NAIAD WHITE PAPER

CLOSING THE GAP IN

PROTECTION, INVESTMENT, AND INFORMATION

TO SUPPORT EU CLIMATE ADAPTATION

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“An ounce of prevention is worth a pound of cure.”
— Benjamin Franklin

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1 Introduction

This White paper builds on the collective results and experience of the EC-funded research and innovation project, NAIAD (Natural Assurance Value Assessment and Demonstration - grant number 730497)[1], to support the 2020 Public Consultation of the EU Adaptation strategy. The main goal of the NAIAD project is to operationalize the assurance (Denjean et al, 2017) and insurance value of ecosystems (Baumgärtner, S., & Strunz 2014) by means of nature-based solutions (NBS) (Gomez Martin et al, 2018) to reduce the human and economic cost of risks associated with water related hazards (floods and droughts) (Alfieri et al, 2017). This is done by developing and testing the concepts, tools, applications (e.g. Basco et al, 2020), and instruments necessary for its mainstreaming. It has been tested in detail for nine experimental demonstration sites throughout Europe. During the spring of 2020, NAIAD worked with DG Clima, DG RTD, and EASME to facilitate a series of roundtables at the intersection of climate adaptation, natural disaster preparedness and financial and economic affairs. A series of 6 national virtual roundtables were held in Spain, Slovakia, Romania, Sweden, France, Denmark and one at the EU level. More than 160 people attended in total with representatives from cities and local authorities, the insurance industry, research and development in the water sector and flood risk management, NGOs active in climate adaptation and national and European Commission officials. The aim of these roundtables was to provide an arena for discussion, with its results becoming this White paper as Input into the public consultation on the revision of the European Adaptation Strategy published on 13th May 2020. Based upon the results of

[1] https://cordis.europa.eu/article/id/421775?WT.mc_id=exp

these roundtables and extensive learning made over the course of the NAIAD project, this White Paper shares insights into some of the questions posed in the Open public consultation on the revised EU Adaptation Strategy to be unveiled in 2021. The analysis presented in this paper further provides science-based knowledge to support the strategic planning and implementation of the Horizon Europe (HE) framework[2],; European Partnership clusters[3], WaterJPI[4], the Water Resources Expert Group (WREG) [5], and the EU Green Deal[6].

The paper is structured as follows. It first summarizes the analysis of the specific questions posed in the EU Adaptation strategy consultation at it pertains to NAIAD results. This analysis is based on the NAIAD collective experience and highlights priority areas to strengthen implementation of adaptation planning and measures in the new strategy. It includes a quick assessment of specific issues where NAIAD research and tools can be applied. This section is followed by insights gained during the 'Allies for Climate Resilience Roundtables' on climate protection, investment and

[2] Specifically, it contributes to HE missions (i) adaptation to climate change including societal transformation (NBS investment and implementation) and (ii) climate neutral and smart cities (NBS contribute to greener cities)

[3] HE supports European partnerships to deliver on global challenges; outcomes from NAIAD are anticipated to contribute to the clusters on (i) Health (NBS provide this co-benefit); (ii) Climate, Energy and Mobility.

[4] Water JPI Strategic Research and Innovation Agenda (SRIA) 2025 has the core research themes on Ecosystems, Health and Wellbeing, Water Value and Usage and Sustainable Water Management, all which NAIAD outcomes are expected to contribute to for implementation.

[5] WREG under GeoEuroSurveys advices DG Environment on water resources. The content of this report can provide information to WREG SRIA research themes on groundwater and the biosphere: biodiversity, nature-based solutions and ecosystem services.

[6] Specifically on the water related issues on preserving and restoring ecosystems and biodiversity relevant to the EU Green Deal.

information gaps can provide insights that can help to enhance adaptation measures in Europe. The paper concludes with recommendations and suggested ways forward.

Box 1: About the NAIAD Project (www.naiad2020.eu)

The NAIAD consortium is led by the Duero River Basin Authority and I-Catalist and includes twenty-three partners from universities, research centres, SMEs, public bodies, non-profits, and public insurers. The project is dedicated to assessing the effectiveness of nature-based solutions in damage loss prevention. The NAIAD project started in December 2016 and will conclude in August 2020. NAIAD developed methodologies to assess the natural assurance value of ecosystems in disaster risk reduction and climate change adaptation, considering co-benefits analysis, avoided insured damage and social acceptance of NBS. It highlighted effective processes to engage the insurance industry in NBS, CCA and DRR. Extensive research results are available at the NAIAD website (www.naiad2020.eu[7]) and will be made available in an upcoming new book to be published by Springer.

