to another is essential as each small step should serve short-term needs but also needs to be part of a long-term adaptation strategy. This means that when taking a step and implementing a measure or strategy, it is important to think ahead of how this step leads the way to subsequent future steps, which Bloemen (2012) accentuated by saying "*you don't want to commit yourself too much to one strategy in making adaptation choices.*" The ADM concept gives the possibility to postpone the need for drastic measures, while the time gained can be used to learn about climate change and develop innovative and sustainable solutions (Delta Commissioner, 2012). According to Bloemen (2012), the main advantages of ADM are "*a reduction in costs, creating a better balance between under- and over investments, avoiding adjustments during the course of implementation, binding regional parties and creating wide support, and improving the quality of decision making.*" However, linking the short- and long-term in decision making requires the right balance between predicting future climatological developments while at the same time stay committed to flexible decision making.

The use of short-term interventions that fit in a long-term strategy has been adopted by the Delta Program through the concept of *Adaptation Tipping Points*. Adaptation tipping points are defined as points where the magnitude of socio-economic developments and/or the consequences of climate change are such that an adaptation policy or strategy will no longer be able to meet policy objectives and the need for alternative strategies becomes inevitable (Kwadijk *et al*., 2010). Each new strategy will also have its own inevitable tipping point somewhere in the future that, again, requires a strategy switch to be made (Satijn & Ten Brinke, 2011). Thus the degree of climate change or socio-economic developments to which a particular system of adaptation measures can cope is determined. Climate change scenarios and socio-economic scenarios are used to provide insight on the possible need for new adaptation strategies by determining the time frame in which tipping points are to be expected. For decision makers the timing of tipping points is crucial knowledge, as it makes the time frame for decision-making and the possible need for new adaptation strategies explicit (Van Der Most *et al*., 2009). Besides that, with the strategy to implement measures aimed at delaying certain tipping points, available funds will be spent more efficiently over the long-term (Delta Commissioner, 2012; Government of the Netherlands, 2012). A classic example that is often referred to as a tipping point in Dutch water management is the water level management of the IJsselmeer, the largest fresh water buffer in the Netherlands. Here, at low tide surplus water can be released into the Wadden Sea in free overflow. This will however become increasingly difficult considering long-term sea level rise. In order to maintain the ability to release water at the current IJsselmeer water level, the Delta Program is

working on expanding the discharge capacity. But with further sea level rise, at that point the level of the Wadden Sea and that of the IJsselmeer will be almost the same, freely discharging water will become virtually impossible in the long run. This would mean that the tipping point of the current strategy is reached and the inevitable need for a new adaptation strategy arises.

As a result of using tipping points, several potential follow-up strategies, or so-called *adaptation paths*, can be developed on top of the initial adaptation strategy. By following a short-term, stepwise approach, measures could be adjusted or additional ones could be taken if socio-economic factors or the consequences of climate change turn out different than anticipated. This is a major improvement compared to using traditional approaches in which strategies are weighed-up against each other in one single move, well in advance of the moment of implementation (DP2012, 2011b; DP2012, 2011a). However, these short-term measures have to fit in a long-term strategy which means that each step has to connect to the previous one and facilitate the ones ahead in such a way that in combination they form a pathway towards a safe and sustainable strategy. Making the right connection from one step to additional future steps is of vital importance. Even though each step is expected to contribute to water safety, by no means should steps be taken that block essential measures in the future (Satijn & Ten Brinke, 2011). Such measures that do not in advance block out future possibilities are often referred to as *no-regret measures* (see Frankhauser *et al*., 1999; Lim *et al*., 2004; Füssel, 2007; Heltberg *et al*., 2009). Delta Program staff member Floris Hammer (2012) puts this point in ADM as:

> ***"It's important to take wise first steps in Adaptive Delta Management without doing major financial investments which later force you in a particular direction, as this is very likely to create strong path dependency that might limit chances for future options for strategy adjustment."***

While moving ahead, overviews of possible future adaptation paths can be used to look at possible amending or adaptive strategies at a later stage, including conditions under which it could be wise to switch strategies (DP2012, 2011a). When the efficiency and flexibility of a strategy dwindles as a result of changing circumstances, moving over to an alternative adaptation strategy becomes unavoidable (Van Der Most *et al*., 2009). Bloemen (2012) emphasizes that "*the flexibility of an adaptation path is based on the ease with which the strategy can be abandoned in favor of an alternative or subsequent strategy.*" Multiple options for adaptation paths should be kept open for as long as possible, as in the long run water management is nothing more than just a succession of different short-term strategies (Satijn & Ten Brinke, 2011). It is important to take into account possible follow-up strategies early on in the process and to do early investments in these cases in which they might lead to a better cost-effectiveness. In doing so, disproportionately expensive alternatives are being avoided and plenty of room is preserved for reaching a solution that optimally connects to actual developments (DP2012, 2011b). On the other hand, program staff members Bloemen (2012) and Hammer (2012) admit that by using ADM there is the possibility of missed income related to keeping decisions open and the possibility of additional costs due to activities being carried out in such a way that expansion might be needed in the longer-term.

A strategy based on adaptation paths is sustainable when it is able to cope with various possible futures while at the same time being flexible enough to be adjusted or replaced in case developments unfold differently than anticipated. This approach does not block alternative measures or future strategies and serves several interests at the same time by linking adaptation strategies with other investment agendas (DP2012, 2011a). A classic example of a sustainable strategy based on a resilient approach often referred to in the Dutch case is the strategy of sand nourishments for coastal flood protection. Even though this strategy is facing uncertainties with respect to the effectiveness of large scale sand replenishment, the extent of sea level rise and system dynamics, the type of intervention is ideally suited for adjustment based on knowledge findings and monitoring outcomes (Van Der Most *et al*., 2009). Sand nourishments do not block alternative future measures or strategies and serve several interests at the same time. Otherwise, strengthening flood protection by building seawalls or raising dikes is far less sustainable, as they might be in the way in case the need for alternative strategies arises (Satijn & Ten Brinke, 2011). However, to become and stay adaptive throughout the Delta Program process, creating adequate enabling legal and financial frameworks and conditions is essential. The next section will further describe these conditional factors and will enlighten how they are meant to contribute to successful decision making using ADM.

5.4 The 5 D's of Adaptive Delta Management

The conditional basis of the ADM approach in the Delta Program is brought back to five key elements, the so-called "*5 D's*" (Van Alphen, 2010). These 5 D's stand for *Delta Decisions*, *Delta Fund*, *Delta Commissioner*, *Delta Act* and *Delta Program*. In this section these factors and their role in creating the right legal, political and financial preconditional context for the successful use of ADM in developing adaptation strategies in the Delta Program will be discussed.

Delta Decisions

The complexity of decision making in Dutch water management requires a strict hierarchy in decisions to be made. The core task of the Delta Program is constituted by the preparation of five important national decisions on long-term water safety and fresh water supply for the coming century. Based on the program planning (see **Figure 7**), these five so called *Delta Decisions* have to be presented by the end of 2014 and will be directional for plans and measures contained in the Delta Program to be carried out from 2015 onwards as a framework for regional and national elaboration of adaptation measures. Bloemen (2012) described the Delta Decisions as "*five structuring decisions to get better grip on the incomprehensible labyrinth of underlying decisions. Small decisions will logically be based on the Delta Decisions.*" Delta Decisions will thus provide coherence between regional developments. The five Delta Decisions at stake in the Delta Program are (DP2012, 2011a):

Water safety	Updating safety standards and developing regional safety strategies
Fresh water strategy	Developing a strategy for the sustainable supply of fresh water
Water level management	Developing a decision regarding the long-term water level

IJsselmeer region	management of the IJsselmeer, focused on water safety and fresh water supply
Rhine-Meuse delta	Developing a strategy for the protection of the Rhine-Meuse delta and solutions for fresh water supply
Spatial adaptation	Developing a national policy framework for the (re)development and restructuring of built-up areas and recommendations regarding the effects of climate change

By explicitly listing these Delta Decisions, a meaningful picture is created of the most important constraints and tasks to be dealt with by the Delta Program (DP2012, 2011a). These five decisions will have a great impact on the future of water management and climate policy in the Netherlands. In this regard the climate change issues are the decisive factor in creating future regional adaptation strategies (Government of the Netherlands, 2012). All sub-programs contribute to a greater or lesser degree to the completion of these Delta Decisions by exchanging research results and findings.

Delta Fund

The total cost of the Delta Program has been estimated between €1200 and €1600 million annually until at least 2050 (Werners *et al*., 2009). In order to finance all measures, provisions and costs of related basic information provision and research required, a national *Delta Fund* has been established. This fund is essential in the implementation of the long-term package of investments for strategies and measures that are currently under development. The Delta Fund will provide stability in financial resources as government finances are set aside for the investments required, reducing dependency of economic developments and the uncertainty of political decision-making (Government of the Netherlands, 2012). The Minister for Finance is responsible for feeding, administering and supervising the Delta Fund, while the Minister of I&M bears final responsibility for expenditures. The fund is not included in the annual national State budget but is anchored in a separate *Delta Act*, which means that stability is provided in financial resources, without having to compete with other political goals. From 2020 onwards, the Delta Fund will be funded by at least €1 billion from the general resources each year to ensure momentum in the implementation of the Delta Program (Delta Commissioner, 2012). This burden is, according to the solidarity principle, spread evenly across the population of the Netherlands across multiple generations (Government of the Netherlands, 2012). Partly bearing in mind the scarcity of financial resources, available funds should be used as efficiently possible, while at the same time seeking to attract additional private investment (DP2012, 2011a). With the introduction of the Delta Fund, it is important to set rules regarding the conditions for the use of its resources. The MIRT rules have been designated as the point of departure, which means all activities to be initiated must meet MIRT conditions to qualify for government funding (Government of the Netherlands, 2012).

Delta Commissioner

With the establishment of the Delta Program a special government commissioner has been appointed for directing this intergovernmental process (Van Alphen, 2010). This *Delta Commissioner* plays a

central role in the administrative field of the Delta Program and is responsible for both contents as well as the overall developing process of the program (Delta Commissioner, 2012). Therefore the Delta Commissioner will facilitate, stimulate and monitor coherence and quality in and promotes the formation, implementation and progress of the Delta Program as a whole. Part of this effort is about realizing full and integrated implementation, acquiring sufficient legitimacy for plans and creating flexibility in sub-programs approaches (Kuijken, 2010). Another important role of the Delta Commissioner is to build a strong foundation of support among parties involved in the multi-governmental process. In fact the commissioner serves as a liaison between ministries, the state and the regions, authorities and civil society organizations. Another task is to monitor the cohesion between various components of the Delta Program and ensure decisions are made at the right moment to meet long-term goals (Government of the Netherlands, 2012). Another responsibility is to ensure that various government bodies, water boards, companies and social organizations are and remain properly involved in the program and assume their responsibility for the range of measures to be taken (Kuijken, 2010). The Delta Commissioner occupies a central position in the government administration and falls under the political responsibility of the Minister of I&M (Government of the Netherlands, 2012). The commissioner reports to and advises the coordinating members of governments involved and participates in the advisory Council of Ministers (Delta Commissioner, 2012). The Delta Commissioner also advises ministers and, if need be, may urge them to intervene (Government of the Netherlands, 2012). The first and current Delta Commissioner Wim Kuijken has been appointed for a term of seven years (Delta Commissioner, 2012), which underlines the importance stressed to an effective long-term application of the Delta Program and the role of a leading person in this process.

Delta Act

Since early 2012 the Delta Program as a whole is officially anchored in a formal *Delta Act*. This act provides the legal foundation for the program, determines its operational scope (DP2012, 2011a), defines the authorization of the Delta Commissioner to be appointed for the program and sets out the financial conditions as described under the Delta Fund (Werners *et al*., 2009). As such the Delta Act lays a solid legal foundation for long-term adaptive developments in Dutch water management policy.

Delta Program

Finally the Delta Program itself is the overarching integral policy program executed by the Ministries of I&M and EL&I that consists of the measures that are being prepared, planned and will be executed over the coming period in order to guarantee long-term water safety and sufficient fresh water supply in the Netherlands. In addition, other important functions of the program are to achieve innovations in the process of water management, enhance commitment of the parties involved and structure the regional processes in sub-programs and make these sub-programs line up with the decision making trajectory of the national program (Werners *et al*., 2009).

The Delta Program aims to structure the complex process of finding suitable flexible governance approaches to adaptation that facilitate learning and social commitment while at the same time guaranteeing sufficient decisiveness and progress by using a strict generic time frame for sub-program processes. In this task the Delta Act, Delta Fund and Delta Commissioner can be seen as political-administrative conditional factors and the overarching Delta Program with its Delta Decisions functions as a substantive conditional framework in structuring decision making in long-term water management based on the ADM concept. Taking account of these 5 D's, it appears they mainly serve to establish the Delta Program and create the right conditions for ADM in working on future adaptation measures and strategies, but the presence of these preconditional factors does not necessarily guarantee legitimate and accountable adaptive governance at the regional scale where adaptation strategies are developed and eventually ought to be implemented. Therefore, because of the complexity of and variety in generic and regional sub-programs, the greatest challenge for the Delta Program is to make the concept ADM applicable at the sub-program level, a complex task which Hammer (2012) strikingly accentuates by stating that "*the notion of Adaptive Delta Management changes as the scale of its application changes.*" A serious challenge remains how to operationalize the centrally developed ADM concept in the sub-programs and make this approach perform to its full potential at the decentralized level. This operationalization of the ADM concept in sub-program activities and the complex considerations that come with it is the greatest area of priority in the current phase of the Delta Program. This chapter concludes by looking at this challenge of operationalizing the ADM concept and links the principles of ADM to the theoretical underpinnings of adaptive management.

5.5 Operationalizing Adaptive Delta Management

Reflecting on the theoretical characteristics of adaptive management and the adaptive management process as elaborated in **Chapter 2**, some interesting observations can be made in analyzing the ADM approach. When looking at the Delta Program, it can be clearly stated that gaining knowledge by extensive learning processes in the context of uncertainty and complexity plays a key role in the current phase of developing adaptation strategies. Despite this emphasis on knowledge development, adaptive management also requires sufficient time to set up iterative learning cycles in which efforts for structured learning can take place and frequent strategy adjustment or development can evolve along with knowledge expansion in a flexible way. However, analyzing and comparing the adaptive management cycle from **Figure 1** in **Chapter 2.4**, which displays a theoretical interpretation of an iterative adaptive management process, with the phased decision making trajectory of the Delta Program for the period up to 2015 as elaborated in this chapter and displayed in **Figure 7**, gives rise to some remarkable points of attention. While the ADM approach is, based on adaptive management principles, striving for flexibility, innovation and sustainability in long-term decision making, the adaptive process is at the same time substantially restricted by the use of this strict linear process phasing of five years in which preferential strategies have to be developed from nearly scratch. As mentioned earlier, this time frame is based on legal time constraints laid down by the MIRT program that forms the framework for financial investments for the Delta Program that will be updated in 2020, the Delta Fund that will become available annually from 2020 onwards and the NWP that will be

updated in 2015 and requires implementation agendas by then to be included. In that relatively short amount of time this strict time frame makes multiple iterations of the adaptive management cycle and the conditions for structured learning in working on optimal adaptation strategies and Delta Decisions a nearly impossible task. This difficult balance in the use of ADM, which is expressed in the need for iterative process structures of adaptive management versus the strict time planning of the Delta Program, leads to strong tensions between on the one hand the search for flexibility and on the other hand progress in decision making in developing sustainable adaptation strategies.

For successful ADM an attitude is needed in which all parties involved in the Delta Program work together on common goals, swap interests and are willing to invest in measures that help the ambition of others in order to get something in return. Key aspects of such governance arrangements are clearing the way for investments across domains and creating more space for the business community and research institutes to innovate. The establishment of the Delta Program, with a Delta Commissioner who stands above all individual interests and a special Delta Act that combines budgets from different domains into the Delta Fund, offers ample opportunities to create these conditions (Satijn & Ten Brinke, 2011). However, the ADM method will be further developed in the years ahead, both in substantial as well as in conceptual terms and will bring more experience with its practical application at the spatial scales where actual implementation of measures and strategies will be taking place. Some sub-programs are already explicitly taking adaptive approaches to tasking, which is being reflected in the strategies that are currently under development, while other sub-programs are still struggling to set up their approaches to developing adaptation strategies in an adaptive way (DP2012, 2011a). Even though the design and organization of sub-programs is to allow for change in both contents and process, apart from recognizing the guidelines in the instructions, few concrete steps are proposed in the instructions from the national Delta Program on how to apply ADM. This means that the way in which all sub-programs fulfill their obligations is pretty much open. However such a new approach has to fit in existing institutional and organizational structures and regional contexts and that is exactly why it is valuable to get a better grip on how the concept of ADM is being translated to the regional and local levels where adaptation strategies need to be developed by 2015. In the next chapter a closer look will be taken at the Wadden Region sub-program and the particular dilemmas this program runs into in using ADM in working on a preferential water safety strategy.

Chapter 6 – **Wadden Region Sub-Program**

Despite the theoretical benefits, the use of an adaptive approach will inevitably lead to dilemmas in setting up adaptation strategies, especially at the regional and local level. The centrally developed Adaptive Delta Management concept has to show its practical added value in adaptation tasks at the regional sub-program level, which are not uncommonly covered in complexity and uncertainty. All sub-programs have their own unique regional context, character and specific tasks, which means there is no generic approach that will have the same applicability on the objectives of each sub-program. Therefore a closer look will be taken at the role of adaptiveness in the regional sub-program Wadden region, a region that is known for its ecological value and precious natural-historical character. In analyzing the impact of the Adaptive Delta Management concept for this sub-program in the task of guaranteeing water safety, while at the same time trying to preserve its uniqueness, strong emphasis is placed on the dilemmas that are being encountered in this process.

6.1 The Wadden region sub-program

The Wadden region is the world's largest tidal salt water area that stretches from the northern part of the Netherlands, past the north-west of Germany up to Denmark. The Wadden region sub-program comprises the Dutch part of the Wadden Sea that consists of the five Wadden Islands, the Eems-Dollard estuary and the coastal zones of the provinces Fryslân, Groningen and Noord-Holland that border the Wadden Sea and Eems-Dollard estuary. The Afsluitdijk, a causeway separating the fresh water IJsselmeer from the salty Wadden Sea, does not fall under the Wadden region sub-program but is part of the IJsselmeer sub-program (see **Figure 6** and **Figure 8**). The Wadden region is the most naturally dynamic coastal zone of the Netherlands with exceptionally complex interests and tasks around the interplay of water safety, ecology and economy (DP, 2011d). The natural dynamic system of the North Sea coastal zone of the Wadden Islands and the intertidal area comprising the Wadden Sea and Eems-Dollard estuary acts as a natural breaker for waves, which together with the mainland coast forms an important link in warranting water safety of the northern part of the Netherlands (DP2011, 2010; DP2012, 2011b). Approximately 400 thousand people live in the Wadden region and its unique character attracts large numbers of tourists. Due to its specific ecological and great cultural-historical value, the Wadden Sea has been placed on the UNESCO World Heritage List in 2009 (Government of the Netherlands, 2012).

However, based on current predictions climate change is expected to have major consequences for the Wadden region and there is prevailing uncertainty on how the Wadden system will further develop into the future, which means that the continued existence of the system in its current form is anything but guaranteed for the long-term (DP Wadden, 2010; Government of the Netherlands, 2012). The most important effects of climate change for the Wadden region are expected to be an increase of water pressure on dike systems, a decrease of natural resilience, the drowning of sandbanks, a decrease of water quality and adverse impacts on precious ecosystems. Over the years human interventions such as impoldering and large scale construction of dike systems has restrained

fundamental natural dynamic processes essential in maintaining natural resilience against sea level rise. Besides that, accelerated sea level rise will also lead to an increasing level of sand accretion in the Wadden Sea, a process that keeps the Wadden region in a geomorphologic equilibrium. However, there is expected to be a future point at which sand accretion cannot keep up with the increasing rate of sea level rise with the result that the tidal system of marshlands and sandbanks will drown and lose its current form (DP Wadden, 2010). As a result dynamic ecosystems will vanish, a process that will only be fortified by further sea level rise. These effects are only being intensified by ongoing soil subsidence that, in interplay with sea level rise, is expected to have major inevitable consequences for the region in its current state and also in its role as a natural buffer in guaranteeing water safety. According to the 2011 Delta Program report these prospectives necessitate countermeasures such as maintenance and reinforcement of the main sea defense structures according to established safety standards and artificial sand replenishment to let the Wadden system grow apace with sea level rise. Therefore the sub-program is focused at mapping out possible impacts of climate change and on the development of future regional adaptation strategies in order to guarantee long-term water safety.

