

3.1 *Publishable summary*

Effectively and efficiently reducing, or adapting to, natural hazard risks requires a thorough understanding of the costs of natural hazards to develop sustainable risk management, as well as risk mitigation and adaptation strategies. Considering the limited financial resources available, **reliable and comprehensive estimates of costs and benefits of natural hazards** are crucial. These contribute to informed decision-making and developing policies, strategies and measures aimed at preventing or limiting the impact of natural hazards on societies as well as at improving their coping and adaptive capacities. The current methods assessing the costs of different natural hazards employ a diversity of terminologies and approaches for different hazards and impacted sectors. This impedes ascertaining robust, comprehensive and comparable cost figures.

CONHAZ- Costs of Natural Hazards - a Coordination Action Project funded by the EU 7th Framework Programme - aimed at compiling and synthesising current knowledge on cost assessment methods to strengthen the role of cost assessments in the development of integrated natural hazard management and adaptation planning. In order to achieve this, CONHAZ has adopted a **comprehensive approach**, considering natural hazards ranging from droughts, floods and coastal hazards to Alpine hazards, as well as different impacted sectors and cost types. In this respect, CONHAZ differentiates between direct tangible damages, losses due to business interruption, indirect damages, intangible effects, and costs of risk mitigation as an important part of the overall costs of natural hazards.

The specific **objectives** addressed with this approach have been 1) to compile the state-of-the-art methods for cost assessment; 2) to analyse and assess these methods in terms of technical aspects, as well as terminology, data quality and availability, and research gaps; and 3) to synthesise resulting knowledge into recommendations as well as to identify further research needs. Regarding the first objective, the compilation of the state-of-the-art methods for cost assessment focused on assessment as used in European but also international case studies. Central aspect for the second objective lied in contrasting the analysed methods to practices and end-user needs to identify best practices and to determine research needs. The third objective emphasized the presentation of the research needs and identified recommendations for practice and policy across the range of natural hazards and impacted sectors considered including the preferences and needs of practitioners.

Cost assessment address different target groups, such as national and regional governments, insurance companies, and private companies or house owners. With them, the objectives of cost assessment vary requiring different cost assessment methods. CONHAZ's **main focus** was on economic cost assessments for governments, in particular with the objective to support public decision making on the allocation of funds to particular hazards and on alternative risk mitigation measures (project appraisals). These can be regarded the most important fields of application, as the principal aim of CONHAZ is to strengthen the role of cost assessments in the development of integrated natural hazard management and adaptation planning. Cost assessments for other objectives were not in the main scope of the project. Nevertheless, some of the CONHAZ findings also refer to methods particularly used for ex post costs assessments or for the insurance industry.

The **CONHAZ project** took place from February 2010 until January 2012 and was organized in a matrix structure combining method-related work packages (WPs 1-4) and hazard-related work packages (WPs 5-8). While the former were to provide in-depth knowledge on methodological issues related to the different types of costs considered within CONHAZ (direct costs, cost due to business interruption, indirect costs, costs of intangible effects, and costs of risk mitigation), the latter addressed the whole spectrum of the costs for different hazard types (droughts, floods, coastal and Alpine hazards). This assured the extensive exchange of knowledge within the project. The intensive cooperation between the various WPs enhanced the identification of best practices and knowledge gaps, and contributed to the provision of practical and research recommendations on the costing methods. Additionally, the CONHAZ matrix structure ensured that stakeholders from both politics and science were brought together to discuss and disseminate project results.

During the **second year of CONHAZ**, its eight project partners¹ have continued to substantially progress in their work and achieved the finalization of the project. In this time, the partners have conducted three team meetings which aimed at guiding the project's progress and at ensuring a common understanding and consistency throughout the consortium. Each partner contributed towards their own work package as well as their partners' work packages according to the working plan. This ensured the completeness and timely delivery of all deliverables and milestones relevant for the second and final project year. To accomplish the project's objectives, in total eight complementary studies were carried out over the project time.

Within the second project year, the **four work packages related to different cost types** each finalized their methodological report presenting methodological aspects across impacted sectors concerning cost types, including 1) direct costs and costs due to business interruption (Bubeck and Kreibich 2011), 2) indirect costs (Przyluski and Hallegatte 2011), 3) costs due to intangible, non-market effects (Markantonis et al. 2011), and 4) costs of risk mitigation (Bouwer et al. 2011). These reports provided the final compilation of the state-of-the-art approaches for all four hazard types, an analysis and assessment of these methods, as well as of respective terminology and data. These reports provided the final compilation of the state-of-the-art approaches for all four hazard types, an analysis and assessment of these methods, as well as of respective terminology and data.

