

## Summary

The program aims at improving tools for design and evaluation of adaptation strategies with a special focus on spatial planning and cross cutting issues. The program focuses on three core elements 1. tools for formulation of the adaptation task, based on climate scenarios and economic development 2. tools for development and visualization of adaptation strategies in general and in particular related to hotspots and case study areas of KvK; and 3. evaluation and monitoring tools for assessing adaptation strategies in terms of various indicators such as costs and benefits; side effects; equity issues; efficiency and temporal and spatial scales. The program elaborates on results of previous research (NOP, BSIK, EU programs) and extends the analysis in order to make further progress in the scientific domain and in order to apply the results in the context of the case studies and hotspots of KvK in close consultation and collaboration with stakeholders.

The program will contribute to the ongoing planning process in the Netherlands at various levels, such as Deltaprogram and current Regional Strategic Visions (Structuurvisies), the National Adaptation Strategy (NAS) and the execution of national policies. Summary by WP is as follows:

**WP1:** Work package 1 will improve the spatial modeling and the socioeconomic scenarios as such that they can be better used at the regional level. This makes it possible to analyse the adaptation options at the local and regional level in the context of well defined socio-economic scenarios. This is essential for the applications of adaptation options in the hotspots and case study areas.

**WP2:** The work package offers improved assessment of flood risks and the disturbing effects of floods on regions, enabling policy makers to anticipate on increases in flood risk associated with climate change. Notably post-flood effects on real estate, recovery assessment and insurance issues are vital policy issues for spatial planning, insurance and public finance.

**WP3:** WP3 makes results from all work packages available for use in interactive design and evaluation of adaptation strategies. Starting point is quantitative spatial information from the "Climate atlas". Other inputs are the results from spatial and economic modeling (WP1 and 2), damage estimates (WP2) and risk perception (WP 5). Results from spatial valuation (WP 6) and Visualization (WP4) are fed back into the design process to improve the adaptation strategies.

**WP4:** This WP will provide visualization tools and guidelines, based on desk top study and as results from case studies via the consultation with stakeholders and policymakers. The visualization tools will assist in communication and to obtain the best solutions (mitigation and adaptation), particularly for spatial aspects and cross sectoral issues, e.g. nature conservation, agriculture, tourism and water management and their spatial implications, with explicit linkages to themes 1-5 of KvK.

**WP5:** WP 5 focuses on improving and climate proofing the freshwater system in the Netherlands under climate change. It will allow for an integrated analysis that can deal with the opportunities and the needs of the various regions in the Netherlands and will combine a hydrological and economic approach.

## Summary

**WP6:** This work package focuses on cost benefit analysis and other evaluation tools in the context of the optimal timing of policy measures. Results can be directly applied in the assessment of adaptation options and in the temporal and spatial planning of adaptation, based on a profound assessment of the various options and considering the perspectives of stakeholders and policymakers, also with explicit linkages to themes 1-5 of KvK and application in the Hotspot Haaglanden in the context of the development of the adaptation strategy for the western part of the Netherlands.

**WP7:** Results will be applied in the near future for monitoring adaptation in the Netherlands based on an appropriate strategy and well-designed and selected indicators.

## Overview of main research questions on three levels

The main research questions for the overall program (level 1) can be summarized as:

1. How can - in a dynamic context and given the uncertainties related to climate change- the targets be identified for adaptation in the various sectors and the various regions of the Netherlands and what will be the desired timing?
2. How can a consistent adaptation strategy and alternative and innovative adaptation options be generated, both in terms of changes in infrastructure and changes in behavior and society, in order to cope with climate change and to make the Netherlands climate proof?
3. How can assessment and evaluation tools be developed and applied for adaptation in the various regions in the Netherlands and for the various sectors and hotspots, including crosscutting issues?

The main research questions for the work packages (level 2) can be summarized as:

**WP1:** How can the existing land-use modeling framework be improved in order to facilitate the preparation and evaluation of spatially explicit adaptation measures?

**WP2:**

1. What are the impacts of flood event and flood risk on (adaptive) behavior of firms and households?
2. How do regions recover from flood events?
3. What is the role of governmental policy in an economic recovery of the flooded region?
4. What are the economic modeling instruments, which can help policy makers and researchers to predict the future development of the flooded region as well as to choose the most optimal policy to promote its recovery?

**WP3:** How effective are map based decision support tools for interactive design of special adaptation strategies?

**WP4:** How can interactive visualization and simulation systems for various types of target group directed protection measures contribute to the use of climate change information in planning for regional and local adaptation strategies?

Summary

**WP5:**

1. How efficient are current freshwater resources allocation decision rules across sectors and regions in the Netherlands from an economic point of view?
2. What are the economic implications of future climate change scenarios on the freshwater resources allocation across sectors and regions in the Netherlands?
3. How can economic efficiency of freshwater resources allocation be improved across sectors and regions in the Netherlands given future climate change through cost-effective adaptation strategies?
4. What role is there for economic markets to improve freshwater resource allocation efficiency across sectors and regions in the Netherlands given future climate change?
5. How to design efficient economic markets to improve freshwater resource allocation efficiency across sectors and regions in the Netherlands given future climate change?

**WP6:** 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?

**WP7:**

1. Which evaluation methods and associated indicators are available or can be developed to monitor and evaluate the implementation of adaptation measures and the climate-robustness of plans, programs and projects?
2. How does the choice of methods and indicators depend on the scale of application, on time, and on the specific policy objectives?
3. What is a coherent framework to structure evaluation methods and indicators in the broader context of sustainability?
4. How can monitoring and evaluation methods and indicators of climate change adaptation and climate resilience best be integrated into existing monitoring programs?
5. How can indicators be communicated and visualized, taking into account uncertainties? (with Work Package 4)?

The research questions for the projects coincide with the research questions for the Work packages if only one project is in a work package.

For work packages WP1 and WP4 the research questions at the project level are:

Research questions for projects (level 3) in WP1:

WP1 Project 1: How can the contributing sector-specific models be better aligned and integrated ion the current land-use model?

WP1 Project 2: How can residential densities and multifunctionality of land use be included in a land-use model?

Summary

Research questions for projects (level 3) in WP4:

WP4 Project 1: How can visualization techniques improve the effectiveness of decision support tools in bridging the gap between science and policy in adaptation planning at the local/regional level?

WP4 Project 2: How can the effect of heavy local rainstorms be predicted in a reliable way, and how can we make use of extremely high resolution input data, so that the computational speed remains high, while the flow results, with optimal accuracy, fit exactly in the detailed geometrical data?

WP4 Project 3: How can a high quality 3D visualization of large-scale geodata, and an advanced numerical flooding simulation be integrated in a single interactive system with interactive speed, which is suitable for climate adaptation strategy evaluation?