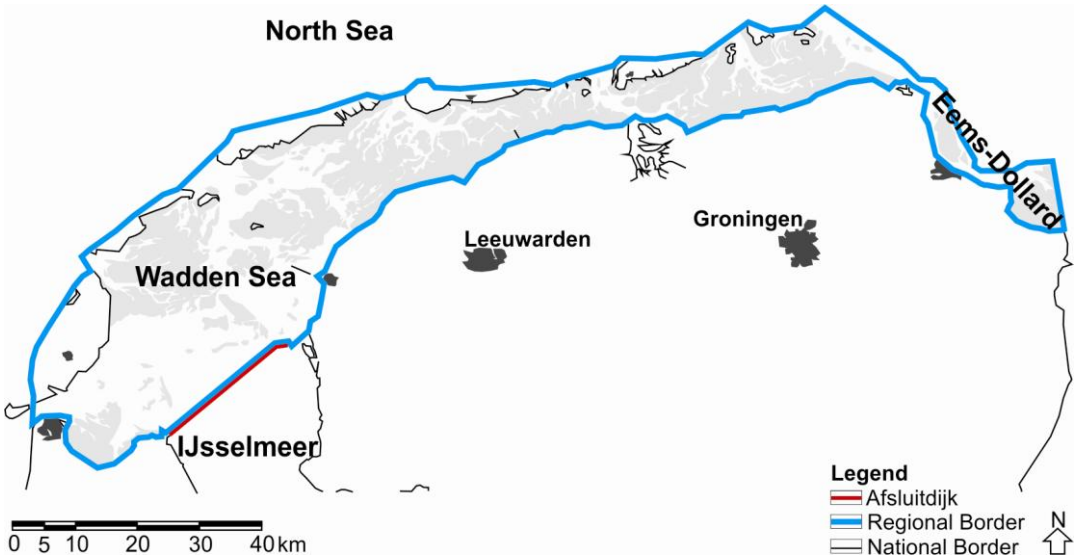

Figure 8 – The Wadden region (based on DP Wadden, 2010)

The main objective for the Wadden region is to anticipate these effects of climate change and to come up with a preferential regional adaptation strategy by 2014 (see **Figure 7** and **Chapter 5.2**). In this regard, the Wadden Region Delta sub-program has a dual task that on the one hand is about current safety tasks for the Wadden region while on the other hand it is about the ability to keep answering complex long-term water safety questions in the future (DP Wadden, 2011b). First and foremost the Wadden region must remain safe from the increasing effects of climate change in the most sustainable way possible (DP Wadden, 2010). Secondly, structured monitoring of the impacts of climate change on the Wadden region and further knowledge development is required to get a better grip on the complex dynamics of the Wadden system and to work on possible future responses to climate change (DP2012, 2011b). This approach is expected to facilitate the ability to determine, at the earliest possible stage, what adverse effects of climate change really are showing, how the system is

developing and subsequently what adaptation strategies can be developed in order to guarantee long-term water safety (DP2011, 2010; Government of the Netherlands, 2012).

The existing water safety task for the Wadden region consists of measures needed to update the primary flood defense system to comply with legal safety standards. This maintenance task follows from the *second* and *third Safety Assessments* done in 2006 and 2011 and is nothing more than business-as-usual adjourned by regional water boards. Based on the second assessment a *Flood Protection Program* (in Dutch: Hoogwaterbeschermingsprogramma) has been carried out for rejected dike segments that require reinforcement. The results of the third assessment showed that still approximately 130 kilometers of dike segments along the Wadden coast did not comply with legal standards (DP Wadden, 2011a). These findings, together with expected sea level rise, soil subsidence and the possible updating of flood safety standards have provided input for mapping out future water safety tasks for the Wadden region (DP2012, 2011a). Besides this task emerging out of possible updated flood safety standards, national legislation prescribes the avoidance of a structural withdrawal of the *Basic Coastline* (in Dutch: Basiskustlijn) and a preservation or increase of the sandy *Coastal Foundation* (in Dutch: Kustfundament) off the coast of the Wadden Islands (DP Wadden, 2010). Guaranteeing safety of areas outside of dike systems, such as harbors, ferry ports, marshlands and nature reserves, industrial sites, energy supply and (recreational) housing, is another focus point for the Wadden region sub-program. In case of high water these areas run the risk of flooding, which for marshlands and nature reserves actually is desirable, as it stimulates natural dynamics, while for other spatial functions flooding might have disastrous consequences. Currently this problem is not considered urgent and safety is not yet an issue, as flooding is not seen as an imminent threat for these areas (DP2012, 2011b). However, further sea level rise might require elevation or adaptation on the longer-term and therefore spatial adaptation is considered in the Wadden region sub-program as well for those areas for which preventive measures against flooding are not considered possible, feasible or cost-effective (DP Wadden, 2010;-DP Wadden, 2011a).

Besides the tasks that are currently being addressed in this sub-program, there will be additional tasks for the future. In order to sufficiently determine these future tasks for the Wadden region and be able to develop measures and strategies, reliable prognoses of system developments and further knowledge development of the Wadden region are needed. In order to safeguard long-term safety and to chart the effects of climate change on the Wadden system, in 2011 the sub-program has performed a number of quick-scans into subjects such as the impacts of new safety standardization, governance, policy integration and innovative water safety concepts, to get insight into the availability of knowledge needed to answer critical policy questions (DP Wadden, 2011d). Without going deeper into these quick-scans here, they have given a comprehensive view into available knowledge that might yield answers to present and future policy issues, showed the most striking gaps in knowledge and made clear that expansion of the knowledge basis and long-term monitoring of the Wadden system is absolutely essential in preparing for climate change related long-term water safety tasks (DP Wadden, 2011a; DP Wadden, 2011d).

Besides the general basic values and principles of the Delta Program discussed in **Chapter 5**, the Wadden region sub-program has specified two additional criteria in their task. The first criterion is that adaptation strategies generated within the sub-program have to fit within current policy frameworks at the national, provincial, water board and municipal level, such as the *National Water Plan* (NWP), which forms the legal framework for the Delta Program and prescribes all efforts in the Wadden region should be directed in ensuring long-term flood prevention by maintaining primary embankments (NWP, 2009), the *Key Planning Decision third note Wadden Sea* (in Dutch: Planologische Kernbeslissing) (PKB) and *Natura2000* legislation (DP Wadden, 2010). It is indisputable that ecological values are omnipresent and therefore form a crucial precondition in working on water safety in the Wadden region. This means human intervention in system dynamics should be kept to a minimum, in accordance with the legal goals from the PKB and Natura2000 legislation, that prescribe to let the Wadden system function and develop in the most dynamic way possible (DP Wadden, 2011a). The second criterion is that, even though first and foremost the Wadden region must remain safe, the need to take an integrated approach in looking for necessary adaptation measures is encouraged (DP Wadden, 2011b). Given the fact that the Wadden region has the status of a World Heritage site, water safety strategies also need to safeguard ecological interests in an integrated fashion (DP2012, 2011a; Government of the Netherlands, 2012). Besides the ecological aspect, ambition also is to look for possibilities to link up with regional economic and leisure interests, ambitions and local spatial developments. The Delta sub-program Wadden region wants to provide sustainable water safety and at the same time create chances for a robust and resilient natural environment and sustainable human exploitation (DP2012, 2011a). The main saying is that "*water safety and nature can reinforce each other, since working together with nature is better than fighting it"* (DP Wadden, 2011a: 5-6). A focus on consistency, resilience and an approach in which the integration of safety measures is considered jointly with regional characteristics such as ecological and socio-economic interests, seems to be best options to prepare the Wadden region for the long-term adverse effects of climate change in the most sustainable and efficient way possible (DP2012, 2011a; DP Wadden, 2010).

6.2 Organization and approach of the Wadden region sub-program

Coordination with the national Delta Program plays an essential role in the work of the sub-program on prospective studies on the Wadden region and the development of a coherent safety vision (DP2012, 2011a; Government of the Netherlands, 2012). As one of nine Delta sub-programs, the Wadden region sub-program not only has a strong relationship with the overarching national Delta Program, but also with other regional and generic sub-programs, both in a geographical as well as in a substantial sense. Especially the findings of the generic *Safety* and *New Urban Developments and Restructuring* sub-programs play an important role in contributing to the development of safety strategies for the Wadden region and vice versa findings from the Wadden region can serve as part of the input for these two generic sub-programs in working on generic policy frameworks and the *Water Safety* and *Spatial Adaptation* Delta Decisions which are also expected for 2014 (DP2012, 2011a). Besides these two generic sub-programs, two regional sub-programs are of direct importance for the Wadden region, namely the *IJsselmeer region* and *Coast* sub-programs, which in a geographical sense directly border

on the Wadden region and as a result have overlapping interests, tasks and responsibilities. Decisions made in these sub-programs might have direct or indirect effects on the Wadden region sub-program and vice versa decisions made in the Wadden region sub-program may affect the room for maneuver for these programs (DP Wadden, 2011c). This requires cooperation and mutual coordination of program tasks and objectives, both in a substantial as well as in a procedural sense. Changes in future water level management and discharge regimes of fresh water from the IJsselmeer into the Wadden Sea will, for example, conflict with legislation safeguarding ecological interests of the Wadden region as these measures will affect the salinity of the Wadden Sea and therefore the state of ecosystems (DP2011, 2010). Hence, joint conditions are provided for a future drainage regime for the IJsselmeer that is mutually satisfactory in guaranteeing water safety for both regions (DP2012, 2011b). Cooperation with the Coast sub-program especially focuses on how to preserve the Coastal Foundation of the Wadden Islands, the use of sand replenishment to keep the Basic Coastline intact and ways to improve sedimentation in strategic locations in the Wadden region (DP2012, 2011a).

This interconnectedness within the Delta Program between sub-programs makes that national, regional and local governments, water boards, societal organizations, knowledge institutes and citizens have to work closely together within the Wadden region sub-program. Since decision making within the sub-program is a complex process, strong emphasis is placed on the role of this cooperation and participation in developing a vision, create and test alternatives and develop knowledge on which future decision making can be based (DP2012, 2011a), not just to get support for development plans, but also to take advantage of the contributions and opinions of actors and parties involved in the region. The organization of the Wadden region sub-program consists of a *program team* of delegates of collaborating ministries, provinces, water boards and municipalities, headed by an independent *program manager* who is supported by a *regional steering group* (Government of the Netherlands, 2012). The regional steering group of the Wadden region consists of representatives, regional administrators and relevant departments such as the provinces of Noord-Holland, Fryslân and Groningen, the regional water boards, involved Wadden region municipalities, Rijkswaterstaat and the responsible Ministry of EL&I (DP Wadden, 2010; DP2012, 2011a). This steering group forms an essential link between the national government and the region for the steering and administrative coordination of the work to be done as it guides the sub-program organization, directs the development of program products, decides on the interim- and final results of research, discusses with responsible authorities, and places strong emphasis on the involvement and consultation of regional stakeholders (Government of the Netherlands, 2012). Thereafter, in order to further link the central and provincial levels and connect regional with national issues, proposals developed by all sub-programs are discussed in a *national steering group* and the national consultation body of Ministers and administrators. After careful consultation, decision making on specific policy initiatives and water safety measures will eventually be done by competent regional authorities. This gives both steering groups a central role in the Wadden region sub-program organization in preparing the work to be done in the Wadden region (DP2012, 2011a). The iterative decision making trajectory of the Delta Program (see **Figure 7**), from possible to promising to preferential strategies, on which decision making in the

regional steering group is based, is a means of creating a strong and long lasting interaction between the national and the regional level (DP Wadden, 2011b). Finally, the Wadden region program team consists of around ten delegates from the cooperating ministries, provinces, water boards and municipalities and carries out its task under supervision of the Ministry of EL&I and the regional steering group (DP Wadden, 2009). The Wadden region program team is led by program manager Kees van Es, who is responsible for designing the sub-program approach and realizing its goals by steering program team activities.

With the program direction becoming more specific over time, the Wadden region sub-program needs to involve regional parties and local stakeholders more closely in the program. Firstly, participation and cooperation have the goal to create wide support, while secondly it will also help to gain access to specific context dependent local and regional knowledge and creative ideas which are abound throughout the Wadden region (DP Wadden, 2010). As the regional steering group emphasized its desire to let as many stakeholders participate in the process as possible, a growth model for public participation in the sub-program organization has been developed (DP Wadden, 2010). Based on a rigorous stakeholder analysis study by research institute Alterra (see Klostermann *et al*., 2010), the intended first step in this growth model was the establishment of a *citizens' panel*, followed by a step in which a *social forum* of social organizations had to be established (DP Wadden, 2010). However, these organizational bodies have not yet been installed as the structural inclusion of a social forum and citizens' panel is currently not considered being of added value, as program manager Kees van Es (2012) declared, *"there's deliberately chosen not to include a citizens' panel and social forum in the current phase of the sub-program organization, since the program still works on such a high abstraction level that regional stakeholders might be left confused or don't feel sincerely involved."* Since the Wadden region sub-program has not yet reached that point and abstract talk about vague innovative safety concepts is something most interest groups cannot fully participate in Van Es (2012) states it will be more interesting for regional parties to be actively involved once the sub-program starts working on more concrete projects and measures. About the decision to not include a structural participation track at the initial stage of the sub-program Den Besten (2012) said:

"A participation track should have a clear added value and parties involved should be given the outlook of getting something in return."

At the current stage the input from the Wadden region in the program's steering group is considered sufficient as far as Van Es (2012) is concerned, as these parties know about the relevant discontents and worries amongst their communities. Most other program team members support this vision on public participation in the early stages of the process. General believe is that as soon as the sub-program is starting to work on the actual implementation of water safety measures at lower spatial scales, the sub-program has no choice but to involve regional stakeholders more explicitly.

Program team member Siep Groen (2012) on the other hand has a rather different look at the participation strategy of the Wadden region sub-program. He accentuates that while the sub-program has been hesitant in including a social forum in the start-up phase of the process, such a large scale

program with such high stakes cannot start soon enough with setting up a structural participation track in its program organization. He states "*in fact we are terribly late in setting up a social forum if you ask me.*" The reason for this fundamental disagreement on the role of public participation emerges out of the fact that some program team members state that first of all a better grip on the tasks and a better knowledge base are needed before parties should be invited to participate in the process. Groen (2012) counters this by emphasizing that "*the main objective is already clear; we're looking for sustainable water safety by linking up with regional developments. Put this objective on the table, challenge other stakeholders, listen and see where it might lead to.*" Despite these conflicting visions, the participation track is expected to be further intensified as the program develops and becomes more concrete.

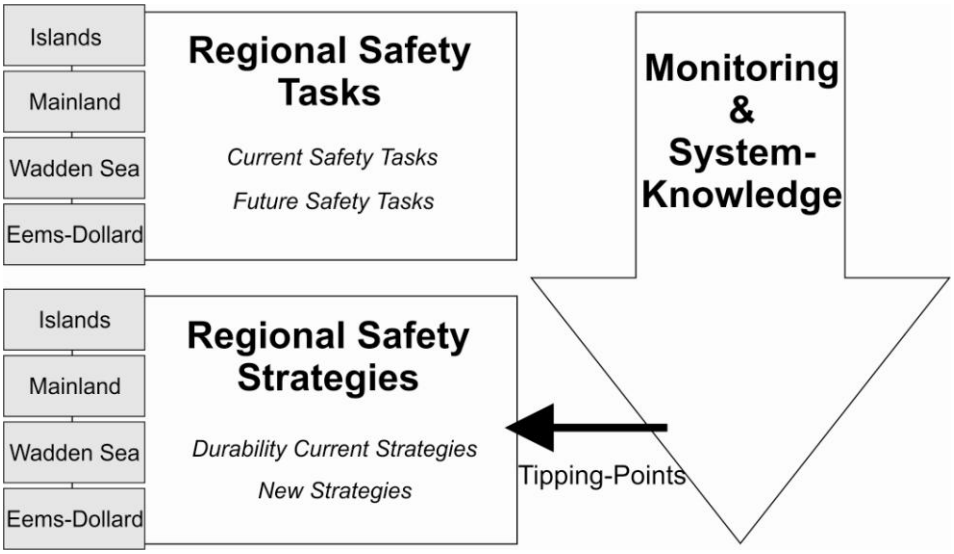

Figure 9 – Wadden region sub-program cluster organization (based on DP Wadden, 2011b)

Although there is a strong interconnectedness between sub-programs, each sub-program is for the most part free in setting up its own program organization and approach to comply with the task from the national Delta Program to anticipate in an early stage the effects of climate change and evaluate possible future safety strategies by 2014. On the one hand this objective is about a fundamental understanding of the safety tasks for the Wadden region and on the other hand about developing a set of strategies and measures to respond to these safety tasks (DP Wadden, 2011b). Hence, since its establishment in 2011, the program organization of the sub-program Wadden region is divided into three working tracks or *clusters* based on task fields in working on the objectives laid down by the Delta Program. These three clusters are aimed on the exploration of current and future *Regional Safety Tasks*, the improvement of *Monitoring & System Knowledge* in order to increase the knowledge base to build on into the future and the development of alternative future *Regional Safety Strategies* (Government of the Netherlands, 2012; DP, 2011c). The tasks and objectives of these three clusters are strongly interconnected and together they form a carefully thought out approach in working towards regional water safety strategies and creating a broader knowledge basis (see **Figure 9**) (DP, 2011d). The clusters and their mutual relationships will be discussed in more detail below.

In working on relevant long-term water safety strategies, more insight is needed into both current as well as future tasks in this field. Therefore, to stay ahead of potential climate change effects, the *Regional Safety Tasks* cluster is focusing on both current and expected future safety tasks for the Wadden region. The main task will stem from the coherent safety program and Delta Decision to be developed by the generic *Safety* sub-program (DP Wadden, 2011a). The standards to be laid down in this decision will provide the basis for future water safety tasks the Wadden region has to deal with (DP Wadden, 2010). In preparing the methodology for setting up future safety tasks for the Wadden region, prediction techniques are used that are based on multiple models that can give an indication of investments in each of the four Delta Scenarios (see **Figure 5**). In fact this approach is derived from the current methodology used in testing the safety of primary dike systems. The results of these tests can be used to make projections based on Delta Scenarios in which preconditions can be derived that tell how sea defense structures should look like in 2050. Cluster leader Kees de Jong (2012) admits that "*conveniently this is being called the future water safety task for the Wadden region."* However, besides the tasks arising out of the current legal safety assessment, future safety tasks for the Wadden region are also determined by the effects of climate change, soil subsidence, possible changes of safety norms and new insights. De Jong (2012) clarifies that this cluster mainly focuses on those aspects of water safety that can be expressed in norms and risks and does not specifically look at regional ambitions in other policy fields, an objective that the Delta Program and the steering groups have emphasized as one of the main focus points besides the safety aspect in working on strategies for the Wadden region. The analysis of future regional safety tasks will form the basis on which current safety strategies can be adjusted or alternative strategies can be developed (Government of the Netherlands, 2012; DP, 2011c).

