Optimal timing, cost benefit analysis and adaptation strategies

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In close cooperation with dr. H-P Weikard

Content

1 Description work package

1.1 Problem definition, aim and central research questions

Problem definition

Adaptation options are very specific for the sectors and the locations involved (cf. Routeplanner Project and EU Adam project, 2008). This means that detailed assessment of the adaptation options needs to be fine tuned to the local circumstances and that very detailed knowledge on the sectoral and technical aspects of the various adaptation options needs to be shared with the stakeholders in important sectors such as agriculture, industry, energy, transportation, recreation, nature conservation, infrastructure and housing. Stakeholders and actors have limited information on the impacts of climate change, on the strategies to adapt, and on the costs and benefits of the various adaptation options. Efficient implementation of adaptation requires a detailed assessment of the costs and benefits, and other characteristics of adaptation.

Central aim

The project aims at developing detailed methods that can be applied in various case studies in a consistent manner, considering the future climatic change, based on the scenarios of KNMI and other meteorological offices. In close cooperation with the hotspots, it will be identified what type of assessment (CBA, MCA or qualitative methods) is required and what level of detail will be applied and what will be the relevant discount rates and CBA categories to be included in the analysis. We will focus on no regret options and precautionary measures and develop a clear set of guidelines on how to make assessments in a practical setting, based on the OEI framework for CBA but extended to cover issues

that are particularly relevant for climate adaptation, such as irreversibilities and reservations for future actions. Special attention will be given to resilience and robustness, with linkages to PhD projects envisaged by Deltares in KvK Themes 1 and 2. The project will particularly be linked to the hotspot Haaglanden and will contribute in close cooperation with the stakeholders to the development of the regional adaptation strategy for Haaglanden.

Research questions

How can optimal timing of adaptation measures be determined in a setting of decision making under uncertainty and what are the implications for developing a adaptation strategy for climate change at the regional level?

Methods

The work package will specifically focus on the optimal timing of adaptation options and discounting of costs and benefits of adaptation under uncertainty, in a setting where overtime more information is becoming available on the expected climate impacts and on the best options to adapt. This calls for flexible systems that allow for adjustment in later years. This flexibility however, often comes at a cost and these costs need to be balanced with the uncertain benefits that are provided by choosing a flexible strategy.

In the project we will elaborate the theoretical framework, based the real option theory (cf. Pindyck (1994)) and we will apply the framework in a set of cases related to hotspot Haaglanden, where the costs and benefit structure will be analyzed in detail.

An important topic in this respect is flooding as a results of excessive precipitation in a setting where insufficient storage capacity is available because of the very intensive land use in the western part of the Netherlands. Because of the greenhouses of horticulture insufficient drainage is occurring and regularly flooding of greenhouses with high damages to agricultural production occur. Climatic change is expected to intensify this tendency and adaption measures for water storage and additional removal of excess water are required. This involves investment and one of the issues is the optimal size of these investments and the timing of the actual implementation of the investment program, and the adjustment of the program if new information on the impacts of climatic change becomes available.

A specific issue in the project will be how to deal with ancillary benefits that often have public good characteristics, such as benefits related to nature conservation and biodiversity. In traditional CBA these elements are often covered by pro memoria (pm) entries, which do not provide any information on the scarcity or the economic values involved.

A special phenomena in the Netherlands is that public benefits that accrue to low income categories are often excluded in cost benefit projects for projects that require government subsidies, because it is argued that these subsidies are not meant to provide additional benefits (for instance in terms of improved scenic values) to low income groups, as was recently shown in a cost benefit analysis for the Westflank Haarlemmermeer. How to deal with different income groups in CBA and possible redistribution will also be analyzed from a welfare theoretical perspective.

1.2 Interdisciplinarity and coherence between the projects

The workpackage has a multidisciplinary perspective because in the optimal timing economic aspects play a role but also the meteorological aspects and the hydrological aspects and the specific economic circumstances in the various sectors. In addition careful analysis of the governance issues is envisaged through close cooperation with theme 7 and with the hotspots. In earlier research (BSIK IC5) we have focused on the cases in the Zuid Plaspolder and coastal protection near the city of Katwijk. In the new project the optimal timing of measures is the central focus.

1.3 Stakeholders

Policymakers at national regional and local level. Hotspots like Haaglanden, Veenweide, rural areas and city planners. Results will also be communicated consultancy organizations (e.g. ARCADIS, Haskoning) and with CPB, PBL, Ministry of VROM, Ministry of V&W, Ministry of Agriculture.