The **four hazard related work packages** within CONHAZ each presented a report applying this knowledge on the state-of-the-art approaches for different hazard types on 1) droughts (Logar and van den Bergh 2011), 2) floods (Green et al. 2011), 3) coastal hazards (Lequeux and Ciavola 2011), and 4) Alpine hazards (Pfurtscheller et al. 2011). Based on these, they provided first recommendations on best practices and identified first knowledge gaps that were contrasted in expert and stakeholder workshops. The second project year saw three of those **expert workshops** taking place; on the cost assessment of droughts, coastal storms, and Alpine hazards. The workshops' findings were integrated particularly into the hazard specific reports, but also into the methodological reports, allowing for a diverse knowledge exchange and integration across communities.

¹ The CONHAZ project is coordinated by the Helmholtz Centre for Environmental Research – UFZ in Leipzig, Germany and is scientifically represented by Prof Dr Reimund Schwarze (Reimund.Schwarze@ufz.de).

The described four methodological reports and four hazard specific reports form the basis for the final **CONHAZ synthesis**. This synthesis comprises findings regarding best practices, overall knowledge gaps and recommendations for practice and research. Emphasis was put on the practitioners' view on best practices and recommendations for cost assessment of natural hazards by contrasting and discussing CONHAZ findings again but with a larger audience of experts and decision makers at the **CONHAZ Final Synthesis Conference**. Together with the CONHAZ results, this input contributed to the CONHAZ key recommendations and a vision on cost assessments of natural hazards together with their integration in decision making (see Meyer et al. 2012).

The **key findings on current practices and knowledge gaps**, as well as the resulting recommendations for practice/policy and for research include the following. CONHAZ differentiates for direct tangible damages, losses due to business interruption, indirect damages, intangible effects, and costs of risk mitigation. It was shown that the main focus of cost assessment methods and their application in practice is on direct costs. Other existing methods for assessing intangible and indirect effects are rather rarely applied and methods for assessing indirect effects can often not be used on the scale of interest (e.g. the regional scale). Furthermore, methods often focus on single sectors and/or hazards, and only very few are able to reflect several sectors or multiple hazards. Process understanding and its use in cost assessment is poor, leading to highly uncertain results. However, sensitivity and uncertainty analyses as well as validations are hardly carried out.

Important **recommendations** were that costs can be assessed more comprehensively by including indirect and intangible effects. Furthermore, CONHAZ outlined the importance of identifying sources of uncertainties, of reducing them effectively and of documenting those remaining. One source of uncertainty concerns data sources. A framework for supporting data collection on the European level ensuring minimum data quality standards would facilitate the development and consistency of European and national databases. Furthermore, an improvement of methods is needed with regard to a better understanding and modelling of the damaging processes. In particular, there is a need for a better understanding of the economic response to external shocks and for improving models for indirect cost assessment based on this. However, models to estimate direct economic damage also need to be based on more knowledge about the complex processes leading to damages. Moreover, the dynamics of risk due to climate and socio-economic change have to be better considered in the models to unveil uncertainties about future developments in the costs of natural hazards. Finally, there is a need for appropriate and transparent tools and guidance to support decision makers integrating uncertain cost assessment figures into their decision making process.

The compilation and synthesis of currently available and applied methods for cost assessments of natural hazard risks, and especially the identified knowledge gaps and recommendations within the CONHAZ report and synthesis, outlined **a vision of the CONHAZ project** for a cost assessment integrated into risk management. Such a vision has been presented, considering the various recommendations given, in an attempt to describe how cost assessment could look like in Europe in about ten to fifteen years from now. It emphasizes a cost assessment framework that can be applied by different actors in risk management for their specific aims (context-specific and applicable),

which includes all relevant cost types (comprehensive), considers and communicates uncertainties in an appropriate way (transparent) and accounts for changing hazards and risks (considers dynamics).

Further reading:

Meyer V, Becker N, Markantonis V, Schwarze R, Aerts J C J H, van den Bergh J C J M, Bouwer L M, Bubeck P, Ciavola P, Daniel V, Genovese E, Green C, Hallegatte S, Kreibich H, Lequeux Q, Lochner B, Logar I, Papyrakis E, Pfurtscheller C, Poussin J, Przyluski V, Thieken A H, Thompson P, Viavattene C (2012) Costs of Natural Hazards - A Synthesis. CONHAZ Report.