In order to make well-founded statements about future safety tasks and develop alternative future safety strategies, a comprehensive approach to improve system monitoring and gain knowledge of the Wadden system has been developed in the *Monitoring & System Knowledge* cluster. Climate change will inevitably change the Wadden system, but how much and how fast is still largely unclear. In order to improve the ability to accurately predict developments in the Wadden region, more knowledge is needed about the interplay of system dynamics in the context of climate change (DP Wadden, 2011d). Therefore integral long-term system monitoring will be used to learn about system dynamics to get a better grip on the functioning of the system and obtain appropriate data to be used in models that predict future climatic effects (DP Wadden, 2010; DP Wadden, 2011b). This is not a one-off exercise, as building and using system knowledge and setting up monitoring systems should be seen as an ongoing cyclical process (DP Wadden, 2011b). However, not all has to be examined from scratch, as much knowledge is already available with knowledge institutes and regional organizations involved in the Wadden region (DP, 2011d). Therefore, cooperation between the Wadden region sub-program and knowledge institutes is essential in solving knowledge questions the sub-program struggles with (DP, 2011d). Based quick scans insight was gained into knowledge availability and especially gaps in knowledge on how to deal with future climate change in the Wadden region (DP Wadden, 2009). The knowledge-intensive nature of the Wadden region sub-program promotes interaction between

knowledge seekers and -suppliers, between national and regional knowledge and between scientific and practical knowledge. It is important to indicate what particular knowledge is needed, who provides, how knowledge provision is organized and how knowledge will be disseminated. The Delta Program has formulated a number of principles for *Joint Fact Finding*, a method for developing knowledge in an interactive fashion, with the aim of maximizing the use of available knowledge with all parties involved and creating support for jointly developed insights (DP Wadden, 2009). Therefore knowledge development in the Wadden region on setting up long-term adaptation strategies can be characterized as strongly interwoven and multidisciplinary (DP, 2011d). Parties abroad possess useful knowledge as well, which explains the initiative to carry out research and monitoring programs in an international fashion. In collaboration with research and policy programs in Germany and Denmark, a so called *trilateral cooperation* has been established (Government of the Netherlands, 2012; DP, 2011c). This cooperation should lead to a bundling of international research efforts, a better coordination in setting up and using the outcomes of pilot projects and eventually more efficient investments in knowledge development (DP Wadden, 2011d). Initiator of this trilateral cooperation Den Besten (2012) made clear that because each country in this effort has its own interpretation of their self-developed knowledge of the Wadden system, differences in outcomes, insights and knowledge exist between countries on for example safety measures or norms. Within this international cooperation this might lead to a mutual adjustment of knowledge and policy targets. Den Besten (2012) emphasizes this by stating that "*by bundling knowledge and monitoring data, a more solid foundation will be created on which new and better system understanding can be based.*" Another goal of the international cooperation is to increase the efficiency of experiments and monitoring, by setting up joint pilot projects that all participants can benefit from. Together these countries will monitor the effects of climate change on regional safety, ecology and economy with the aim to better gear adaptation strategies towards mutual targets (Government of the Netherlands, 2012).

Based on how climate change will have an effect on the Wadden region, as examined by the *Monitoring & System Knowledge* cluster, and the therefrom arising future safety tasks, as examined by the *Regional Safety Tasks* cluster, the durability of current strategies into the period from 2050 onwards and the chances or the necessity for a new or adjusted regional strategy will be mapped out (DP Wadden, 2011b). The outcomes of the *Regional Safety Tasks* cluster might form an incentive for the *Regional Safety Strategies* cluster in deciding whether to carry on as before or to look for alternative strategies. The *Regional Safety Strategies* cluster examines the validity of current strategies to guarantee sustainable water safety and uses these findings in deciding if making adjustments or developing alternative safety strategies will be necessary for the long-term. In short this means the task emerging from the sub-program Wadden region is not only focusing on the durability of the current strategy, but also on judging the necessity and feasibility and eventual development of alternative strategies (DP Wadden, 2011b; DP Wadden, 2011a). In working on the development of alternative future safety strategies, parties involved in the Wadden region sub-program constantly emphasize the need to look for the right balance between long-term thinking and short-term action, on which the regional steering group uses the motto "*the whole is greater than the sum of the parts*" in

looking for directions for solutions for water safety, which is being pursued by striving for synergy and coherence with other regional developments and ambitions (DP Wadden, 2010). The challenge is to connect the long- and short-term and bring them more closely together by setting up long-term explorations and short-term initiatives that enable regional learning processes to take place. New alternative strategies to be developed for a natural reserve like the Wadden region obviously have to anticipate possible future safety tasks, within the framework conditions of safety, contribute to other local, regional and national ambitions in the region, make more use of natural processes and use the dynamics of the Wadden system to increase its self-adapting capacity, develop opportunities for a robust and resilient nature, sustainable human exploitation and avoid unforeseen future tasks (DP Wadden, 2011b; DP Wadden, 2011a; Government of the Netherlands, 2012; DP, 2011c).

The challenge is to develop alternative strategies that can guarantee long-term water safety and have more to offer and are more cost-efficient compared to the current water safety strategy (DP Wadden, 2011d). Looking at the future role and arrangement of clusters in this process, program manager Van Es (2012) admits a subdivision of the Wadden region into smaller, more local sub-regions might be necessary as the specific and complex tasks for the North Sea coast and Wadden Islands are strongly differing from those for the main coast or the Eems-Dollard estuary that all have their specific dynamic behavior (see **Figure 9**) and therefore would require a tailor-made approach. Eventually a specific safety strategy has to be developed for each of these sub-regions anyway as the safety tasks for the Eems Dollard estuary and the north-eastern part of the Wadden region are expected to have a significantly different character and require a substantially different approach than the rest of the region, which is a direct result of the complex dynamics of the Wadden system. To be able to judge whether current strategies could or should be continued on to the long-term, research is being done in finding strategy *Tipping Points* (see **Figure 9**) that make the continuation of current strategies undesirable or unrealistic (**Chapter 5.3**) (DP Wadden, 2011a). To a certain extent the Wadden system in its current form will be able to keep up with the oncoming effects of climate change. An important question however is whether and under what conditions a tipping point will be reached at which a continuation of the current strategy is no longer adequate and the Wadden system will lose its current form and function for water safety. Considering the great uncertainty in the Wadden system, defining such tipping points is a challenging issue which will be an important subject for monitoring and knowledge development (DP Wadden, 2010; DP Wadden, 2011b). As already covered in **Chapter 5**, the Delta Program prescribes the use of the adaptive approach extensively elaborated in the ADM concept. The remainder of this chapter will however show that developing future safety strategies using this *Adaptive Delta Management* (ADM) concept for a complex region like the Wadden region, with many contradicting interests and great uncertainty around future developments related to water safety, is easier said than done.

6.3 Adaptive Delta Management in strategy development for the Wadden region

Once the safety tasks for the Wadden region have been brought into focus, the sub-program will, according to the Delta Program decision making trajectory (see **Figure 7**), start working in three

iteration rounds on subsequently exploring *possible strategies* in the 2013 Delta Program report, developing *promising strategies* in the 2014 report, towards creating a *preferential water safety strategy* in the 2015 report. As elaborated in **Chapter 5.2**, this iterative process is meant to tighten up and make provisional judgment of future tasks and objectives and use obtained knowledge to gradually work towards a preferential water safety strategy. Knowing that climate change is already taking place and some effects will be irreversible, it is important to start developing alternative strategies as soon as possible. For the Delta Program a strategy describes the coherent whole of tasks and objectives, measures, instruments and strategic choices to realize tasks and achieve objectives, the timing of measures and the use of development paths on the mobilization of measures (DP Wadden, 2011b). However, looking at the Wadden region the picture of what exactly a preferential strategy entails is anything but unanimous. Sub-program member De Jong (2012) for instance expects that a preferential safety strategy will consist of a hard list of measures as well as the acknowledgement that working on adaptation solutions should continue into the future in the most adaptive way possible.

"Presumably a preferential strategy will consist of preferential concepts connected to regional water safety tasks in such a way that freedom remains to switch to the continuation of the current approach at any given moment."

Groen (2012) states that although a preferential strategy might sound permanent it will not be that definite in practice, because "*as soon as a preferential strategy has been set up towards 2015, it will be further explored in the MIRT trajectory* (**Chapter 5.2**)*, which means implementation won't take place earlier than 2020. Therefore, another option is to extend the exploration phase by a few more years, link up with ongoing regional activities and let this process follow its own dynamics instead of forcing it.*" It will clearly remain unsure what a preferential strategy for the Wadden region sub-program will look like in 2015, will it be a complete and hard development framework for water safety tasks or a development path along which further decision making can take place.

Based on the present state of knowledge, the continuation of current water safety elements, like traditional dike reinforcements and sand suppletions (**Chapter 6.1**), are considered sufficient in guaranteeing water safety for the coming decades. In getting a better overview of the durability of these strategy elements, possible *Adaptation Tipping Points* (**Chapter 5.3**) can be recognized in the continuation of the current strategy that indicate the need for considering strategy adjustments or alternative strategies to postpone or avoid these limits. On tipping points, Van Es (2012) states that for a long time it was believed the Wadden system was drowning as a result of sea level rise. However, monitoring outcomes show that instead the demand for sand is increasing over time, which means the system is silting up instead of drowning. Now there is expected to be a natural limit somewhere in the future where this demand for sand might cause safety problems for the Wadden region (DP Wadden, 2010). Groen (2012) explains that "*the silting up of the system has a positive effect on its buffer function in absorbing wave load, which is also beneficial for protection standards of dike systems. However, if this process will not be regulated, the Wadden Islands will start to erode and will slowly*

disintegrate into the Wadden Sea." Inaction therefore would not only lead to an increasing erosion of the Wadden Islands' Basic Coastline, a structural withdrawal of the Coastal Foundation and an increased wave load for dike systems, but will also form a threat to the identity of the Wadden system and its world heritage status. Therefore recent safety strategy elements consisting of periodical sand suppletion along North Sea coast contribute to preserving the Basic Coastline and the accretion of the Coastal Foundation and indirectly to guaranteeing the stability of primary embankments (DP Wadden, 2011b).

This situation might however change given the great uncertainty around future sea level rise, related morphological changes in the Wadden system, like altering sediment flows, long-term shifts in tidal currents and increasing storm surge (DP2012, 2011a). Current suppletion programs are expected to be insufficient to have the Coastal Foundation and the Wadden system fully grow apace with sea level rise on the longer-term, which might lead to serious deliberations on ways to safeguard water safety (DP2012, 2011b). However, getting more insight in strategy tipping points is a challenging task and identifying where they call for strategy adjustment or alternatives requires thorough and comprehensive research and monitoring. The exploration of possible future tipping points in the current water safety strategy forms no leading item on the agenda at this point, since current efforts of the Wadden region sub-program are primarily geared towards postponing the most threatening ones. Van Es (2012) emphasizes that for the Wadden region,

> ***"…it's hard to anticipate what alternative strategies to apply in the future, but doing short-term investments with the aim of postponing larger measures on the long-term, leading to better cost efficiency and wider social support, forms an important principle."***

To get more insight into long-term safety tasks, whether tipping points are actually going to be reached within a foreseeable time and to make deliberate decisions on possible future strategies, a better understanding of the development of the Wadden system in the context of climate change is crucial, since as long as the Wadden system is able to maintain itself the need for alternative safety strategies is not an imminent issue (DP Wadden, 2011a). For the longer-term the survival of the Wadden region is uncertain and in order to respond to potential future safety effects, it may be necessary to intensify current suppletion programs or to adopt an alternative water safety strategy somewhere in the future. However, whether future climate change effects or strategy tipping points can even be indicated, require new safety strategies and in what time frame, is hard to indicate as a result of the uncertainty surrounding long-term developments of the complex and dynamic Wadden system, especially since tipping points should not be made up when they simply are not there. Even if tipping points are expected somewhere in the future, uncertainty and complexity make them hard to grasp, which makes them ill-suited to fully base decision making on.

The question is whether true alternative water safety strategies for the Wadden region exist at all, which are able to respond to the great long-term uncertainty and complexity of climate change better than the current strategy is. Alternative strategies preferably make more use of natural processes to

increase the self-adapting capacity of the Wadden system and will also create a platform for the realization of innovative concepts that might lead to alternative visions, like for instance spatial adaptation measures, that are strongly contradictory to established approaches (DP Wadden, 2011a). Groen (2012) illustrates that for an alternative water safety strategy, the Wadden region sub-program,

"…might as well decide not to intervene too much in the Wadden system, let it develop in a natural way, leave dikes pretty much as they are and instead focus on accommodating the consequences of a potential flood."

The following question then is whether expected climate change is enough reason to start thinking of radical alternatives and corresponding large financial investments for the Wadden region. It is predicted that for at least the next 50 years, climate change will not be an imminent threat for water safety in the Wadden region, regional functions can continue to coexist in an unaltered form and will not demand drastic strategy adjustments or alternatives. Therefore, Groen (2012) accentuates that it is difficult to speak of true alternative strategies within the Wadden region sub-program, also since most initiatives nominated alternative or innovative are in fact not that groundbreaking and have been implemented or at least considered before. On the lack of alternatives Van Es (2012) states emphasis is almost exclusively placed on adjusting existing strategy elements, like for example sand suppletion efforts, "*will they be maintained, intensified, reduced, or do we decide to further monitor the system for 20 more years to see what's really going on?*" De Jong (2012) declares that on the one side this is reflected in the search for *no-regret-measures* and on the other side in the never ending development of innovative concepts for the Wadden region. In this context Groen (2012) admits that if the sub-program wants to take up the development of an alternative strategy, water safety is no legitimate motive for large scale investments. For the Wadden region Van Es (2012) presumes:

"It's not so much the goal to look for alternative strategies, but instead to link current water safety concepts with other regional objectives and spatial development ambitions."

Many secondary spatial objectives exist in policy fields such as nature development and preservation, economy and tourism and exploring possibilities for linking up with these ambitions becomes a prominent task, which puts emphasis away from the core task of guaranteeing water safety. The fact that around 100 kilometers of dike segments have been rejected (**Chapter 6.1**) apparently is not enough reason to structurally take up innovative dike concepts in developing alternative strategies. For the Delta Program the main challenge then becomes to immediately look for opportunities to link up straight forward water safety measures with other regional ambitions, or arrange spatial developments in such a way that the link with water safety can still be made in the future. However, linking up regional spatial developments and water safety ambitions is complicated by the complexity and uncertainty in the Wadden system, in such a way that the sub-program might roughly estimate future climate change effects for the Wadden region, but sensibly decides not to do so, since such predictions can in no way be justified.

As a result of the low predictability, the Wadden region sub-program is more knowledge-intensive than other sub-programs, and strongly focuses on learning how the Wadden system responds to different climate change effects and might require alternative or adjusted water safety strategies. This situation is further reinforced by the fact that the Wadden region sub-program is not built around a specific Delta Decision, like for example the IJsselmeer sub-program that specifically focuses on water level management for the IJsselmeer (**Chapter 5.4**). Further to this, Van Es (2012) emphasizes that decisions to be made for the Wadden region will not be that straight forward, as there will not be a clear decision point at which the further program course will be set out, like Delta Program frameworks might suggest (**Chapter 5**). Instead, for the Wadden region a trajectory is foreseen based on the optimization of the current sand suppletion strategy and the monitoring of system dynamics to get a better understanding of its functioning. Because of the uncertainty present in the Wadden region, the sub-program is forced to base efforts and research on *learning-by-doing* concepts, such as pilots and system monitoring on which Van Es (2012) declares:

"There's also a clear strategy in the start of a number of pilot projects to see how alternative concepts work out and learn from them."

Even though the call for pilots in the Wadden region is increasing, Van Es (2012) accentuates that well-thought-out pilots cannot be developed and implemented overnight, as pilots by definition are *"difficult, new and annoying, otherwise they would've long been initiated.*" Instead pilots emerge from opportunities or problems, in cooperation with regional parties and should actually last for multiple decades, especially in case ecological factors play a prominent role. Where opportunities arise, new concepts will be introduced and follow-up steps will be based on new insights to apply them. Only after such a period acquired findings from long-term learning processes may be applied more widespread at other locations (DP Wadden, 2010).

The link between learning-by-doing approaches and adaptive management is obvious, since both concepts are aimed at increasing adaptiveness by emphasizing structured learning to gain system knowledge and improve interventions when desired effects stay out or problems develop. However incorporating this learning-by-doing philosophy for the Wadden region considering the strict Delta Program decision making trajectory and the legal and process frameworks for ADM is quite something else. A future strategy will either be based on long-term monitoring and research to see how the Wadden system develops or on a more short-term anticipation ahead of possible climate change effects by making adjustments to current strategy elements. The eventual result of the Wadden region sub-program will presumably lie somewhere in between these two extremes. However, Van Es (2012) openly doubts whether this approach is in line with the ADM concept:

"Well, is this a form of Adaptive Delta Management? Perhaps, I don't know."

Taking into account the 5 D's (**Chapter 5.4**), intended as conditional factors for the successful application of ADM, it becomes clear that it takes more than the Delta Decisions, a Delta Fund, a Delta Commissioner, a Delta Act and a Delta Program to come up with a preferential water safety strategy in

a regional process. On these 5 D's Van Es (2012) stresses they play no leading role in regional decision making, because "*the Delta Commissioner merely directs the program and monitors progress, the Delta Fund mobilizes financial resources which will undoubtedly lead to regional discussion whether it is large enough and the Delta Law is only preconditional in that it guarantees the availability of resources and long-term progress.*" However, on the regional scale where decision have to be taken, the regional steering group still has to establish regional ambitions for the Wadden region and political decisions still have to be made on how to fulfill water safety tasks, the percentage that should be regionally financed and the amount that will be demanded from the Delta Fund.

It will be clear by now that ADM does not take a prominent place in the Wadden region sub-program and its practical added value in this region seems questionable. On the one hand the principles that characterize the ADM concept seem to be part of the solution for setting up a new adaptive approach for the long-term tasks of the Delta Program on how to deal with the complexities and uncertainties of climate change, while on the other hand the concept also seems to be part of the reason why working on long-term safety strategies for the Wadden region is so hard. The use of the concept is likely to lead to difficulties with current institutional and political frameworks and can therefore not blossom in current regional governmental and decision making processes. Still many dilemmas and questions exist in the regional process of developing alternative water safety strategies for the Wadden region (DP Wadden, 2010). Van Es (2012) admits that he does not think the ADM approach is the way to go in the Wadden region as he rather thinks this concept might have an added value for those sub-programs dealing with more classical water safety tasks. He stresses that in the Wadden region it is more "*the uncertainty of whether we are able to make good decisions, or whether we even want to make decisions.*" In pursuing adaptiveness for extremely complex water safety tasks, the Wadden region sub-program encounters many dilemmas emerging from this uncertainty and complexity of regional decision making. The next section will go deeper into these dilemmas for the Wadden region sub-program using the ADM concept for flexible decision making.

6.4 Dilemmas for the Wadden Region sub-program in the pursuit of adaptiveness

Finally, interview respondents from the Wadden region sub-program team were asked about the dilemmas the program organization encounters in the apparently complex task of developing alternative water safety strategies for the Wadden region and the attempts to apply the ADM concept in this process. These interviews have revealed a wide variety of dilemmas experienced in the Wadden region sub-program, of which the most significant will be further denounced in this paragraph. The listing of these dilemmas will be based on the same categorization of barriers that adversely affect adaptation policy development and implementation processes by Biesbroek *et al*. (2009b) and Biesbroek *et al*. (2011) elaborated in **Chapter 2.6**. All these seven categories of barriers to adaptation will be addressed extensively in the following section to see whether and how these barriers play a role and lead to dilemmas in decision making and policy development in the Wadden region sub-program. Due to the widespread character of dilemmas that has become apparent, as well as the strong interconnectedness of most barriers, the categorization of some dilemmas described below

may be arbitrary. Nevertheless, this categorization is solely used to structure the complex variety of dilemmas experienced in process of strategy development for the Wadden region.

Uncertainty

The role of uncertainty in the Wadden region sub-program is evident and therefore forms a central theme in the process of developing alternative water safety strategies. The approach of developing strategies for a highly complex region like the Wadden region inevitably has to deal with this uncertainty, both in a physical as well as in an administrative sense, which makes long-term planning a huge challenge for the sub-program organization. On the role of uncertainty in the Wadden region, Groen (2012) puts that "*an important part of our uncertainty is that we don't know how the Wadden system will react to long-term climate change.*" However, as already stated in **Chapter 2**, uncertainty not only covers a lack of scientific understanding of long-term developments, but also the missing coherence between scientific understanding and the political, cultural and institutional context in which decision making is taking place. Following up on this, according to Den Besten (2012) the most important factor of uncertainty is the lack of knowledge and the inability to predict future developments of critical system factors and the economic and ecological interests that are at stake in the Wadden region. These two combined have led to the conclusion that:

"No matter what water safety measures will be taken, investments in the strengthening of the knowledge basis are required anyway."

Finding appropriate ways of dealing with this uncertainty in the pursuit of using the concept of adaptiveness in long-term objectives of the Delta Program is causing serious dilemmas for the Wadden region sub-program. In this matter, Van Es (2012) says that the statement made by national Delta Program staff member Bloemen (2012), to give an explicit role to uncertainty role by using structuring decisions such as Delta Decisions (**Chapter 5.2**), "*exactly captures the split the Wadden region sub-program is in.*" According to Den Besten (2012), generally spoken the adaptive character of Delta Decisions might form a very useful approach for developing principled decisions in guaranteeing long-term water safety as they are being tightened-up in conjunction in an iterative fashion (see **Figure 7**), which is a great way of eliminating uncertainty in a step-wise manner. Uncertainty in time, on the question whether initiatives are really necessary are partly overcome by striving for as much flexibility and adaptability as possible, avoiding large decisions to be made and instead focusing on what small and robust steps could be taken in a variety of scenarios that will eventually still form sensible decisions in the long run. Using this approach thought out by the national Delta Program, the central way of dealing with uncertainty is to wait and see how climate change effects will manifest themselves, while decision making is ought to keep options open to be able to deal with every possible scenario. Practice has shown that as soon as interventions are meant to anticipate worst-case scenarios, they will almost certainly be pushed backwards in time. Therefore the central way of dealing with uncertainty in the Delta Program, based on the ADM concept, is made up of long-term water safety objectives that are being cut up into short-term steps.