WP6 will particularly focus on cooperation with the stakeholders that are represented in Haaglanden. We are supporting Haaglanden for the collaboration in this domain and will particularly focus on CBA analysis and optimal timing of measures for water storage and prevention of water damages as a result of excessive precipitation. For this purpose we will have regular meetings, at least twice a year, and we will jointly work on an assessment of the best options for preventing and reducing potential damages. The joint activities will be coordinated by the consortium leader in close cooperation with Carl Paauwe of Haaglanden and we will closely cooperate with representatives of the horticultural sector and other sectors that may suffer damages. We also will cooperate with Prof Guus Stelling of TUDelft, who in workpackage 4 will work on the hydrological and visual aspects of excessive rainfall.

In addition we will closely cooperate with Haaglanden and the province of Zuid Holland in developing the adaptation strategy. For this purpose we will have regular contacts with the stakeholders, at least twice a year, in order to discuss the general issues to be dealt with in the strategy and the cost and benefits of alternative strategies. We will not only focus on cost benefit analysis but pay attention to other aspects, such as the imponderabilia, the various perspectives of stakeholders and the institutional and socio psychological aspects of the various alternatives, such as the political support for or the acceptability of proposals.

Furthermore the international scientific community, although not a direct stakeholder, will benefit through publication of the methods and results in international journals.

2 Project 6.1 Optimal timing, cost benefit analysis and adaptation strategies

Project leader: prof.dr. E.C. van Ierland and dr. Hans Weikard

2.1 Problem definition, aim and central research questions

Problem definition

Adaptation options are very specific for the sectors and the locations involved (cf. Routeplanner Project and EU Adam project, 2008). This means that detailed assessment of the adaptation options needs to be fine tuned to the local circumstances and that very detailed knowledge on the sectoral and technical aspects of the various adaptation options needs to be shared with the stakeholders in important sectors such as agriculture, industry, energy, transportation, recreation, nature conservation, infrastructure and housing. Stakeholders and actors have limited information on the impacts of climate change, on the strategies to adapt, and on the costs and benefits of the various adaptation options. Efficient implementation of adaptation requires a detailed assessment of the costs and benefits, and other characteristics of adaptation.

The work package will also focus on the optimal timing of adaptation options and discounting of costs and benefits of adaptation under uncertainty. The joint PBL-CPB project “redefining the discount rate” will be one of the starting points for the definition of the PHD proposal.

Central aim

The project aims at developing detailed methods that can be applied in various case studies in a consistent manner, considering the future climatic change, based on the scenarios of KNMI and other meteorological offices. In close cooperation with the hotspots, it will be identified what type of assessment (CBA, MCA or qualitative methods) is required and what level of detail will be applied and what will be the relevant discount rates and CBA categories to be included in the analysis. We will focus on no regret options and precautionary measures and develop a clear set of guidelines on how to make assessments in a practical setting, based on the OEI framework for CBA but extended to cover issues that are particularly relevant for climate adaptation, such as irreversibilities and reservations for future actions. Special attention will be given to resilience and robustness, with linkages to PhD projects envisaged by Deltares in KvK Themes 1 and 2. The project will particularly be linked to the hotspot Haaglanden and will contribute in close cooperation with the stakeholders to the development of the regional adaptation strategy for Haaglanden.

Research questions

How can optimal timing of adaptation measures be determined in a setting of decision making under uncertainty and what are the implications for developing an adaptation strategy for climate change at the regional level?

2.2 Approach and methodology

Methods

The work package will specifically focus on the optimal timing of adaptation options and discounting of costs and benefits of adaptation under uncertainty, in a setting where overtime more information is becoming available on the expected climate impacts, on the vulnerability (Füssel et al. 2006) and on the best options to adapt (Smit et al . 200, 2002) This calls for flexible systems that allow for adjustment in later years (Reilly et al. 2000). This flexibility however, often comes at a cost and these costs need to be balanced with the uncertain benefits that are provided by choosing a flexible strategy.
In the project we will elaborate the theoretical framework, based on the real option theory (cf. Dixit and Pindyck 1994) and we will apply the framework in a set of cases related to hotspot Haaglanden in the Western part of the Netherlands, where the costs and benefit structure will be analyzed in detail. The project aims at developing detailed methods for efficient adaptation (Mendelsohn, 2000) that can be applied in various case studies in a consistent manner, considering future climatic change, based on the scenarios of KNMI and other meteorological offices, and considering the probability of extreme events (Weitzman, 2009). In close cooperation with the hotspots, it will be identified what type of assessment (CBA, MCA or qualitative methods) is required and what level of detail will be applied and what will be the relevant discount rates and CBA categories to be included in the analysis. We will focus on no regret options and precautionary measures and develop a clear set of guidelines on how to make assessments in a practical setting, based on the OEI framework for CBA but extended to cover issues that are particularly relevant for climate adaptation, such as irreversibilities, discount rates to be applied (Stern, 2008) and spatial reservations (e.g. for water storage and retention) for future actions.