However, Den Besten (2012) stresses that when looking at the role of uncertainty in the Delta Program as a whole, the Wadden region is a sub-program that stands out with quite another approach of dealing with uncertainty. In the Wadden region the greatest uncertainty lies on the inability to predict future developments in system dynamics and the possible effect of this uncertainty on water safety. For the Wadden region sub-program uncertainty has led to the question how to deal with a lack of system knowledge, which has resulted in a strong reliance on *learning-by-doing* concepts and the desire for regional pilot projects in which monitoring the effects of innovative measures can be used to see whether new initiatives are considered viable for more broad scale implementation throughout the region. At the same time Van Es (2012) also emphasizes that:

"It's hard to announce innovative measures in concrete terms, because uncertainty is just too high."

The highly complex dynamics of the Wadden system in combination with the complexity of regional decision making structures makes legitimate decision making a serious challenge. The question now is how ADM is being deployed to overcome this uncertainty in this sub-program that stands out when compared to other regional programs. As elaborated earlier in this chapter, program team manager Van Es (2012) states that "*speaking of adaptiveness, the Wadden region sub-program is heavily suffering from uncertainty and is therefore heavily relying on knowledge development.*" Most other sub-programs, such as the Southwest Delta, do not have to deal with as much uncertainty in deciding what approach and what water safety measures to take, which Van Es (2012) accentuates by saying:

"On the one side the Wadden region water safety task is pretty classical on how to deal with sea level rise and soil subsidence, while on the other hand there's persistent uncertainty in developing system knowledge on Wadden system behavior in climate change and how to deal with it."

This the main reason why the Wadden region sub-program is investing much more time and effort in system monitoring and knowledge development compared to other sub-programs. Nevertheless, Van Es (2012) also emphasizes that the role of uncertainty in the Wadden region sub-program should not be exaggerated. "*It's not that the sub-program is drowning in uncertainty, but for a governmental program organization it's critically important to know where you're going, which means a constant process of shifting, tightening-up and searching.*" Even though the Wadden region sub-program uses Delta Scenarios (**Chapter 5.1**) to see what might happen with sea level rise and subsequently develops a strategy based on these prospects, Van Es (2012) stresses these Delta Scenarios may seem rather unambiguous, but at the same time still harbor a lot of uncertainty. On the practical application of Delta Scenarios in the Wadden region he argues "*the rate of sea level rise could be calculated or at least approximated, but what this will mean for sand transportation, the soil and other elements that are critical in safeguarding water safety for the Wadden region remains unclear, since the interaction between morphology and sea level rise isn't included in calculation models.*" That is why much uncertainty still remains in place and why the sub-program puts so much emphasis on this subject. For the Wadden region sub-program uncertainty obviously forms the source of the impasse

the development of a preferential water safety strategy is currently in and both directly and indirectly is more than likely to lead to other dilemmas on other factors that play an important role in the tasks of the sub-program, which will be described on the following pages.

Fragmentation

Besides dilemmas born out of uncertainty, much of the complexity in decision making for the sub-program is the result of fragmentation that refers to the large number of actors involved in the process of strategy development and implementation at different levels of governance, and to widely dispersed insights, approaches and responsibilities divided across and between organizations. The diversity of visions on regional development as well as the many and sometimes conflicting interests of parties involved in the Wadden region, will all have an effect on processes within the sub-program and on the development of a water safety strategy for the Wadden region. Den Besten (2012) accentuates the role of fragmentation in this process by stating that:

"The Wadden region isn't only complex in an ecological and morphological sense, but certainly also in an administrative sense."

Fragmentation forms a complex challenge for the Wadden region sub-program that can only partly be seen in other regional sub-programs. Den Besten (2012) continues "*the administrative complexity leads to an immense jigsaw puzzle of ambitions present in the Wadden region and the question: who has responsibility for certain political tasks.*" Besides that, fragmented decision making processes are characterized by a lack of connection and coordination among involved institutions, organizations, and policies at different governmental scales, a picture that clearly applies to the Delta Program. Due to the fact that varying perceptions of strategies and objectives exist at various scales in the Wadden region, while setting up adaptation strategies requires a multi-level and multi-sector approach, fragmentation inevitably leads to dilemmas in deliberately developing regional adaptation strategies. In case of the sub-program under study, program manager Van Es (2012) emphasizes that:

"The sub-program team and regional steering group are made up of delegates from a variety of organizations and governments that all have a distinctive view on long-term water safety of the Wadden region."

All program team members are delegated on a part-time basis from national and regional government bodies, which makes frequent consultation within the sub-program organization nearly impossible. As a result, the fragmentation of program bodies is considerable, which obstructs decisiveness in working on water safety and following Delta Program guidelines.

Looking at the organization of both the national Delta Program and the Wadden region sub-program, some practical dilemmas appear that seriously affect the possibilities of fully utilizing the potential benefits of adaptive decision making. On this, interview respondents considered the process of multi-level governance as a serious dilemma for decision making, as hierarchically and centrally governed political structures, concepts and decisions ought to be combined with local aims, ambitions and

objectives about what is desirable and socially acceptable to fit into a specific regional context. On this topic De Jong (2012) experiences the process steps (**Figure 7**) of the Delta Program as considerably compelling and clear-cut. In terms of substance and question phrasing,

"…the Delta Program decision making trajectory provides strong direction on what to formulate and what to decide as a regional sub-program."

On that account De Jong (2012) states it feels like the national program immediately agrees to sub-program products, as long as they are being put on the table in time. Van Es (2012) experiences Delta Program guidelines as if the ball is with the Wadden region that has been given freedom to fill in regional safety tasks and the program approach at the sub-program level.

"A lot of responsibility has been put down by the sub-program, while at the same time it's pushed into the Delta Program pattern that annually tapers towards a preferential water safety strategy by 2015."

Although this blue-print for decision making processes might seem straight forward, at the same time a complex regional process is being pushed into its time stretch of only a few years. Based on legal requirements from the NWP, the MIRT program and official consultation procedures, Groen (2012) states that a concept water safety strategy has to be completed by the end of 2014, one year earlier than the strategy that will eventually be released by the Delta Program in 2015 (see **Figure 7**). This is very short-dated for the Wadden region, especially since the knowledge basis is so fragile. The Wadden region case shows that even though this Delta Program time frame (**Chapter 5.2** and **Figure 7**) might suggest clear decision points towards a preferential regional water safety strategy, it will more likely become a trade-off between this structured process and the sub-program taking own responsibility. The question however remains whether the Wadden region sub-program, regardless of the approach, is able to make this decision by 2015 in the first place.

The national program framework also affects the way in which uncertainties are being considered in the Wadden region sub-program, on which Den Besten (2012) states that "*the Wadden region sub-program tries to take as many factors into consideration, while at the same time it has to resign itself to align with the pace of decision making in other Delta Program units.*" Despite its practical pitfalls in the Wadden region, this framework is implemented throughout the Delta Program, which means the absolute desire for certainty to base decision making on is not necessarily fulfilled. Van Es (2012) continues that "*the Wadden region might require another sort of agreement with the Delta Program, like a growth path agreement in which further strategy development and adjustment can still take place in the future.*" Even though the aim is for organizing structured feedback and adjustment of goals, it is difficult to walk apace with this funneling process of the Delta Program in combination with a regional process and the uncertainty and complexity of the Wadden system, which has created a terrible struggle. Such process steps suggest an isolated process, which of course is nonsense as administrative and program complexity and uncertainty in the region is way too high. On the other hand Van Es (2012) believes that guaranteeing this coherence in the Delta Program is another way to

determine when a joint step in the decision making process has to be taken and that using a time frame will definitely help to keep the program organization in a certain flow and structures the process.

The fact that the majority of program elements and concepts that play an important role in setting up regional strategies, is being thought out at the national level and therefore does not specifically take contextual factors into consideration that play at the regional level, has caused great fragmentation within and between organizations and governments involved in the Wadden region sub-program. Program manager Van Es (2012) admits the Wadden region sub-program is struggling with concepts like ADM, as:

"Reality is quite different from what policy documents suggest."

The Delta Program search for models and calculation methods has triggered a real struggle for the Wadden region sub-program, especially since the region is not included in the Delta Model (**Chapter 5.1**), but the Wadden region sub-program still has to indicate the possible impacts of climate change on regional functions, which Groen (2012) puts as "*a task that's hard to deliver without any scientific foundation and therefore is based on expert-judgment or plain gut feeling.*" In the quest to tackle uncertainties, views are deeply fragmented and divided as to whether the Wadden region sub-program needs new models and tools in estimating the possible effects of strategies at this stage of the process, a dilemma that Groen (2012) describes very well by stating that:

"The search for models almost resulted in a tribal fight between research institutes on the one side having the tendency to capture every little detail in models and regional parties on the other side trying to clarify that some contextual factors cannot be captured in models."

In making policy concepts more regionally applicable, De Jong (2012) states that even though there are impulses from the national government to give concepts like ADM more attention in the Wadden region, they remain mere words on paper. It turns out that at the national level very little initiative is taken to actually make them better applicable in a variety of specific regional contexts, a point Van Es (2012) aptly describes by stating it sometimes seems as if substantial matters developed or initiated at the national level, are simply not applicable in the Wadden region.

Fragmentation at the sub-program level becomes apparent in the fact that Delta Program initiatives do not take place in a policy vacuum, since multiple policy processes are being played at the same time which affect the development of alternative water safety. De Jong (2012) has the impression that in the start-up phase of the Wadden region sub-program a lot of things needed tackling in a short amount of time. For some regional sub-programs relevant processes or researches were already running at the time the Delta Program was initiated, and have simply been piled up and so formed a specific Delta sub-program. However, for the Wadden region no such regional initiatives were present that could be combined into a comprehensive regional water safety program. And so, other sub-programs rushed on, while the Wadden region was having trouble to synchronize with Delta Program processes,

since especially generic sub-programs had no notion of the applicability of their findings in the Wadden region. Therefore, *"it's sometimes hard to decide whether sub-programs are at the same point in decision making, since each sub-program has its own specific task and chooses its own approach, all based on defensible arguments.*" On fragmentation between sub-programs De Jong (2012) regards the mutual coordination with relevant sub-programs as rather poor. "*Even though consultation and collaboration between the Wadden region and Coast sub-programs is intensifying as the Delta Program evolves, in the construction phase of the Delta Program the division of labor and tasks was too unspecific and not very helpful.*" A reference should also be made to the generic Safety and New urban developments and restructuring sub-programs, that in De Jong's (2012) opinion *"have executed their generic program far too little to be applicable in the specific water safety tasks of the Wadden region.*" This means that specific questions of the Wadden region sub-programs on generic themes mostly remain unanswered and have to be picked up in the Wadden region sub-program itself of which is doubtful how far this sub-program can take these specific tasks besides other complex regional activities.

Looking at the Wadden region sub-program, the bodies participating in the development of strategies for the Wadden region are temporarily, yet its members are agents from a variety of existing government bodies. This program staffing leads to a number of practical dilemmas, which Den Besten (2012) elaborates as:

> ***"The sub-program team and regional steering group ought to work for the region, developing a sustainable water safety strategy. However, besides this task, these delegates also have a home base, which turn out to be two completely different worlds, as the way in which parties look at tasks and initiatives at their home base may differ from what the sub-program gets out of jointly focusing on regionally shared objectives."***

Following on from this, De Jong (2012) stresses that consultation and cooperation between the three sub-program clusters is mainly taking place through cluster members from the program team. The ultimate goal however is to intensify and broaden this collaboration and the connection among research institutes that undertake research for the sub-program, by for example exchanging information on research findings, since "*so far, research organizations and departments within organizations act pretty much in isolation, which leads to low efficiency and low mutual understanding.*" On the theme of leadership and responsibility in the Wadden region sub-program, Den Besten (2012) believes of all regional parties involved provinces have a director-role, the question however is whether they are actually willing to take this role. The same applies to Ministries, municipalities and water boards, parties that all have particular interests and priorities around water safety in the Wadden region. The fact that the sub-program is working on developing potential water safety strategies for the Wadden region unfortunately does not automatically mean these interests will actually be picked up by participating parties and organizations. According to Den Besten (2012) this translation from having a jointly shared vision on long-term water safety for the region, towards each

party distilling their fragment from this vision and picking it up at their home base organization, "*is a very complex puzzle*." Besides the dilemmas elaborated here, dilemmas resulting out of institutional fragmentation, somehow related to the Wadden region, also play an important role in the Wadden region sub-program. These dilemmas will be discussed in the next section.

Institutional void and institutional crowdedness

As elaborated in **Chapter 6.1**, a main criterion for the Wadden region sub-program is that adaptation strategies have to fit within current policy frameworks at the national, provincial, water board and municipal level. On the one hand the sub-program has to deal with an *institutional void*, especially around the use and implementation of new policy concepts in long-term decision making such as ADM, while on the other hand a strong *institutional crowdedness* of national and regional policies, agreements, visions, and legal guidelines exists on the establishment of water safety strategies, since the Delta program policy pathway is implemented alongside official ongoing policy streams in an ecologically precious region where numerous interests are at stake. Therefore, the ultimate challenge for the Wadden region sub-program is to mainstream adaptiveness into existing institutional arrangements and climate related policy domains. Some essential program elements, of which ADM is the most flagrant example, currently lack commonly accepted formal institutions, rules, laws and norms according to which processes are to take place. This lack of legal guidelines enabling, facilitating, or stimulating adaptation, referred to here as the institutional void, forms a major dilemma not only for the Wadden region sub-program but for other Delta sub-programs as well. An institutional void therefore does not mean that there are no institutions in place at all, but rather that there are no institutions that address the policy issue in particular. This lack of understanding and agreement on essential program elements further complicates the already difficult communication among program bodies, involved governments and organizations and as a result has led to a lack of consensus on what adaptive decision making should comprise for the Wadden region and what an alternative water safety strategy for the Wadden region should look like, as already elaborated in **Chapter 6.3**.

At the same time dilemmas have emerged as a result of the surplus of related institutions and legal frameworks in the Wadden region, which is here referred to as institutional crowdedness. Policy problems encountered in the sub-program emerge parallel to existing institutional orders and need to claim a position within prevailing formal and informal rules, norms and values. An exploratory inventory by Biesbroek & Klostermann (2012) on the complex and fragmented legislation in force in the Wadden region, states that legislation sets a framework for the introduction of policy initiatives and innovative water safety measures. This exploratory assessment has helped the sub-program to identify possible legal bottlenecks and opportunities in an early stage both in a substantial as well as in a procedural sense, which should be beneficial to the process of working on water safety strategies. Many organizations and governments are involved in the Wadden region and the region plays an important role in many policy notes and researches at the national, provincial, water board and municipal level, due to its unique cultural-historic and ecological status. Considering the renewing Delta Program objectives, responsibilities, unclear and conflicting goals and divergent perceptions about water safety

and how it should be approached, institutions that were already in place have to compete with newly developed institutions, which is a major cause of dilemmas for the Wadden region sub-program. Existing legislation to a greater or lesser extent can affect the development and execution of innovative water safety strategies and translating valid legislation into policy plans, programs and projects makes it even more complex. In Delta Program documentation former chairman of the regional steering group Henk van 't Land (DP, 2012b: 17) emphasizes that:

"Because of all voluntary agreements and initiatives, a tangle of agreements and policies has developed in the Wadden region over the last decades."

Biesbroek & Klostermann (2012) emphasize that throughout the process account should be taken of valid legislation and policies, since obstructions may just as well result from how the regional process is arranged rather than from the institutions themselves. With taking an integrated approach in looking for water safety strategies, the sub-program aims to combine seemingly contradictory rules and regulations and thereby provide process structure and progress. Given the proactive long-term approach of the Delta Program it is important that development-oriented spatial measures are enabled by legislation. Even though some directives are aimed at preservation, which can hamper an adaptive long-term approach, the Nota Ruimte allows for spatial developments within a preset spatial vision and its successor, the *National Policy Strategy for Infrastructure and Spatial Planning*, designates space for flood risk management and climate-proof urban (re)development as important policy areas (**Chapter 4**). The NWP, Natura2000 and PKB third note Wadden Sea on the other hand should be seen as the most important and potentially obstructive legal frameworks for the Wadden region sub-program aimed at preservation goals. Based on the additional sub-program criterion discussed in the beginning of this chapter that says water safety strategies have to fit within legal policy frameworks, the objectives of these policies are conditional for all initiatives by the Delta Program. Other legal frameworks or policy trajectories that play an important conditional role in the approach and researches of the Wadden region sub-program are especially the MIRT trajectory and the *Faster & Better* program that both strongly established the design of the Delta Program time frame (**Figure 7** and **Chapter 5.2**), regional and local spatial planning visions and plans that offer the opportunity to link up with regional spatial developments or instead might oppose this (DP Wadden, 2010).

Groen (2012) admits that Natura2000 and NWP legislation as well as the PKB Wadden Sea form serious obstructions for decisiveness of the Wadden region sub-program, as they form strict boundary conditions within which to act. The extent to which certain natural values in the dynamic Wadden system are to be conserved has become a stumbling block in working on alternative and flexible water safety strategies. On the role of Natura2000 and PKB legislation in combination with the goal of setting up an adaptive process Groen (2012) argues that:

"In fact this legislation should also become more dynamic and flexible, just like the management approach we're trying to pursue."

Even though flexible strategy elements like for example dynamic dune management and sand suppletion might stimulate the natural dynamic behavior of the Wadden system, these measures can at the same time cause spontaneous relocation of protected species outside the preset boundaries of Natura2000 area, which creates a 'problem' as a result of Natura2000 legislation of which Groen (2012) asks himself how bad such a development actually is. These are dilemmas the sub-program runs into in developing adaptive ways of dealing with water safety. Den Besten (2012) describes the PKB as a piece of policy endorsed by many parties on how to deal with the Wadden region in general, which therefore contains strict conditions, also for the Wadden region sub-program.

"Sometimes the PKB disallows interventions, even though insights might show that such interventions are only moving along with system dynamics and should therefore not be prohibited in advance."

Unfortunately this is what the PKB induces from time to time, something the Wadden program wants to compromise a little bit more sometimes, as Den Besten (2012) stresses. The conservation objectives of Natura2000 legislation might also cause problems when a particular development with a positive effect on water safety, is hindering ecological values (DP Wadden, 2010). On this subject Groen (2012) explains that "*for a long time the broadening of dikes in a seaward direction used to be no problem, but nowadays it all of a sudden is because of the fact the Wadden region has been assigned as Natura2000 area.*" As a result, seaward expansion is only allowed in those cases where no alternative solutions are available, which would be the exception rather than the rule as usually feasible alternatives for dike reinforcement are abundant. Van Es (2012) admits that this is more a governmental issue.

"If water safety requires a seaward expansion of dike bodies the rules of Natura2000 hinder this, unless it's a matter of public interest, which water safety is if you ask me. However, in such a case Natura2000 requires compensation for lost ecological value that is likely to lead to administrative problems, which is something we try to avoid."

According to Van Es (2012) the image of Natura2000 has been juridificated far too much which has a fateful effect on its practical application and so defeats its initial purpose. It is up to the Ministry of EL&I to see how these preservation directions can be used more practically and create more opportunities for regional interpretation and water safety developments. Van Es (2012) thinks that instead:

"Natura2000 legislation should focus more on the system as a whole and on where investments should be placed in a system to get initiatives authorized for implementation, rather than on particular species at a specific location, because in the end that's what counts."

Speaking of the obstructive role of Natura2000 in the light of long-term Delta Program processes, Den Besten (2012) believes it is not that exciting whether possible stumbling blocks on the short-term might

occur. However, still stumbling blocks do occur, especially in the implementation of pilots and other short-term initiatives. Changing the way in which ecological values are to be safeguarded is a very complicated problem for legal experts, that definitely needs to be resolved in order to increase chances for long-term adaptiveness in decision making in the Wadden region sub-program. On the other side Den Besten (2012) warns Natura2000 legislation is often being turned into a mockery, since "*as soon as opponents want to bring initiatives to a halt, Natura2000 rules are often seized to block them.*" Therefore it is important to stop kicking into the mockery of Natura2000 legislation and instead get down and work with it, as it also offers many opportunities. Program manager Van Es (2012) states that in this discussion some interpret the Natura2000 status of the Wadden Sea as a reason to avoid any development whatsoever, while others believe safety is a public concern and anything to increase water safety should be allowed, despite the Natura2000 status. Eventually the true role of this legislation in the Wadden region process will lie somewhere in between these two visions. Besides the institutional crowdedness described here, in the search for adaptiveness in water safety strategies, the Wadden region sub-program does not only operate in an institutional void, it also pursues institutional change to include rules, norms and values about including adaptiveness in existing institutional structures. Dilemmas that directly follow out of the ones described here emerge from the discrepancy between the long-term targets of the Delta Program and the usual short-termism of regional and local governments that will be elaborated in the following section.