An important topic in this respect is flooding as a results of excessive precipitation in a setting where insufficient storage capacity is available because of the very intensive land use in the western part of the Netherlands. Because of the greenhouses of horticulture insufficient drainage is occurring and regularly flooding of greenhouses with high damages to agricultural production occur. Climatic change is expected to intensify this tendency and adaption measures for water storage and additional removal of excess water are required. This involves investment and one of the issues is the optimal size of these investments and the timing of the actual implementation of the investment program, and the adjustment of the program if new information on the impacts of climatic change becomes available.

A specific issue in the project will be how to deal with ancillary benefits that often have public good characteristics, such as benefits related to nature conservation and biodiversity or impacts on mitiagation (Mills, 2007). In traditional CBA these elements are often covered by pro memoria (pm) entries, which do not provide any information on the scarcity or the economic values involved. A special phenomena in the Netherlands is that public benefits that accrue to low income categories are often excluded in cost benefit projects for projects that require government subsidies, because it is argued that these subsidies are not meant to provide additional benefits (for instance in terms of improved scenic values) to low income groups, as was recently shown in a cost benefit analysis for the Westflank Haarlemmermeer. How to deal with different income groups in CBA and possible redistribution will also be analyzed from a welfare theoretical perspective.

In close consultation with the stakeholders in hotspot Haaglanden we will contribute to the development of the regional adaptation strategy by identifying the most important impacts of climate change for the regions and the options that are available to adapt to climate change (Adger et al. 2005, 2007). Specific attention will be paid to the optimal timing of the adaptation measures and the uncertainties involved. We apply the real option approach to assess whether irreversible investment is required in an early stage or whether adaptation can still be postponed.

2.3 Scientific deliverables and results

The project will provide a fundamental analysis of optimal timing of adaptation options under uncertainty, based on an analysis of decision making under uncertainty and learning about the impacts of climate changes in terms of changes in precipitation and temperature, based on the best proxies for the probability density function for specific weather extremes. We will show how optimal timing will be affected by new information on the impacts of climate change becoming available. Specific attention will be paid to fixed and flexible costs in the investments for adaptation and the options to adjust adaptation in later stages, for example by investing in additional water storage or retention areas. The project will also contribute to the development of an adaptation strategy for the hotspot Haaglanden in close consultation with the stakeholders.

We expect that the project will provide a fundamental analysis of how to deal with the uncertainties on the impacts of climatic change in developing adaptation strategies. In particular we contribute to the analysis of the optimal timing and the flexibility in the adjustment of the investment programs.

Scientific deliverables:
d1 Scientific paper on how to deal with uncertainties in the adaptation to climatic change given uncertainty on the climate impacts and irreversible investment.
d2 Scientific paper on reducing the damages of excessive precipitation in the specific setting of the case study area Haaglanden in the Netherlands.
d3 Scientific paper on how to deal with new information on the impacts of climatic change and how to develop a flexible adaptation strategy that allows for adjustment if new information is becoming available.
d4 PhD thesis on how to deal with adaptation to climate change in the context of uncertainty about future impacts and new information.

2.4 Integration of general research questions with hotspot-specific questions

Special attention will be given to resilience and robustness, with linkages to PhD projects envisaged by Deltares in KvK Themes 1 and 2 and in particular a contribution will be made to the development of an adaptation strategy for the hotspot Haaglanden, one of the key hotspots in the Netherlands in the densely populated Western part of the Netherlands. See also the general description on interaction with the stakeholders in the WP description.

2.5 Societal deliverables and results

Sofar adaptation strategies are based on rather arbitrarily chosen scenarios on climate change. Sometimes a central projection is selected, at other occasion some more extreme scenarios are considered. However appropriate adaptation needs to consider the probabilities of certain events to occur. The project will contribute to substantial cost savings on adaptation because of better insights into what is urgently needed in the short run and what can be postponed till later. We aim at reducing over-investment and at the same time reduce the risks that are related to adaptation strategies that are coming too late. The societal deliverables are as follows:

d5 A report on the optimal timing of adaptation measures and uncertainty in the context of the adaptation strategy for hotspot Haaglanden.
d6 A report on the flexibility of adaptation strategies and new information on expected climate impacts.

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