Conflicting timescales

Another dilemma that plays an important role in decision making in the Wadden region emerges from the conflicting timescales utilized by parties throughout the Delta Program and the Wadden region sub-program. Part of this dilemma is the direct result of the conflicting timescales used in the complex processes of the Wadden region sub-program and the strict time planning of the national Delta Program, as captioned in the decision making trajectory intensively elaborated in **Chapter 5** (see **Figure 7**), **Chapter 6.3** and the previous categories on uncertainty and fragmentation. This incongruence in time horizons has led to difficulties in setting up coordination and cooperation among sub-programs and the national program, and it also limits possibilities for implementing ADM in a time span of only four years time in a complex region like the Wadden region, of which long-term system developments are still largely unknown as the system suffers from strong uncertainty. Besides the conflicting timescales used within the Delta Program, the incongruence between long-term planning horizons of Delta Program processes in looking for sustainable regional strategies to respond to uncertain future climate change effects on the one hand and the significantly shorter time horizons regional governments and organizations are used to work with on the other hand also negatively affect progress in climate-proofing the Wadden region. As a result of the strong fragmentation of the program team, governments and organizations in the Wadden region, a huge gap in timescales traditionally used in water management and spatial planning, and the strategic vision of the Delta Program, is showing in the Wadden region sub-program, which leads to persistent dilemmas in the activities and the role of program team members, both at their home basis as well as in Delta Program activities. Especially De Jong (2012) experiences strong discrepancies between the aspired timescale used by

the Delta Program and the timescales used by regional and local governments involved in the Wadden region sub-program, as he is a program team member delegated from a regional government (water board Noorderzijlvest) that is not used to such long-term planning horizons. According to De Jong (2012), the dilemma around conflicting timescales in the Wadden region sub-program is the direct result of the strongly fragmented program team organization, which he declares by stating that:

"The Delta Program uses a completely different time horizon than program team members are used to work with."

This also means that efforts in making a one-on-one connection between the long-term Delta Program approach and activities, and the approach used by regional and local governments is not that straight forward, mainly since these regional and local governments, like municipalities, provinces and water boards, are busy enough dealing with water safety tasks from their own, generally much shorter, time horizons. As an example De Jong (2012) refers to maintenance work on dike systems that is traditionally planned and implemented by regional parties using a time horizon that looks at least 50 years into the future, which means that "*awareness of the need to use long-term horizons is definitely present in this region governments, but only within small groups directly concerned with the planning and preparation of water safety initiatives, still this long-term thinking is not structurally entrenched in participating governments and organizations*." Therefore the main challenge for the sub-program now has become to create possibilities for making a proper connection between the time horizons that are mainstream for most local and regional parties and the long-term vision propagated by the Delta Program, by taking short-term decisions that support a long-term vision on water safety, as the ADM concept prescribes (**Chapter 5**).

However, even though water safety may require short-term attention, conflicting timescales make it difficult to mainstream long-term concepts such as ADM into both new and existing policy and regional practices. Long-term changes in the climate system and the rate of projected and observed impacts are difficult to relate to the dynamism of societal changes and short-termism in regional decision-making. Continuing on the conflicting timescales used in the Wadden region sub-program, De Jong (2012) experiences that:

"Most municipalities, despite being involved as a partner in the sub-program, are having a lot of trouble turning abstract insights and policy developments into more concrete short-term proposals for local implementation."

The time horizons used by most municipalities for spatial planning and planning water safety initiatives often exceed no more than four years, which is considered long enough for local strategic policy visions. Therefore most regional spatial strategies are revised every five to ten years to better match changing dynamics within society and to use latest insights of pressing issues. However the challenge now is to link up these timescales and intrinsically change the perception and recognition of long-term water safety planning at the regional level. The question is whether the position and scope of regional

parties will change as the Delta Program becomes more concrete as it advances, as this might as well create new dilemmas as long-term and pressing investments are coming closer.

Motives and willingness to act

Another condition that is essential for any strategic policy initiative is the right motives and willingness to act throughout all participating groups and program bodies. Factors such as a lack of understanding, uncertainty and skepticism about climate change, a missing sense of urgency, fatalism and externalizing responsibility can all form barriers in the Wadden region process that might subsequently result in a lack of motives and willingness to act and might pose dilemmas in the sub-program activities. As a result of the strong fragmentation and the great uncertainty in the Wadden region, agreement on the reasoning why to engage in strategic adaptation action is far from unanimous in the sub-program and involved regional parties. Van Es (2012) makes clear that:

> ***"Even though there's a necessity for action which stems from existing water safety task for the Wadden region, at the same time there's a lack of pressing urgency for immediate action."***

This lack of urgency and the inability to make reliable predictions makes the sub-program even more intractable in defining what decisions to make in the period up to 2015. Without the right motives and willingness to start adapting, a number of dilemmas have emerged in the Wadden region sub-program. Since urgency is low and no radical water safety interventions are foreseen in the near future, the absence of the right motives for actions might lead to the danger of taking convenient approaches, while on the other hand more time seems to be available for developing possible future strategies and getting a better grip on uncertainty by setting up large scale studies and monitoring. According to Groen (2012),

> ***"…the danger of a lack of motives and time pressure is that knowledge development and system monitoring will take more time than strictly necessary."***

Looking at the Delta Fund (**Chapter 5**), which will come into force in 2020, many financial reservations have already been made by sub-programs dealing with more urgent water safety tasks, to start their implementation as soon as the fund becomes available. "*If other sub-programs are further in developing alternative water safety strategies they may seize the Delta Fund while the Wadden region, finishing its task at a later moment in time, is missing out.*" This might be a reasonable argument to become more vigorous and decisive and start working on alternative water safety strategies, but on the other hand many administrators acknowledge that it is not wise to make rash decisions about measures and strategies of which is not even know whether they are really needed and what their possible side effects might be. Therefore the Wadden region sub-program is trying to strike a balance between decisiveness to walk in line with the Delta Program trajectory and taking sufficient time in order to be able to develop a broad knowledge base on which future steps can be taken.

The fact that the Delta Program is on the political agenda in the Wadden region seems to be the right occasion to look for chances to let other initiatives link up with these investments. Even though there is no obligation on linking up with regional ambitions in working on regional water safety, the Delta Program prescribes that investments in water safety will cause increasing regional activity and dynamism, which should offer opportunities to reach a greater variety of possible interventions. In stimulating these regional motives and willingness to start working on strategic water safety policy for the Wadden region, Den Besten (2012) stresses that:

"Naming the opportunities this sub-program might have for regional parties is essential in the joint development of water safety strategies."

The opportunities for regional parties should be addressed explicitly and parties should be kept on board as the program progresses, since linking up with regional ambitions might increase possibilities for making sustainable investments that not just have a positive effect on water safety but on the region as a whole. As Groen (2012) once more emphasizes, "*progress of the Wadden region sub-program depends on regional activities and developments, so that involved parties can link up, get detached from their core businesses and instead jointly look at the broader picture to see whether they are willing to collaborate and to not only let them pick the part of a strategy they consider appropriate.*" However, as already mentioned in the category of fragmentation, it is mainly employees from national government bodies, rather than from regional governments, participating in the sub-program team, that have to execute the desires as laid down by the regional steering group. According to Van Es (2012) "*therefore one could say that the Wadden region doesn't give top priority to sub-program activities, as they give up less of their personnel staff compared to national governments.*" As a result of this lack of regional motives for action, the number of regionally involved members in the program organization is very small, which demonstrates the lack of regional involvement and willingness to participate in Delta Program activities. This is a though dilemma, especially since municipalities and provinces need to be bold enough to rise above their own level of intervention to make this approach work, as they all see the necessity of taking action, but no one is willing to take the first step.

In looking for possible links with regional ambitions, Groen (2012) states a lot of attention goes to coastal development projects, as regional port companies often have commercial development visions, for which there is no way around looking for possible impacts on water safety, ecological impacts and economic impacts in the hinterland and possibilities to connect them, when considering harbor development. De Jong (2012) continues "*the best idea would be to bring all those objectives together into one regional development plan.*" This approach would make it easier for parties to get involved into regional Delta Program activities as it concretizes interest to get involved in regional development. However, setting up regional development plans also leads to difficulties.

"Frankly, it's hard to get a clear picture of regional development agendas, which makes the development of water safety strategies even more difficult than it already is. So far provinces, municipalities and water boards take a rather hesitant stance to wait and see what program outcomes will look like,

instead of taking a proactive stance in order to create an irresistible package of initiatives."

Illustrating this dilemma, Groen (2012) refers to energy supply and gas extraction in the Wadden region, as no protective spatial measures have been made for these facilities in the event of a flood. Groen (2012) states "*these companies simply assume that it's highly unlikely for such a devastating flood to take place.*" And even though the increasing vulnerability is not immediately life-threatening, it might become highly inconvenient as economic activities and energy supply are strongly interlinked and nuisance at one sector or location can have large impacts throughout the whole region. This hesitant stance changes the approach of water safety, while at the same time in order to make significant changes the willingness of regional parties will be needed to cooperate in further climate-proofing the Wadden region. However, as this example shows the right motives and willingness are simply not there with all parties involved in the Wadden region.

The downside of the approach of linking up with regional activities is that the Wadden region sub-program must be very careful in what it is that regional parties are pursuing with their spatial development ambitions. The municipality of Den Helder for example is looking for ways to fight looming population decline by creating new local employment. This goal should be achieved by developing a new harbor complex in the Wadden Sea, which is a very sensitive matter to many parties, is this of such importance that this development has to be located in the Wadden Sea? Then why is landward oriented development no option? However, this municipality came up with this initiative and at the same time wants to compensate for ecological damage which was only possible because of already acquired grounds for a spatial development project that got cancelled. Groen (2012) therefore states:

"It sometimes seems that municipalities are artificially bringing in the Delta Program, by emphasizing that interesting spatial developments are taking place that might be worthwhile for linking up with water safety tasks. However, in these cases the Delta Program is used as a means of developing their own ambitions, something we have to be very aware of."

This is exactly what the Delta Commissioner repeatedly accentuates in program wide negotiations, regional ambitions should be of added value for the core business of increasing water safety or the Delta Program will not co-finance such initiatives from the Delta Fund. In order to improve willingness for action in the Wadden region sub-program, communication with regional parties plays an important role in raising awareness and developing long-term initiatives, of which the dilemmas will be discussed in the next category.

Lack of awareness and communication

Following straight from the lack of motives and willingness to act, a lack of awareness and good communication on program activities has also led to dilemmas in the process of setting up alternative

water safety strategies for the Wadden region. Setting up communication structures in the Wadden region sub-program is important to increase public and political awareness about the impacts of climate change, the need to start adapting and the regional adaptation efforts. The limited role of participation of regional stakeholders in the Wadden region sub-program has already been discussed in **Chapter 6.2**, and the relationship, cooperation and communication between program bodies and sub-programs has already been discussed under dilemmas emerging from fragmentation. Despite the problems these organizational decisions have led to, the Wadden region sub-program still acknowledges participation is a key instrument for involving interest groups and individuals in the development of water safety strategies and to capitalize on their expertise and views in order to improve the quality of decision making, and thus reinforce awareness for interventions. However, Van Es (2012) experiences this lack of awareness and communication as a strong dilemma, *"as it would help the process evolve and create a clear image of program goals, measures and planning to reach it.*" According to Den Besten (2012), the sub-program needs to make a clear distinction in the reason for stakeholder involvement and the goal of participation, as throughout the various phases of the process different aims of participation can be distinguished.

"Raising public awareness for regional water safety cannot start soon enough. However, as soon as participation has to contribute to the development of viable water safety approaches, you should also pay attention to your own role and commitments in participation processes and what to offer and promise parties, as non-committal participation processes are likely to lead to little viable contributions and long-term commitment."

Therefore, using the instrument of participation in the most sensible way possible is easier said than done and requires a lot of preparation.

On the responsibility of the Delta Program in setting up structural communication tracks with regional parties, Groen (2012) experiences the way of communicating uncertainties to regional stakeholders as the single greatest dilemma for the Wadden region sub-program.

"The extreme caution of the sub-program on how to take uncertainties to the outside world and instead keep on waiting and studying in anticipation, leads to a situation in which the program team eventually presents a solution to the outside world, instead of working jointly on defining the problem and on develop possible solutions."

However, De Jong (2012) clarifies the problem with participation is that *"sooner or later stakeholders start to think they actually have something to do with decision making and I believe that in developing something as a governmental program and to put forward a result that only has to be accepted or rejected is a bad start of something we call participation or knowledge sharing in the first place*." Therefore De Jong (2012) would tend to at least provide some clarification on the problems to deal with and possibilities to overcome them, even though possible solutions are still not known. Although

this is difficult, it is important to give proper insight into the instruments and approaches used, to at least exclude any existing doubt or ignorance on the work of the program and on possible solutions. It will not be possible to completely overcome this, but there definitely is purpose in trying in an early stage. Continuing on this, Groen (2012) explains that social interaction should be stimulated earlier in the process of working on water safety strategies. Studying longer on gaining system knowledge not necessarily has to be a problem, as long as this is taking place in consultation with regional parties, who have their own questions, problems and experiential knowledge. Groen (2012) states that:

"If the research based approach will be continued, we'll end up having a number of pseudo-strategies not supported by regional parties at all. I find this a huge stumbling block for the sub-program, which I believe is too much based on sending new knowledge and insights instead of cooperatively developing widely supported regional strategies."

This is an important point, since a lack of communication between science, policy and society on climate change adaptation can result in a low level of awareness, skepticism, overconfidence, or even denial of the problem which might seriously affect decisiveness in the Wadden region.

Program team member De Jong (2012) continues that consultation with local citizens from the main coast about activities in their immediate surroundings currently has no priority in the Wadden region sub-program. However, on the Wadden Islands participation plays a more prominent role since "*these communities have a stronger connection with the Wadden region, are more aware of and interested in Delta Program activities and feel a stronger need to be involved in this process.*" Van Es (2012) emphasizes that:

"The 'us-them-discussion' between the national government and regional governments is very strong in the Wadden region."

Regional parties on the Wadden Islands for example often have no confidence in models developed by Rijkswaterstaat and rather use their own distinctive vision on Natura2000 legislation in regional policy development, as elaborated under dilemmas emerging out of uncertainty and fragmentation. This situation in which the region strongly resists pretty much any initiative or guideline from the national government is also the result of a retiring national government that is no longer directly involved on the islands, which has strongly affected the relationship, communication and cooperation with the Wadden region. Right through this conflict runs the discussion of the Wadden Islands that are concerned about their safety, while Rijkswaterstaat denies this concern by stating that the Basic Coastline stays perfectly in place and blames it on natural dynamics. Van Es (2012) admits that the regional concern has a lot to do with emotions that are hard to grasp in a long-term policy process. In this discussion awareness is clearly present with all parties involved, the question however is whether all parties really interpret this as a motive for action. An important part of the lack of motives for action is the result of financial consequences of being involved in regional strategies, of which the main reasons will be elaborated in the next category.

Resources

The last category covers the dilemmas emerging out of the absence of resources in the process of working on alternative water safety strategies for the Wadden region. Important resources in this process include factors such as the availability of staff, sufficient preparation time, process finance, implementation finance, knowledge and data availability, information credibility and legitimacy, and the availability of land for spatial measures. The interviews respondents at the Wadden region sub-program level acknowledged that a lack of resources, or the inaccessibility of resources, have formed profound barriers to adaptation and have led to numerous dilemmas that oppose progress in developing water safety strategies for the Wadden region. In this regard the interviewees especially accentuated the role of financial resources and the availability of labor force and expertise at the regional level. When looking at the financial resources needed for guaranteeing long-term water safety initiatives for the Wadden region, all long-term financial insecurity seems to have been taken away now that the Delta Act and the Delta Fund, two of the 5 D's considered to be conditional factors for the implementation of ADM in the Delta Program, have come into force (**Chapter 5.4**). However, as the sub-program progresses and the complexity of setting up regional development initiatives becomes more apparent, it appears other specific financial obstructions have emerged in the Wadden region sub-program that require additional tailor-made financial arrangements.

Regardless of the establishment of the Delta Act and the Delta Fund, meant to facilitate progress and long-term financial security, their formulation and lack of inclusiveness increasingly becomes an obstacle for the integral implementation of complex regional development agendas. In a Delta Program publication, Delta Commissioner Wim Kuijken (DP, 2011d) states that "*the greatest benefit with the Delta Fund is that the structural availability of financial resources for investment measures after 2015 will be guaranteed.*" However, looking further ahead, he has to ascertain that these financial reservations are probably not enough for already planned interventions, which means that for the near future additional financial arrangements will be needed, or these interventions will take more time than initially planned. De Jong (2012) explains that for a long time the national government has fully financed reinforcements of primary dike systems, while currently water boards have to make considerable financial contributions as well. Municipalities on the other hand, are still left untouched. Only in those situations in which specific regional or local ambitions are to be included in water safety tasking, municipalities are expected to contribute as well. However,

> ***"…municipalities are not awaiting additional financial commitments, especially not in current times of financial crisis and fund cutbacks."***

Continuing on this Groen (2012) stresses once more that, while working on sustainable water safety, the sub-program is looking for possibilities to link up with regional development opportunities in fields other than water safety. This might sound like a well thought out regional approach, but once working on these objectives the mechanism will be faced that "*the Delta Fund, which will become available in 2020, is only meant to cover water safety tasks. If the sub-program team continues its approach looking at regional ambitions, this also means involved regional parties and governments have to bring*

in their own finances." The consequence of linking up with regional developments is the attention shifts to the search for financial arrangements to reach efficient integral regional developments, away from a focus on water safety. However, Groen (2012) continues that "*at this point regional parties keep their cards close to their chests, like all well and good, but when it comes to putting their money where their mouths are...*" This process of looking for financial arrangements in the Wadden region is difficult and complex and clearly hampers progress in working on water safety strategies, especially since the Delta Program is not forced to link up with regional ambitions and, as Van Es (2012) puts it, "*financing a classical water safety approach would be more convenient as it would have been covered entirely by the Delta Fund.*" This situation is only further aggravated by the strict conditions from PKB Wadden Sea and Natura2000 legislation, to which as clarified by Van Es (2012), again no funding is attached, which makes the obligatory integration of ecological values and uncertainties of innovative concepts into Delta Program activities besides the regional development ambitions an even more complex task. Van Es (2012) therefore expects that:

"The dilemma of financing is likely to remain a serious stumbling block for the Wadden region sub-program, despite the presence of a Delta Fund."

Delta Program advice for implementation of water safety measures includes encouraging innovation and learning through a rich variety of experiments and innovative approaches that might probe possible directions for large scale implementation in the future. Although the Delta Act provides in setting up experiments, financial support is also conditional on regional co-financing and so far the Wadden region sub-program clearly struggles in planning for such experiments. If it appears that such initiatives are not practically feasible within the Delta Program, regional governments quickly tend to turn their heads away and lose interest and priority in cooperating with and participating in Delta Program activities. Besides that, it will also become a challenge to create sufficient time in the already tight schedules and financial budgets to try out new innovative techniques and procedures in addition to already tried and tested concepts in the development of water safety strategies. Large scale experimentation with alternative dike concepts for primary dike systems for example, is pretty much unattainable for the Wadden region sub-program, which means the process of setting up pilot projects is mostly concerned with planning the procedural steps in order to accomplish structural change, a process that as De Jong (2012) already foresees is likely to take a lot of time.

As already described in previous dilemmas, Wadden region sub-program members experience a strong barrier in the pace of the Delta Program trajectory (see **Figure 7**) that the Wadden region sub-program struggles to keep up with and especially how to fulfill its rather compulsory obligations. De Jong (2012) explains that "*in specifying this pace at the national level I don't have the impression that there has been any recognition of what a regional sub-program considers to be a reasonable goal in this specific time frame.*" The ability to comply with these goals within this time frame depends on a wide variety of factors. De Jong (2012) continues that the fact that research funds are not available or become obtainable too late slows down research and puts the sub-program even further behind schedule. The main reason for this lies in the amount of working time available for this task, of which

the great majority is already being claimed to constantly keep all involved regional administrators and program members informed about substantial regional matters, researches and concepts developed at the national level. According to Van Es (2012) this dilemma is caused by the capacity picture of the sub-program, as he admits that even though the current program clusters used in the sub-program (**Figure 9** and **Chapter 6.2**) might suggest a large program organization, while in fact:

> ***"The program team is made up of around ten people, who together share four or five FTE, which is relatively small when set against the interests at stake. As program manager carrying ultimate responsibility, this means I'm especially busy keeping ten people informed and less actually working on future water safety for the Wadden region."***

Directly connected to the dilemmas arising from the strict time frame and the time allocation of regional governments, is the fact that municipalities all of a sudden require additional expertise to be able to negotiate and think along as equal partners in developing water safety strategies for the Wadden region. The fact that this task of developing substantial strategies is being delegated to the regional governments, represented in a regional sub-program, obviously leads to a difference in working pace between the national and regional programs. De Jong (2012) believes these differing levels of performance will reflect in the way in which the Wadden region sub-program team is able to work out adaptive strategies within the available time frame. It is therefore very important that understanding between program team members from both national and regional governments, on when to make provision to regional parties or when to intervene as national government, is being respected throughout the process and that cooperation is crucial in reaching the best possible outcomes. In conclusion, the final part of this chapter will give an overview to see how the most prominent dilemmas elaborated in this chapter affect the Wadden region sub-program strive for adaptiveness.

6.5 Overlooking the role of adaptiveness in the Wadden region sub-program

What started out as an inventory of stumbling blocks for the Wadden region sub-program ended up as an extensive elaboration of a broad range of interrelated dilemmas in the development of future regional water safety strategies for the Wadden region. The actual crux of the most striking dilemmas faced in the Wadden region sub-program seems to lie in the widespread uncertainty, the stringent complexity of the Wadden system and in highly fragmented decision making structures within and between scales of governance involved in the program, in such a way they significantly limit the possibilities of developing long-term initiatives. In any case, what these dilemmas have highlighted is that adaptive decision making in the Wadden region is a highly complex and anything but straight forward task. The Wadden region sub-program has been given leeway in setting up a specific regional process for developing strategies, which at the same time has to take place in accordance with a conditional framework as set out by the national Delta Program. In a complex region like the Wadden, these strict guidelines inevitably includes there is too little time available for the sub-program to fulfill all obligations and to gain sufficient knowledge to make deliberate decisions, which has led to impossible tasks and therefore one might say that as a result of uncertainty and complexity, the

progress of the Wadden region sub-program, consisting of for instance public participation and the process of linking up with regional ambitions, is seriously lagging behind on the Delta Program schedule. As a result many tensions emerged in configuring the philosophy used in the Wadden region sub-program, which is being reflected in the great variety of dilemmas this sub-program has ran into since its establishment. Even though the Wadden region sub-program is aware and convinced of the fact that the demands made by this framework for adaptive decision making are not practically feasible in a complex region like the Wadden region, the sub-program tends to take an approach that actually is much more adaptive than the national Delta Program envisioned when setting up generic concepts and conditional frameworks for ADM. In this approach in which uncertainty and complexity are much more espoused than the program framework would allow. However, the conditions set by the Delta Program form a tight decision making framework that, in combination with the search for regional ambitions and creating investment arrangements, only further reduces the adaptive and flexible character of dealing with uncertainty and complexity in the Wadden region.

After the elaboration of the underpinnings of the ADM concept in **Chapter 5** and the difficulties of its practical implementation in the Wadden region in this chapter, the question can be asked whether ADM actually has the same long-term added value for the Wadden region as intended at the Delta Program level. Even though, theoretically, adaptive approaches might form a considerable improvement when compared to traditional approaches in reaching long-term sustainable, flexible and efficient outcomes in complex decision making (**Chapter 2.3**), in practice it seems like this potential of adaptiveness is not being used to its full potential in the ADM concept (**Chapter 5.5**), at least not in the Wadden region sub-program. With respect to the governance dimension adaptiveness, an adaptive process is ought to be structured in small short-term steps, allowing for response to new insights at any possible moment in time, in reaching long-term goals. However, at the start of the Delta Program in 2010, the decision making trajectory as set up at the national level revealed that particular essential decisions had to be made already by 2012, which means required exploratory researches and monitoring efforts had to be completed within this preset time frame as well. Yet, this trajectory from scoping to selection of alternatives (see **Figure 7**) foresees very little feedback possibilities to return to scoping when, for example, insights change or new information becomes available, which is critical for flexible decision making and structural learning processes (Werners *et al*., 2009) and makes ADM fundamentally contradictory to the theoretical underpinnings of what an adaptive process entails (**Chapter 2.4** and **Figure 1**). The difficult balance between the national Delta Program's foundation of the ADM concept on the one hand and its problematic implementation in the Wadden region on the other hand is demonstrated by numerous factors discussed in **Chapter 5** and in this chapter. However, interestingly enough the dilemmas that are being experienced in the Wadden region sub-program in the pursuit of adaptive decision making do not directly and exclusively result from the characteristics and application of the ADM concept, but instead seem to be the result of very specific contextual factors emerging from the uncertainty around system dynamics in the context of climate change and complex ecological processes, fragmented governance regimes, unclear division of tasks and responsibilities, conflicting regional interests, legal constraints and the consequences of political

rationality and prioritization in this region. Yet, at the same time it also seems that the dilemmas these central guidelines and concepts imposed from the top down, have definitely not contributed to successful long-term adaptive processes for improving water safety in the Wadden region, but instead only further strengthened the struggle of the sub-program that is expressed in a strong reliance on traditional and convenient approaches. This is, to say the least, a remarkable finding since ADM in the first place was meant to be a management approach specifically designed to deal with those complex conditions and uncertainties traditional approaches are not able to cope with.

Chapter 7 – **Reflection and Conclusion**

In this final chapter outcomes from all research steps in previous chapters will be brought together in order to answer the central research question and draw well-founded and clear conclusions. After a brief overview of the main line of argumentation and research findings, the conclusion will get back at the research objectives elaborated in the introduction. Subsequently, the opportunity will be seized to further discuss on research outcomes and findings by pulling adaptive planning and decision making and the notion of adaptiveness into a broader perspective of water management and spatial planning paradigms that characterize current policy practice. Following, a critical view will be used to reflect on the value and shortcomings of research efforts and outcomes in this thesis. Finally, general recommendations on possibilities for improvement of Delta Program activities and options for follow-up research will be given to further develop the potential of adaptive management in future complex decision making processes.

7.1 Line of argumentation and main research findings

To put this concluding chapter in the right perspective and to introduce the reflection and conclusion in the best possible way, a short overview will be given of the main line of argumentation used in this research as well as the most relevant research findings. The main research objective, first introduced and further clarified in **Chapter 1**, was to gain a deeper understanding of how the *Adaptive Delta Management* (ADM) policy concept, aimed at using more flexibility in establishing regional water safety strategies for the Wadden region, is being translated from the national Delta Program to the regional level and how the new principle of adaptiveness affects traditional decision making structures and approaches in improving water safety strategy development and long-term planning. The three methodological research steps that constitute the conceptual framework lay-out in **Chapter 3** (see **Figure 4**) have served as the starting point for three analytical chapters which together form the main line of argumentation. These three research steps have been chosen in such a way that they line up with the theoretical concepts elaborated in **Chapter 2** and in this way fill in the conceptual foundation for this scientific challenge. By splitting up the initial task into a number of manageable research steps, a decent overview of the line of argumentation towards answering the main research question and drawing conclusions is guaranteed throughout the research. The methodological *triangulation* strategy applied in these steps (**Chapter 3**), that combined information from policy documentation, presentations and interviews with program members, has played a vital role in creating a broad picture to draw a comprehensive and decently argued conclusion of the Delta Program, the dilemmas encountered in the Wadden region sub-program and the role of adaptive management. To further clarify this line of argumentation, the main findings from each of these research steps will be briefly elaborated below.

The first research step in **Chapter 4** served as the starting point for the empirical research with an introduction into the most essential characteristics of and developments in Dutch water management and spatial planning policy and -practice over the last decades, in response to the *uncertainties* linked

to climate change, increasing administrative and regional *complexity* and increasingly *fragmented decision making* arenas. In this elaboration a clear transition in Dutch water management from a *command-and-control* towards a more *adaptive* paradigm has become apparent, in which the emphasis has gradually moved from traditional approaches based on *risk reduction* or *risk management* towards a variety of approaches based on *impact reduction* or *adaptation,* which only further complicated policy process through the inclusion of spatial planning. This new policy paradigm has a focus on *climate-proofing* spatial planning by increasing society's *adaptive capacity* to respond or adapt to unforeseen climatic developments. An important parallel process of interest for this study is the process of the *decentralization* of (parts of) water safety and spatial policy responsibilities and tasks from the national to the regional and local levels over this same time period. As uniform and standardized measures no longer seem to be appropriate for climate change adaptation in different spatial contexts, a significant part of decision making has been decentralized and increasingly becomes subject of multi-level governance that requires substantial input from stakeholders and contribution of local knowledge and values in policy processes (Dietz *et al*., 2003). It turns out these transitions have largely determined how water safety policies, programs, concepts and approaches are currently being initiated and implemented. Therefore elaborating this policy context was essential in placing recent governmental adaptation programs and initiatives in the right perspective, since large-scale governmental programs, like the Delta Program, are always products of their time in terms of policy paradigms and related institutional structures.

For the second research step, in **Chapter 5** a closer look was taken at the Delta Program, an intergovernmental program aimed at guaranteeing long-term water safety in the Netherlands. Its main tasks is to set up a national adaptation strategy by working on generic topics related to water safety, water supply and spatial adaptation to climate change and on six regions for which these topics are so complexly interrelated they require a specific approach by setting up regional water safety strategies (see **Figure 6**). In this task the Delta Program is also responsible for the introduction of the ADM concept, which prescribes the use of flexibility and learning in approaching uncertainties and complexities in strategic planning and decision making. This concept is built around short-term decisions and measures that are in line with long-term objectives, while at the same time increase adaptability by keeping options open for possible future adjustment. By means of postponing *Adaptation Tipping Points* in existing strategies and explicitly taking account of possible future safety tasks for which successive water safety strategies or *adaptation paths* are to be developed, the need for radical interventions somewhere in the future can be postponed and available finances will be spent more efficiently (**Chapter 5.3**). The Delta Program provides in financial, legal and organizational conditions (see 5D's **Chapter 5.4**), meant to guarantee long-term stability in this process of adaptive decision making. The regional sub-program level is the scale where these aspirations for adaptive planning eventually take shape in the development of regional safety strategies. However, the process of *decentralization* of spatial policy development and implementation, has led to the question for regions how to deal with this new pursuit of *adaptiveness* in decision making and thus how to follow up the ADM concept. The ambiguity so closely interwoven in the ADM concept will therefore not show

itself until the start of the development and implementation of regional strategies. The program organization, related legal frameworks and especially the considerations on ADM how to deal with uncertainties and complexities of climate change have played an essential role in analyzing the pursuit of adaptiveness by the Delta Program. The theoretical underpinnings of the *adaptive management* concept as elaborated in **Chapter 2** and opinions of Delta Program members on the practical applicability of ADM and how to turn this sophisticated concept into reality, both in a substantial as well as in a procedural sense, are essential topics discussed in this chapter. It has turned out that, when set against the theoretical underpinnings of adaptive management, the ADM concept seems to fail to provide on a number of critical aspects of adaptiveness. The most striking examples include, for instance, limited feedback and learning possibilities as a result of strict Delta Program time schedule (see **Figure 7**) and a lack of governance structures in the concept design, mainly since the Delta Program needs to fold to related legal guidelines and national decision making frameworks, like for example the *MIRT* and *Faster & Better* programs (**Chapter 5.2**), that only further obstruct chances for learning and regional leeway for adaptiveness. This limited practical role of adaptiveness in the ADM concept has caused major ambiguity and fuzziness in regional decision making using flexibility while working on water safety, which is the main focal point of the final research step.

With the insights from the Delta Program, in **Chapter 6** the focus of the third and final research step shifted to the regional level by taking a deeper look into the Wadden region sub-program, one of the regions where strategy development is eventually taking place. With exceptionally complex tasks around the interplay of water safety, ecology and economy, as well as the strong uncertainty around long-term system developments in the face of climate change, the Wadden region can be described as a highly fragmented, complex and dynamic region for working on long-term water safety. Due to the comprehensiveness, uncertainty and complexity around water safety tasks and developments in the context of climate change, great accent has been placed on the role of *knowledge development* and *system monitoring* in the organization and adaptive approach to get a better insight into the development of the Wadden system and so develop a legitimate basis for decision making. However, by further analyzing the sub-program approach and organization and the way in which the ADM concept is being picked up, it has become clear that there is a wide variety of *dilemmas* this sub-program runs into using flexibility in developing a future safety strategy (**Chapter 6.4**). While some dilemmas are the direct result of the changing mindset required for adaptive decision making, others can be attributed to the complexity of long-term regional decision making in general. Although ADM offers good and innovative opportunities and possibilities, most dilemmas ran into are comparable to those experienced in earlier water safety efforts, such as conflicting time scales, binding with regional partners, raising problem awareness, communication, problems on dealing with uncertainty and complexity and so on. The lack of pressing water safety tasks and problem awareness, motives to act and political priority from within the region itself, has led to a situation in which the sub-program is forced to explore and consider spatial development initiatives for linking up with water safety elements, which makes the development of adaptive regional water safety strategies, while at the same time meeting program demands, even more challenging. Based on these dilemmas, it might be stated that

ADM is not the basic premise for the task of developing water safety strategies in the Wadden region. An explanation for the lack of adaptive aspects in decision making in the Wadden region sub-program might be found in the institutional and legal frameworks in which this radically new style of adaptive decision making has to take place, as such contextual factors put a lot of external pressure on adaptiveness in traditional decision making structures in the field of water safety. Following, the conclusion will go deeper into these remarkable findings that show the limited value of adaptive decision making in complex long-term planning.

7.2 Conclusion

Taking the research findings into account, the question can be asked to what extent *adaptive* decision making in the Delta Program, as defined in the ADM concept, actually differs or is an improvement when set against *traditional* ways of doing in Dutch water management. In drawing up a general conclusion for this research, this chapter will give a synthesis of the aforementioned findings on the policy transitions in Dutch water management and spatial planning, the development, introduction and underpinnings of the ADM policy concept by the Delta Program, experiences with the practical implementation of this concept in the Wadden region sub-program and the dilemmas this intended transition in water management approaches has led to. Analyzing the way in which the ADM concept is being translated from the national Delta Program level to the regional sub-program level was vital in getting a good understanding of the actual relevance of adaptive decision making and long-term planning in the Delta Program as a whole, when set against the initially intended and expected benefits of ADM at the national program level. The outcomes of the three research steps combined however, have showed a poor legacy of true adaptiveness in complex strategic water safety planning in the Wadden region sub-program, which has given rise to the question what exactly is so difficult about pushing the idea of adaptiveness further in complex strategic water management and spatial planning tasks. The research clearly points towards one single declaration for this problematic role of adaptive decision making that gets back to a persistent paradox inherently linked to *adaptive planning*, as introduced in **Chapter 1.1** and further elaborated in **Chapter 2.2**. The fact this paradox plays such an important role in the Delta Program made the true adaptive character of ADM in water management practice rather questionable, as the subsequent conclusion will prove.

Returning to the beginning of this thesis where references were made to Wiechmann (2007: 11) it was stated that in adaptive planning a paradox has emerged from "*the tension between deliberative planning and incremental adaptation to emergent developments*". The main reason for this *paradox of adaptive planning* is linked to the extent to which the traditional comprehensive and rational notion of *planning* is seen as a suitable tool for *adaptive* decision making in complex and dynamic settings and vice versa how *adaptiveness* is seen as a suitable approach for long-term planning. According to Wiechmann (2007) *planning* and *adaptation* can therefore be considered as the superior principal paradox of spatial strategy-making. Even though both *traditional* and *adaptive* management regimes fundamentally contradict (see **Table 1**), it is nowadays generally accepted that it takes both the intended as well as the emergent to come up with viable adaptive decision making. The central

challenge of *adaptive planning* therefore is to strike a balance between the traditional rationalistic approach of planners and the adaptive approach of incrementalists, while taking into account the specific context, content and process of a spatial setting. This led to an obvious general conclusion in this research on the role of adaptive planning in water safety management in the Delta Program, since the combination of *adaptiveness* and *planning* in the notion of *adaptive planning* – the ultimate purpose of ADM – has paradoxically created a so-called *oxymoron*, a rhetorical device that combines two seemingly contradictory terms, which has created serious practical obstacles. While *adaptiveness* suggests flexibility though learning and the ability of ongoing adjustment in decision making, the *traditional* notion of planning suggests the deliberate establishment of a foreseen and rigid long-term spatial strategy. As a result, the application of adaptive management is likely to devaluate the traditional status of plans and the traditional role of planning in long-term decision making. This apparent contradiction seems to justify the question whether *true adaptive planning* even exists and – if it does – how it could be maintained in complex governance structures and long-term management processes.

Looking at the Delta Program and the use of ADM, the *paradox of adaptive planning* is clearly reflected in the struggle between the strive for ensuring sufficient *decisiveness* in short-term decision making versus the simultaneous call for *adaptiveness* in long-term planning to gather knowledge and monitoring data in order to increase the ability to reduce uncertainty, make better predictions around long-term developments and maintain flexibility for strategy adjustment throughout the process, just like the ADM concept prescribes (**Chapter 5**). The Delta Program is responding to this paradox by trying to find a suitable balance between the traditional water management dogma based on rationality, risk management and central steering and the new adaptive dogma based on flexibility, learning and process structures in developing long-term water safety strategies (see **Table 1**). However, this balance between the traditional and the adaptive perspective in the influence of ADM turns out to be rather uneven in the Delta Program, an imbalance that seems to end up in favor of the traditional side of the spectrum. Based on the theoretical underpinnings of adaptive management elaborated in **Chapter 2**, it turns out that the Wadden region sub-program actually tends to perform in a pretty adaptive way. However, the restrictions of the Delta Program and its strict decision making trajectory elaborated in **Chapter 5** (see **Figure 7**), aimed to safeguard *decisiveness* in decision making, have in fact undermined most of the intentional adaptiveness and have put serious pressure on this adaptive process. Long-term monitoring- and learning processes, meant to give more insight into uncertain developments and opportunities for adjustment in working on alternative water safety strategies, play a key role in the Wadden region sub-program (**Chapter 6.2**), while the national Delta Program grants no time for long-term learning processes by means of pilot projects, system monitoring or structured feedback opportunities in case knowledge developments or new insights would require so. In this way, the possibilities for adaptiveness are seriously restricted by squeezing iterative learning processes into a predefined five year time span. Besides that, considering the national guidelines and legal frameworks that have to be met by sub-programs in an era of *decentralization* of policy responsibilities (**Chapter 4**), it is questionable to see what true leeway is for regional sub-

programs in developing tailor-made adaptive approaches to suit a regional context. The core of the problem lies in the fact that with all program framework demands and restrictions, the Delta Program aims to maintain or even increase *controllability* over uncertain and complex water safety tasks, for which ADM was expected to have a flexible response, by holding on to traditional water management aspects. Even though, to be successful, adaptive management requires a certain degree of *controllability* to know which strings to pull to reach desired outcomes (see **Figure 2** and **Chapter 2.5**), the Delta Program attempts to do this by using scenarios, models and sticking to a risk management approach as the basis for ADM, which only add additional uncertainty in long-term decision making. Taking this into account, so far ADM actually seems to have led to more confusion than it has provided clarity in the complex task of working on long-term water safety.

There is a clear distinction between being '*well-adapted*' and '*adapting well*', the latter requiring ongoing monitoring and review as well as a process of active learning from experience (Wilson & Termeer, 2011). The ongoing improvement of management approaches by learning from the outcomes of implemented initiatives is meant to build experience and capacity for coping with future uncertainty and change. Properly executed, adaptive processes involve ongoing learning, both in a technical sense and in terms of the process itself, since adaptiveness entails more than just taking adaptive measures, as process flexibility is as least as important. An adaptive process is not a linear pathway towards preset goals, instead it is a continuous process in which long diversions or additional efforts are all about reaching an ultimate goal of – in this case – preparing the Netherlands for long-term effects of climate change in the most sustainable and efficient way possible. Each component of the adaptive management cycle elaborated in **Chapter 2.4** (see **Figure 1**) is likely to prove equally important in addressing adaptation tasks in specific decision making contexts. Focusing exclusively on one or only a small subset of elements of the cycle or entirely neglecting others will most likely lead to failure in adapting. This does however not mean that there is only one generic adaptive approach or that all elements of an adaptive process have to be implemented in one instance. It is basically the opposite that seems to be true for adaptive management (Smith *et al*., 2009). Besides that, in an adaptive approach stakeholders need to be engaged at the initial problem formulation and need to remain engaged throughout the implementation in order to guarantee long-term adaptiveness, facilitating mutual learning and reinforcing the commitment to learning-based management. But how can these basic requirements of adaptiveness be reconciled in ADM with the Delta Program emphasizing *decisiveness* and *controllability*? This emphasis in the Delta Program is a direct and logical consequence of the strong governmental *responsibility* guaranteeing water safety in the Netherlands (**Chapter 4.1**), which apparently has formed an increased chance of relying on convenient approaches rather than taking most advantage of adaptiveness to come up with more innovative and socially acceptable outcomes. Even though the integral character of the Delta Program is helpful in looking for tailor-made solutions for regional water safety problems, the scope of the Delta Program in using the ADM concept seems to be too limited to sufficiently cover the complexity of a truly dynamic region. It appears that regional ambitions in the Wadden region simply are too high to get along with the conditions laid down in the ADM concept and the strict Delta Program decision

making trajectory (see **Figure 7**). Contextual factors, such as regional legislation, administrative fragmentation, uncertainty, time pressure, political prioritization, regional interests and other dilemmas elaborated in **Chapter 6.4**, all have a significant impact on the practical feasibility of ADM within this predetermined time frame and related program conditions. As a result of this external pressure on the desired adaptive character of decision making, the role of adaptiveness in the design of ADM tends to become an idealized generic picture of a policy concept that requires much further contemplation to become applicable in different contexts, especially those in which uncertainty and complexity are considerable.

The analysis of the ADM concept showed that this adaptive approach for long-term water safety planning, as used in the Delta Program, does not prove to be a panacea for each and every long-term water safety task in any given region. Interviewees emphasized that ADM and the emanating rules and guidelines from the national Delta Program are more suitable for implementation in regions that can more easily be associated with *classical water safety tasks*, constructed around *traditional water safety concepts* (**Chapter 6.3**). The Wadden region sub-program, on the contrary, has to cope with much greater uncertainty and distinctive complexity and therefore has no clear decision point on water safety strategy *Tipping Points* and resulting clear *adaptation path* of ensuing strategy elements (**Chapter 5.3**). Therefore the role and added value of ADM in its current form is significantly different from the intended benefits at the national level and the expected application of the concept in varying regional contexts. This finding shows that most present water safety initiatives are in fact continuing old practices rather than introducing new and innovative solutions. Although Dutch water management regimes have adopted adaptive elements with the introduction of ADM, it appears they are still bounded by their institutional heritage, a traditional centralized decision making structure, based on a *predict-and-control* paradigm. One of the main reasons why these traditional aspects are maintained in the Delta Program and are used to sustain progress by means of central steering and *controllability* is to secure *effectiveness* and *decisiveness*, which are hard to secure in an intergovernmental program the size of the Delta Program. In this respect, present management regimes appear to be not sufficiently adaptive and traditional aspects such as *rationality*, *short-termism* and *hierarchical decision making* still clearly play an important role. At this stage the main reason why *true* adaptiveness can only be found in parts of the Delta Program organization and activities is that it seems like most decision making aligns with traditional governance arrangements and existing ways of doing to justify a course of action.

It will be clear by now that structurally including adaptiveness in strategic decision making in the field of water safety will require more than just the development of the ADM concept. Although based on this research no substantiated generic conclusions can be drawn on the role and value of ADM in the Delta Program in general without becoming too prescriptive, this research has demonstrated that adaptive planning processes are difficult to carry out in an existing institutional context built on *traditional* principles, which immediately turns its initially intended benefits into somewhat utopian ideals. Perhaps it is not the uncertainty and system complexity that is causing the greatest problems in decision making for the Delta Program, but instead the strong human interference created around the

adaptive approach, all paradoxically aimed at making uncertainty more controllable and better manageable. Thereby, the question whether it even makes sense to keep on pursuing this goal of using adaptive management in developing long-term water safety strategies seems to be justified. In conclusion, it became clear that it is extremely difficult to accomplish significant policy transitions in water management and successfully apply adaptive management approaches in policy practice, considering the impact such a transition would have as a result of the rigid traditional institutional heritage that requires perseverance to change according to the listed requirements. However, no value judgment should be attached to the fact that the influence of ADM in decision making is still open to improvement and most emphasis is still being placed on *traditional management* aspects. For the future, once the Delta Program trajectory has been concluded in 2015, the question how the notion of adaptiveness will actually perform in the interplay of spatial planning and water management becomes important. For giving ADM a better chance of success, it is critical to acknowledge that some things are simply out of human control. Therefore, for the future dealing with uncertainty, as opposed to the traditional notion of creating certainty, should be seen as a key challenge. Some further insights on this conclusion will be further discussed in the following section.

7.3 Discussion

This research points out that the introduction of adaptiveness in the Delta Program has led to a lot of ambiguity and confusion, both for policy makers and for those having an interest in the decisions to be made. In further discussing and reflecting on the actual value of adaptive management and the new adaptive water safety dogma as introduced in the ADM concept, it is important to not lose sight of the bigger picture in which long-term decision making is taking place. For this task the interview with Govert Geldof has been very valuable in placing the analysis of adaptive management into a broader analytical perspective, outside the direct research scope. According to Govert Geldof (2012), expert consultant in complex decision making in the field of spatial development and water management, the water management sector is struggling with structural problems that hamper the transition from the traditional water safety approach towards the introduction of adaptiveness in present water management and spatial planning frameworks, as elaborated in the conclusion (**Chapter 7.2**). To illustrate this, Geldof stresses that the huge interrelatedness between system properties *complexity* and *uncertainties*, and human constructs *complicatedness* and *risks* might eventually appear as stumbling blocks in adaptive decision making in Dutch water management practice (see **Figure 10**), as they are being used interchangeably, which limits chances for structurally applying adaptive decision making. In the context of this research it will be worthwhile to discuss and reconsider this conceptual balance in order to create the right context in which adaptive ways of managing can flourish. These four key concepts will be briefly elaborated below as well as their interrelatedness and role in water management activities. Finally, Geldof's proposal of introducing *practical wisdom* in the Delta Program to improve the conceptual balance for successful adaptive approaches in water management will be elaborated.

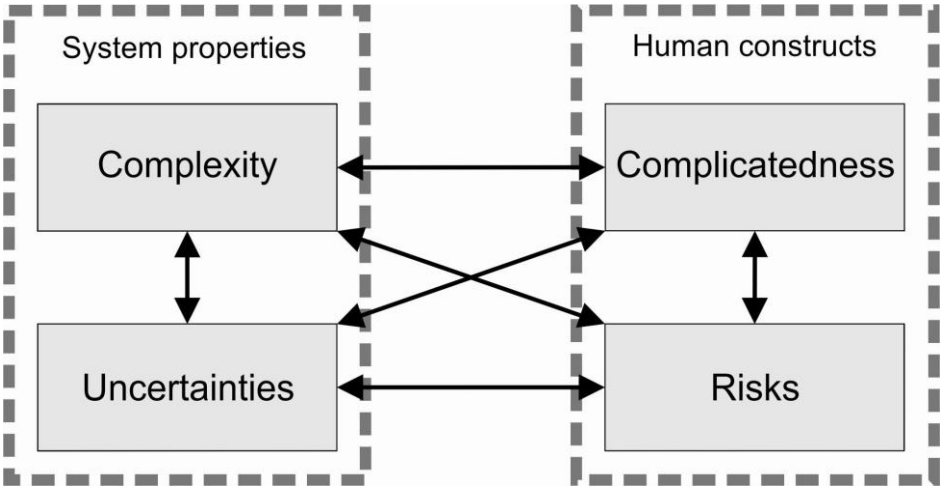

Figure 10 – Four concepts used interchangeably in Dutch water management (based on Geldof, 2012)

Firstly, *complexity* is a natural property of systems that have a certain capacity of self-organization, without any human interaction. In complex systems order and chaos interact and this lack of causality may cause unpredictabilities and surprises at particular moments in time. The complexity of a system can be described by the aspects that have a role in its functioning. Therefore, it is important to decide what aspects to include and what aspects not to include in complex decision making. Geldof (2012) emphasizes that not all complex system processes and characteristics can be taken into account, as progress will be slowed down if decision making becomes victim of the syndrome in which '*everything is interrelated'*. On the other hand it is not advisable either to use a too limited scope and ignore many system aspects. Instead it is about finding the right balance in complex decision making.

"It's essential that system aspects are consciously included or excluded and that special interest remains in those aspects that are excluded."

However, as the conclusion already clarified, once complexity is explicitly being considered in decision making, feasibility and applicability of long-term planning will decline. The only question is whether to accept this complexity or not. In case complexity is not fully embraced in decision making, decision makers will turn out to become Don Quixote fighting windmills, they won't succeed.

Uncertainty is another characteristic inherently linked to complex systems that also leads to many difficulties in decision making. Although uncertainty is often described as a situation of inadequate information, it can still prevail in situations with high information availability as new information can either decrease or increase uncertainty. Still, many parameters cannot be accurately determined and are therefore often simply ignored in decision making, as described under complexities. Since there is neither a commonly shared terminology nor a full agreement on a typology of uncertainties and uncertainty is not just the absence of knowledge, a general definition of uncertainty is adopted by Walker *et al*. (2003: 1), as being "*any deviation from the unachievable ideal of completely determinism.*" However, certainty is never an attainable state in complex decision making as uncertainty is an inherent attribute of any prospect. According to Walker *et al*. (2003: 1):

"Understanding various dimensions of uncertainty helps in identifying, articulating and prioritizing critical uncertainties, which is a crucial step to more adequate acknowledgement and treatment of uncertainty in decision making and more focused research on complex and uncertain issues."

In **Figure 11** a categorization of different levels of uncertainty is visualized, in which the degree of uncertainty increases from left to right. At the left end of the spectrum *determinism* stands for the – only theoretically attainable – situation of full knowledge, while *indeterminacy* at the right end of the spectrum covers the irreducible ignorance. To distinguish between levels of uncertainty between both extremes, a terminology is employed of five degrees of uncertainty. *Statistical uncertainty* is any uncertainty that can be described adequately in statistical terms, such as measurement uncertainty. *Scenario uncertainty* implies that there is a range of possible outcomes, but the mechanisms leading to these outcomes are not very well understood and it is, therefore, not possible to formulate the probability of any one particular outcome occurring. As the use of scenarios implies making assumptions that in most cases are not verifiable, scenarios are associated with uncertainty at a level beyond statistical uncertainty. The level of *qualitative uncertainty* is a level of uncertainty in which complexity makes it merely impossible to come to rational quantification, as it covers known ignorance in which certain patterns can be recognized that cannot entirely be declared based on present knowledge, which might give some support but are not absolute and often have a limited generic value. *Recognized ignorance* refers to fundamental uncertainty about mechanisms and functional relationships and therefore covers those factors perceived to be not known. Uncertainty due to ignorance can be divided into *reducible ignorance*, which may be resolved by further research, and *irreducible ignorance*, which applies when providing sufficient knowledge is simply unfeasible. Finally, *total ignorance* implies a deep level of uncertainty of factors that have been kept out of sight or have not been considered at all, to such an extent that it is unknown what is not known. In **Figure 11** the arrow at the right end of the continuum is used to indicate these '*unknown-unknowns*' (see Termeer & Van Den Brink, 2011) show there is no way of knowing the full extent of ignorance.

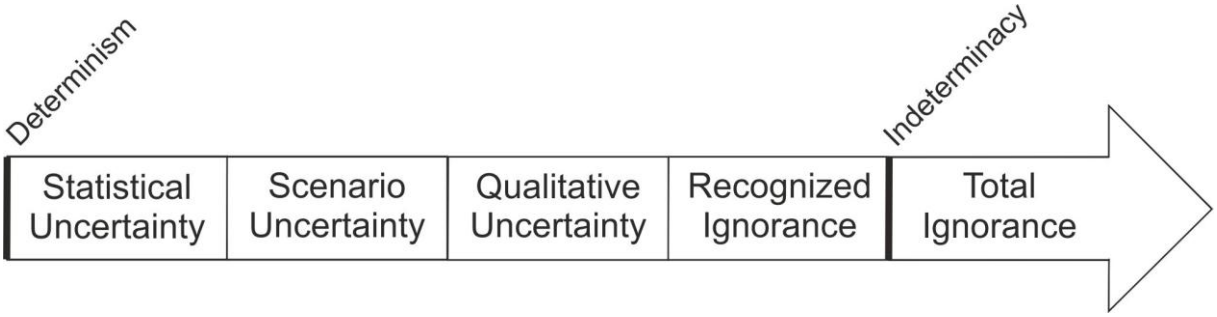

Figure 11 – Five levels of uncertainty (based on Walker *et al.*, 2003; Geldof, 2012)

In water management, often decisions must be taken when there is not only a lack of certainty about future developments and the effects of policy initiatives, but also when some of the effects of policy initiatives remain unknown. In such processes, decision making is faced with the continual prospect of surprise. Many approaches are used to cope with uncertainty and it is exactly in the grey area between the known and the unknown where it will be useful to match management approaches to the

degree of uncertainty and ignorance. The ultimate goal of decision making in the face of uncertainty should be to reduce the undesired impacts from uncertainty, rather than hoping or expecting to eliminate them (Walker *et al*., 2003).

Complicatedness, on the other hand, is a construct that derives from legislation, regulations, protocols, policy and other human interventions, all in a way meant to provide more clarity in the complexity of decision making. Geldof (2012) states that at a certain point all efforts aimed at providing more clarity might lead to a situation where distinguishing the wood from the trees becomes increasingly difficult and sometimes even impossible. Still a lot of trust is being put in the creation of clarity and *controllability* through increasing complicatedness in pursuing optimal water safety. However, in decision making in the field of water management, complexity and complicatedness cannot be viewed in separation, as Geldof (2012) explains both concepts are communicating vessels:

"By suppressing complexity, complicatedness will increase, while creating more room for complexity and associated uncertainties will lead to a decrease in complicatedness."

Geldof (2012) continues that administrators tend to hide behind complicatedness, as they benefit from it and therefore preserve it. This group of experts is conducting study after study, claiming to know what they are doing and, by doing so, not uncommonly disqualifying regular decision making arenas as having insufficient knowledge and expertise to contribute to fully understanding complexity. A shift from relying on complicatedness in water management to embracing complexity would therefore form a real threat to these vested decision making structures.

Risk is another human construct that has been fully embedded in Dutch water management practice and water safety approaches for a long time (**Chapter 4**) (Lorenzoni *et al*., 2005). Risks can be defined by the *chance of occurrence* of an event and the *consequences* such an event might have. A preoccupation with assessing risks means that policy-makers are denied exposure to dissenting interpretations and the possibility of downright surprise. An overly narrow focus on risks therefore is an inadequate response to incomplete knowledge as it leaves science advice vulnerable to social dynamics and to manipulation by political pressures seeking legitimacy, justification and blame management (Stirling, 2010). On this topic, Geldof (2012) believes that legal sharpness, which forms the basis of risk-based norms, leads to a situation where the value and meaning of norms is not being questioned in decision making.

"Water management is based on risk-based-approaches in which norms play a key role and computer-based models are used to calculate how to best achieve these norms. The norm itself is never questioned."

Considering the consequences if norms would not be reached is not an issue, even though it might be way too expensive to comply with all standards in a region, as some locations require measures that seem to be redundant, while other locations require additional measures to guarantee water safety.

This common sense seems to be absent in water management practice, which puts a strong break on creativeness and innovation in policy development and complex decision making. The idea of reaching optimal norm-based outcomes in complex systems is utopian, as reaching optimal outcomes is only possible for tamed problems in fully controllable systems that harbor no uncertainty whatsoever.

The fact that the Delta Program has to deal with uncertainties is beyond question for policy makers and scientists providing decision support. But at the same time there is little awareness of the different dimensions of uncertainty and there seems to be a lack of understanding of their characteristics, relative magnitude and available means of dealing with them. According to Geldof (2012) uncertainty in the Delta Program solely moves around *statistical uncertainty* and *scenario uncertainty* that are explicitly considered in the verification of dike systems, by risk-based-approaches that are being linked to Delta Scenarios. But still there are higher degrees of uncertainty barely included in Delta Program activities. Program manager Van Es (2012) continues that for instance "*the discussion around long-term behavior of sediment flows is suffering much more from uncertainty to a point where the use of scenarios seems to be no longer appropriate.*" Geldof (2012) finds it striking to see that no distinction is made by the Delta Program in types of uncertainty whatsoever, especially since the greatest potential for change lies in the highest degrees of uncertainty. On the conceptual confluence of *uncertainties* and *risks* Stirling (2010) states that especially water management experts and administrators are likely to perceive uncertainties as risks, since such bite-sized chunks make space for decision making considerably smaller. Most administrators dislike complexity and uncertainty in the scientific knowledge base and in decision making processes, and instead expect science to provide advice presented as single definite interpretations that reduce unknowns to measurable risks (Stirling, 2010). From this, subsequently, a sense of certainty is derived after which decision makers assume that uncertainty has been made explicit, while in fact most still remains unknown. With this way of 'eliminating' uncertainty in policy- and decision making, the true complexity of water systems in relation to their context fades into the background and complicatedness gains ground. This means that a critically important part of complexity is not explicitly being considered in decision making. Not knowing what processes are excluded in complex decision making leads to a limited scope and makes controllability appear to be larger than it actually is. Therefore, Geldof (2012) recommends avoiding pressures to simplify advice for decision making, as uncertainty has to be confronted rather than circumvented. As soon as the chaos of complexity would be denominated more specifically, the possibility will arise to indicate where to respect complexity and where not. As soon as problems get wicked, Geldof (2012) continues that adaptation seems to be the way to go and emphasis in decision making should shift to the context behind water safety tasks.

With the introduction of ADM, the Delta Program seems to admit complexity and uncertainty need to be considered more explicitly in decision making. However, Geldof (2012) notes some problems with the way in which adaptiveness is being pursued in the Delta Program. Despite the classic definition of adaptive management that propagates the possibility for working in iterative cycles and emphasizes ongoing adjustment in complex decision making, Geldof (2012) states that:

"Adaptive is often translated as one-sided adjustment, whilst in complexity-science adapting implies a system having a healthy interaction with the context of a task or problem."

Adapting not only means adjusting a system to contextual factors, but also how a system influences this context in return. When a system does not follow contextual developments, tensions arise that may result in instability. Therefore the Delta Program is looking for no-regret-measures that are robust and designed for a wide range of possible futures. However, this research showed the Wadden region requires another approach as uncertainty is too great and therefore controllability is too small. The essence of dealing with complexity is to get a sense of marginal processes and factors that take place out of sight and eventually determine the further course of events. As complex systems cannot be reconstructed or studied outside their context, complex policy tasks require an approach based on action-research within this context, something the scientific world seems to struggle with. As a possible solution to this apparent deadlock in Dutch water management, Geldof brings forward the notion of *practical wisdom*. First scientific efforts on this concept date back to the time of Aristotle, who propagated the idea of using a well-considered balance between reason and sense in complex decision making, in addition to a predominant focus on rational scientific argumentation. More recently the potential added value of practical wisdom in complex decision making processes has been further explored by scientists such as Flyvbjerg (2004) and Statler *et al*. (2003). According to Aristotle, practical wisdom – or *phronesis* – has three dimensions: *logos*, *pathos* and *ethos.* Geldof (2012) declares logos cuts to the heart of rationality, pathos covers a sense of empathy in and commitment to what is going on in reality and finally ethos is about gaining trust and earning confidence of stakeholders to follow up advice, even if it cannot be logically justified from rational reasoning, but instead has to build up and evolve over time. Geldof believes that only in interplay of these three dimensions, wise decisions can be reached in complex decision making. Traditionally, small municipalities and water boards used to be very adaptive, a great example of practical wisdom. Nowadays society seems to be entirely driven by logos as the tendency in policy discourses is to bring everything back to rationality and by doing so marginalizing the importance of pathos and ethos in complex policy processes. This means the adaptiveness that used to be omnipresent at the local level, has been forcefully subverted, which has led to systems that can no longer adapt and images being chased barely have any relation with the complexity of reality. By ignoring historical experience usually a multitude of alternatives is being created, whilst experience can preclude many options for long-term water safety. Illustrating this, Geldof (2012) continues that if practical experience in the Wadden region shows the coast line constantly fluctuates, there is no point in thinking it will stay in place in the future, which turns it into an unrealistic target of Dutch water safety policy (**Chapter 6.1**). In a complex field where everything is uncertain, decision making should rely more on these forms of regional experiential knowledge. Therefore it would be beneficial to include practical wisdom in the process of decision making and not to remain too fixated on the traditional rational scientific approach. Instead of using a prospective approach that looks from the present into the future, the past is much more important, as experience has to be known to understand the present and be able to shape the future.

Using a broader perspective out of the direct scope of this research has proven to be very valuable in discussing Delta Program activities and problems around the use of ADM in water management. The outcomes of this research are very much in line with the current policy context that Geldof describes by the interwovenness of complexity, uncertainty, complicatedness and risk in Dutch water management, displayed in **Figure 10**. Contemplating on the actual value of adaptiveness and adaptive management as a new dogma in water safety planning, this conceptual confusion acts as a serious stumbling block for the implementation of flexible approaches in complex decision making in a context of great uncertainty. With a strong emphasis on scientific knowledge and controllability, the role of regional uncertainty and complexity as full aspects in long-term decision making remains questionable. In the context of strong complexity and uncertainty it would actually be interesting to get a better insight into those factors and uncertainties *not* considered in decision making. On alternative approaches sub-program member Groen (2012) admits that the Delta Commissioner repeatedly emphasizes to look beyond studies in cooperation with recognized knowledge institutes, since regional parties possess a lot of valuable knowledge as well that should be employed in working on water safety strategies. However, "*this only takes place in a piecemeal manner, which mainly is the result of strong doubts in competent authorities whether practical wisdom can actually be perceived and employed as valuable knowledge*." When the intrinsically plural, conditional nature of knowledge would be recognized more explicitly, Stirling (2012) believes science advice can become more rigorous, robust and democratically accountable. This is exactly the point Geldof makes, the main challenge lies in the allocation of usable local knowledge that, in combination with scientific knowledge, can form the foundation on which future water safety strategies can be initiated. In this task the complexity of water safety tasks should no longer be challenged, but instead should be more embraced.

7.4 Theoretical and methodological reflection

Reflecting on the theoretical concepts used in this research, it becomes clear the theoretical framework in **Chapter 2** could both be described as extensively detailed and at the same time rather one-dimensional, which has affected the overall scope, scientific process and research outcomes. If, for example, a closer look is taken at the conceptual scope at the beginning of the theoretical chapter, the focus lies on the tensions around managing climate change adaptation processes. Although this may seem a logical and legitimate scope, since the Delta Program is a governmental program aimed at increasing water safety by taking long-term adaptation decisions, the Wadden region sub-program turns out to be a region where complex and fragmented decision making and governance structures seem to dominate over climate change adaptation aspects in working on long-term water safety. Therefore, based on present knowledge, a focus on complex decision making in general and related governance aspects would seem more appropriate for dealing with the case under study in this research. As far as the theoretical underpinnings of adaptive management used in analyzing policy practice in the Delta Program are concerned, some critical shortcomings can be pointed out. Adaptive management can be seen as a catchall term covering all those management efforts somehow aimed at dealing with uncertainty, approaching complexity with more flexibility and increasing understanding through structured learning. Therefore, analyzing the extent of adaptiveness in Delta Program and

Wadden region sub-program activities, based on such an ambiguous theoretical conceptualization, is rather doubtful. That is why this generic conceptualization of adaptive management has been merely used as a heuristic framework to be able to comment on the role of adaptiveness in the ADM concept. Due to the danger of normative judgment and subjective interpretation of information, some question marks may be raised in concluding on the actual adaptiveness of the Delta Program in general and the Wadden region sub-program in particular, as adaptiveness is no measurable and scientifically agreed on concept. The final critical conceptual decision has been the wide-ranging categorization of barriers to adaptation, used in analyzing the dilemmas encountered in the Wadden region sub-program. It appears that, even though this somewhat preconceptioned and suggestive categorization has offered a suitable framework in structuring and commenting on analytical efforts, it may somehow have affected outcomes of the analysis at the sub-program level, as they may suggest that all dilemmas are directly resulting from the use of ADM, while there is no causal relation and it turned out most derive from complexity and uncertainty in general and other contextual factors at play in the Wadden region. One thing that has become clear from this theoretical choice is that whatever approach will eventually be chosen to work on long-term water safety, either approach will have its barriers and dilemmas.

From a methodological perspective, policy documentation such as Delta Program publications have played an important role in mapping out useful information on the program organization and in giving insight in how the ADM concept was intended to be used in regional decision making. However, since policy documentation often is very visionary and normative, the analysis done in this research has truly benefited from practical knowledge and experiences, since however good policy proposals may look on paper, eventually it is all about how they work out in practice. Therefore, investigating the contradictions between policy documentation from the national level on the one side and the practical insights gained at the regional level has proven to be very interesting in studying the actual role and impact of ADM in practice. However, for follow up research, multiple interviews would be needed, also with other parties involved in the regional process in order to create a wider picture of dilemmas that are at play in the Delta Program in response to the introduction of ADM and to give more specific recommendations on improving adaptive planning and decision making. Interviews with regional steering group members and governments, for instance, will be needed to get a better picture of the interaction and coordination between regions and the national program. In hindsight, the number of two interviews at the national Delta Program level is too low compared to the number of seven interviews at the regional sub-program level. The bulk of the analysis should not have automatically been placed on either of the two program scale levels, since dilemmas experienced at the regional level might just as well be the result of legal frameworks, or decisions or adjustments made (or not) at the national program level, as **Chapter 6** has shown. Reflecting on these methodological points of improvement, it has become clear that interviews have not only played a valuable, but also a decisive role in taking direction and subsequently drawing conclusions. Therefore the value of interviews in the process of drawing conclusions should not be overestimated. As the current stage of the Delta Program can be described as rather fuzzy, basing a conclusion of the functioning of this program on only a small number of interviews is scientifically questionable. However, considering the availability of

time and the initial purpose of this Master thesis, this methodological approach was maintained throughout the research.

7.5 Recommendations

What this research really brought home is the variety of dilemmas in the strive for adaptiveness in setting up long-term regional water safety strategies, a situation that requires further fundamental scientific and practical contemplation to improve the applicability of the ADM concept in a wider range of decision making contexts. In practice the ADM concept is still being perceived as rather vague and ambiguous, especially in combination with national Delta Program timeframes, demands for decision making and *traditional* ways of doing in water management. However, strong scientific analyses on ways in which these shortcomings might be overcome are generally lacking, a gap in scientific research that has hampered the introduction of structural policy improvements to give the role of adaptiveness in strategic spatial planning a better chance of success (Huntjens *et al*., 2011; Moser, 2010; Lahsen *et al*., 2010). This research is not just meant to list these dilemmas, but also to come up with possible propositions and recommendations on how to swing around this deadlock of failed or sub-optimal attempts to integrate the long-term effects of climate change into strategic regional spatial planning and propose a number of possibilities for making spatial planning and water management approaches more receptive to complexity and uncertainty. It is important to acknowledge this research is basically a snapshot in time and displays the many growing pains in the start-up phase between the 2012 and 2013 Delta Program reports, which makes it critical to keep in mind the Delta Program is an evolving process that might require adjustments of research outcomes and conclusions in the future, since some stumbling blocks will presumably be remedied at later program stages. Therefore, no binding conclusions should be drawn from this research, as it instead should be seen as an inventory of the struggle of implementing the principles of ADM in practice. Without becoming too much involved in the discussion of what exactly adaptive decision making entails and instead of coming up with a normative *course of action* on how the application of ADM should look like here, the recommendations given in this section will only focus on those elements that obstruct the full transition to successful adaptive decision making and might contribute to improving the role of ADM in practice.

With the new approach taken in the Delta Program after the introduction of ADM, the Netherlands appoints itself as global leader in water management and directs much effort in exporting knowledge and insights gained in planning for innovative adaptive water management (see Kuijken, 2010). However, now it appears the idea of adaptiveness not even functions flawlessly in the Delta Program itself, it might be worthwhile to instead put this effort into the improvement of the practical applicability of ADM in the Netherlands before shifting attention to its international value. For ADM to reach its full potential in regional decision making, not only changes within the Delta Program are needed, but especially contextual and regional changes are essential in for instance policy development, political prioritization and decision making, related legislation and so on. It is clear that, to substantially improve its practical implementation, the notion of adaptiveness requires a reframed definition of spatial planning and vice-versa. More clarification is desirable on what sort of decisions have to be taken at

what particular moment in time, since long-term decisions might already have legal consequences for related short-term planning initiatives. Why then is it desirable to take such decisions now already, while implementation might be foreseen no earlier than 50 years into the future? Besides that, it is still not quite clear what sort of decision is foreseen speaking of a preferential water safety strategy (**Chapter 6.3**), a politically guiding decision, a legally binding decision, or something in between? Considering the desire for adaptiveness, legally binding decisions should be taken at the latest possible stage, unless there are legitimate reasons to bring them forward in time. This research showed that, given the fact that developing water safety strategies for the Wadden region does not appear to fall seamlessly within the Delta Program decision making trajectory (**Chapter 6.3**), it could well be that a number of long-term administrative principles are to be produced, consisting of arrangements to connect various regional initiatives, while the sub-program takes administrative responsibility for this task. Such principles might just as well form important adaptive milestones, despite they differ from what the Delta Program initially had in mind. Some regions simply have more opportunities to deliver conform these decision making frameworks using the ADM concept, as decisions that probably would have been taken in the future can be moved forward in time (**Chapter 5.3** and **Chapter 6.3**). Likewise, the temporal cohesion with decision making in other policy fields and other sub-programs needs more clarification, as some sub-programs have to finish their decision making before other sub-programs can start exploring potential strategies. Such improvements will eventually give more leeway for adaptive processes as they no longer interfere with the basic requirements of what an adaptive process entails. The greatest challenge that remains is how to deliver the promises of adaptive decision making into regional processes, not just in the flexibility of water safety measures and strategies, but especially in a procedural sense to maintain adaptiveness throughout the national process of decision making. With a renewed focus on long-term policy *performance*, instead of the traditional notion of policy *conformance* between policy implementation and its final outcomes (Wiechmann, 2003), attention shifts to raising awareness of the application of ADM and the potential role of adaptiveness in substantially changing subsequent decision making in water management once the Delta Program has been finished.

The key of innovating long-term decision making around water management using ADM, has so far mostly been sought in a reliance on traditional knowledge, like scientific scenarios, models and concepts (**Chapter 5.1** and **Chapter 6.1**). Sub-program manager Van Es (2012) declares the strong emphasis on this traditional notion of knowledge in the Delta Program as "*from the point of view of knowledge there's plenty, while at the same time there's always too little*." This traditional role of knowledge development again expresses the strong desire for *full-knowledge* and *controllability* in dealing with uncertainty and complexity (**Chapter 7.2**). However, practice shows that initiating study after study is often being used as an excuse to justify inaction, from which eventually a vicious circle might emerge. In adaptive decision making, knowledge development should no longer be seen from the traditional perspective, but rather as an ongoing learning process in a practical setting that relies on incomplete knowledge, pragmatic and intuitive action (**Table 1**). Instead of a scientific monologue, sufficient early-on communication between scientists, planners and decision-makers is needed to

identify issues and stakeholders and gain a shared understanding of tasks and objectives (Lehtonen & Peltonen, 2006). Scientific advice encourages innovation through such experiments and governance structures that probe and debate possible directions through collaboration, policy and science (Werners *et al*., 2009). Although the Delta Act and the Delta Fund (**Chapter 5.4**) do partly provide in setting up experiments and pilot projects in the Delta Program, these options have not yet been fully explored. With respect to knowledge development, parties involved in the Delta Program still strongly rely on their 'own' knowledge institutes and epistemic communities and very few attempts have been done in designing structural governance arrangements. Therefore, even though strong emphasis in the ADM concept is placed on the aspect of *management*, the Delta Program would benefit from further developing the role of *governance*, since this aspect seems to be pretty much neglected in the program design. With an exclusive aim at management, the current ADM concept appears to be insufficient in truly fragmented and complex decision making arenas. Anticipating the dilemmas elaborated in **Chapter 6.4**, that show many problems emerge from complex regional decision making processes, political prioritization and the fragmented character of the Delta Program, which even further hamper dealing with uncertainties and complexities, the balance between substantial factors and procedural governance aspects seems lost in striving for adaptiveness. Therefore, more attention should be paid to the *governance* aspect in the ADM concept to more explicitly consider the complexity and fragmentation of modern days' decision making, since setting up governance structures in a complex decision making context turned out to be nearly impossible using current program frameworks. As already elaborated in **Chapter 2.3**, it turns out the notion of *governance* is indispensable in switching to adaptive decision making in coping with strong complexity, uncertainty and differing interests, as a governance track not just includes all knowledge and expertise of parties involved, but also improves trust and acceptance of initiatives that might motivate regional stakeholders to get involved and work jointly on improving water safety.

Returning to the *decentralization* of spatial development and water management responsibilities from the national to the regional and local level, as described in **Chapter 4**, the question can be asked whether this decentralization actually takes place in the Delta Program. The answer to this somewhat rhetorical question is to what extent this process of decentralization should actually be implemented in climate-proofing spatial developments, since too much central government interference might get in the way of regional and local innovation and creativity, while too little top-down control and coordination instead could lead to a lack of opportunities and resources for decentralized governments in giving the subject a full place on the agenda and calls into question the efficiency of decentralized decision making. However, strong central guidance limits possibilities to get maximum benefit from different visions and approaches that could have been developed at the regional level if sufficient leeway had been available for adaptive initiatives. Under such circumstances, decentralized parties might get a growing demand for control over complex tasks in the long run, as they see opportunities for carrying through situation specific improvements and the freedom to come up with tailor made approaches and solutions when compared to the generic and programmatic central policy (Voogd & De Roo, 2004). The central character of the Delta Program has a clear impact on the sense of

responsibility that now seems to lie on the national level, which leads to reluctance in the region on which Wadden region sub-program manager Van Es (2012) states that "*nowadays it's too much 'reacting' for regions involved in the Delta Program*." Instead he is more an advocate of giving full responsibility to regions to initiate and develop water safety strategies by themselves based on their own considerations, even though there appears to be too little capacity for full decentralization (**Chapter 6.4**). On the challenge of dealing with regional complexity and administrative fragmentation Van Es (2012) continues that using a local scope to look at specific water safety tasks in the Wadden region, explore possible future strategies and steps required to make this change is required to give adaptive and long-term water safety strategies a better chance of success (**Chapter 6.2**), but only time will show the future role of regions in the further elaboration and development of the ADM concept.

The ultimate goal eventually is to make the ADM concept better applicable in a broader spectrum of long-term water safety tasks in a variety of regional contexts. Since some critical topics have not been touched-upon in this research, a clear challenge for science remains to carry the findings from this research to a higher and more abstract level. Further in-depth research will be needed to draw conclusions for the Delta Program as a whole, but based on the available time, capacity and the underlying purpose of this research a more limited analytical scope has been picked with a focus on one regional sub-program. Even though the dilemmas experienced in the Wadden region sub-program do not necessarily have to be the exact same dilemmas as experienced in other sub-programs, the outcomes of this study might still serve as opportunities for improvement and a proposal to set up more thoroughgoing follow-up research from which more analytical and generic conclusions could be drawn that might be of value to the Delta Program in general. Therefore, other than this research that studied the dilemmas in the translation of the ADM concept from the national level to the Wadden region level, further research is needed into the dilemmas experienced in other regional sub-programs and into options on how the national Delta Program can better prepare for and adjust the ADM concept in response to different regional implementation difficulties and shortcomings of using adaptiveness in decision making. Similar researches should be conducted in other sub-programs and might be used to review the findings from the Wadden region to see whether research findings correspond and where they vary. The use and value of the ADM concept should be monitored closely for an extended period of time, in order to draw more profound conclusions and gain deeper insights from which long-term learning and policy adjustment for more successful future implementation of ADM can take place. Besides that, comparable research might be conducted in a number of years to see how sub-programs eventually end up using adaptiveness in working on water safety strategies, what the further role of dilemmas has been in the remainder of the Delta Program, and whether the nature of dilemmas has changed over time.

7.6 Concluding remarks

Even though this research is nothing more than a mere snapshot in time on how the Delta Program and particularly the Wadden region sub-program struggle with the ADM concept, the findings from this research will definitely be beneficial in analyzing the opportunities for flexible ways of dealing with

uncertainty and complexity and to increase the applicability of ADM in a wide variety of regional contexts. As adaptation to climate change is a relatively new policy issue, this research showed that governance mechanisms and policy instruments supporting this concept are mostly still in the process of developing (Peltonen *et al*., 2009). Program manager Van Es (2012) acknowledges this by stating that "*the Delta Program is constantly evolving and searching for improvement.*" Successful adaptation programs at the national, regional and local scales have taken years, even decades, to build. Such processes take persistence, the willingness to take risks, the ability to correct mistakes and dedication to continued improvement and enhancement (Smith *et al*., 2009). Looking ahead at the 2013 Delta Program report (DP 2013, 2012a) and the intended role of ADM in this report, staff member Hammer (2012) accentuates that "*within the Delta Program serious efforts are being made to move the idea of Adaptive Delta Management further forward over the next years.*" Delta Commissioner Wim Kuijken realizes that it will be a complex process, towards obtaining innovative solutions for the Wadden region together with all regional parties involved (DP, 2011d), "*but if we succeed in coming up with true innovations, a giant leap forward will be made in implementing sustainable water safety strategies in the Wadden region*." The selection of barriers that have become apparent in this research and have caused serious dilemmas in regional decision making could therefore be seen as an opportunity for the substantial and procedural improvement of the role of adaptive decision making in the Delta Program. The 2013 Delta Program report shows that for the Wadden region carefully introduces a number of possible strategies using a more local scope to better respond to regional variety and complexity. How promising these program changes turn out to be in the real world remains to be seen over the coming years, since adaptiveness requires an ongoing process of policy development and adjustment, long-term governance structures and finally consistent perseverance.

Appendix

List of interviewees

National Delta Program

Pieter Bloemen, top advisor Strategy and Knowledge of the Delta Program staff, The Hague. He is the point of contact for strategy within the staff of the Delta Program and is mainly concerned with the development of the basic principles for strategy development of the Delta Program. He is also first point of contact in the Delta Program for the subject Adaptive Delta Management.

Floris Hammer, staff member Strategy and Knowledge of the Delta Program staff, The Hague. He works on different subjects around strategy and knowledge, such as Adaptive Delta Management.

Regional Delta Sub-Program Wadden Region

Kees van Es, program director of the Delta sub-program Wadden region at the Ministry of Economic Affairs, Agriculture and Innovation in Leeuwarden. He has a lot of expertise in the region as is also program leader of the comprehensive governmental program Rich Wadden Sea (in Dutch: Naar een Rijke Waddenzee), which is more focusing on the ecological aspects and the sustainable use of the Wadden Sea.

Pieter den Besten, program team member and vice-program director of Delta sub-program Wadden region at Ministry of Infrastructure and the Environment in The Hague. Besides working as a policy advisor for the Wadden region, he is also leader of the Dutch delegation in the trilateral Task Group Climate that is aimed at sharing knowledge and setting up research programs internationally.

Kees de Jong, policy advisor for Water Board Noorderzijlvest and program team member of Delta sub-program Wadden region in Groningen. He is leader of the *Safety Task* Cluster, which is aimed at mapping out current and future water safety tasks.

Rick Hoeksema, program team member of Delta sub-program Wadden region at Rijkswaterstaat Noord-Nederland in Leeuwarden. He is leader of the *System Knowledge & Monitoring* Cluster, which currently receives a lot of emphasis within the Wadden region sub-program to get a better grip on the uncertainties and complexities of the dynamic Wadden system.

Siep Groen, senior policy officer for the Ministry of Economic Affairs, Agriculture and Innovation in Leeuwarden. He is leader of the *Safety Strategies* Cluster that has the task to work from possible, to promising, to preferential strategies for the Wadden region sub-program up to 2015.

External Expertise

Govert D. Geldof, senior expert consultant in the field of complexity in society and a special interest in water management in Tzum. Based on practical experience he doubts the existence of a fundamental paradigm shift in water management and he believes that craftsmanship and experience can play an important role in coping with complex water management tasks.

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