2. NAIAD Review of the 2013 EU Adaptation Strategy Evaluation and Current Consultation on 2021 EU Adaptation Strategy

The current EU Adaptation Strategy was adopted in 2013 (European Commission, 2013). The 2013 EU Adaptation Strategy had three main objectives, was implemented through 8 actions (see Table 1).

[7] https://cordis.europa.eu/article/id/421775?WT.mc_id=exp

Table 1. EU Adaptation strategy objectives and actions

1) *Promoting action by member states*: To promote action by member states to achieve coordination and coherence of different levels and planning (akin to multilevel governance)

- Action 1: encourage member states to adopt comprehensive adaptation strategies
- Action 2: Provide LIFE funding to support capacity building and step up adaptation action in Europe (2013-2020)
- Action 3: Introduce adaptation in the Covenant of Mayors framework (2013/2014)

2) *Better informed decision making*: To improve adaptation knowledge that can support decision making

- Action 4: Bridge the knowledge gap
- Action 5: Further develop Climate ADAPT as the one stop shop for adaptation in Europe

3) *Climate proofing EU action*: To climate proof EU action mainstreaming adaptation into EU policies and for key vulnerable sectors

- Action 6: Facilitate climate proofing the CAP, the CFP and the Cohesion policy
- Action 7: Ensuring more resilient infrastructure
- c. Action 8: Promote insurance and other financial products for resilience investment and business decisions

In 2018 it underwent a process of review (including a public consultation) on its actual implementation and performance on experience gained, lessons learnt to assess if it had matched expectations. The evaluation looked at its effectiveness, efficiency, relevance, EU added value and coherence. The results of the review were published during 2018. An analysis was made on the progress on the main actions identified in the Strategy based on national scorecards (Rica el al, 2017). In this White Paper we give special attention to several actions and their implementation, with a comparative summary of the adaptation scorecard for the countries that host NAIAD Demos. Please note that the Commission itself clearly states that it is necessary to read the full report for each of these aspects and that it has no comparative value across countries but rather it has value as to the country itself in its own policy context.

It is however relevant to note the pattern that emerges in terms of overall gaps where additional research could inform or strengthen the actions taken. The areas where most countries faced the greatest challenges are shown in table 3. These point to several broad areas that should be strengthened to improve the mainstreaming of adaptation in planning processes and its overall implementation. These are: (1)inclusion of prevention/preparedness strategies that take into account climate change impacts and projections within national disaster risk management plans; (2)continued improvement in assessment of risks and vulnerabilities to climate change, (3) development of capacity, tools and robust methods to identify, choose and prioritise adaptation options that can be applied within existing decision-making frameworks and processes; and (4) mechanisms to mainstream adaptation in insurance or alternative policy instruments, and, where relevant, to provide incentives for investments in risk prevention.

Thus prevention, assessment, capacity, and insurance were key areas identified in the evaluation as areas to be strengthened in the next EU Adaptation strategy (see Table 2 for summary).

Table 2. Adaptation scorecard in NAIAD´s 9 DEMO countries

STEP	AREA	INDICATORS	SP	UK	FR	SLO	DK	NT	RO
Step B: Assessing risks and vulnerabilities to climate change	***Current and projected climate change***	Climate risks/vulnerability assessments take transboundary risks into account, when relevant							
Step C: Identifying adaptation options	***Identification of adaptation options***	The selection of priority adaptation options is based on robust methods (e.g. multi-criteria analyses, stakeholders' consultation, etc.) and consistent with existing decision-making frameworks							
		Mechanisms are in place to coordinate disaster risk management and climate change adaptation and to ensure coherence between the two policies							
	Funding resources identified and allocated	Funding is available to increase climate resilience in vulnerable sectors and for cross-cutting adaptation action							
Step D: Implementing adaptation action	***Mainstreaming adaptation in planning processes***	Prevention/preparedness strategies in place under national disaster risk management plans take into account climate change impacts and projections							
		Key land use, spatial planning, urban planning and maritime spatial planning policies take into account the impacts of climate change							
		National policy instruments promote adaptation at sectoral level, in line with national priorities and in areas where adaptation is mainstreamed in EU policies							
		Adaptation is mainstreamed in insurance or alternative policy instruments, where relevant, to provide incentives for investments in risk prevention							
		Adaptation policies and measures implemented, e.g. as defined in action plans or sectoral policy documents							

Current international framing and EU strategies coherence with climate change adaptation

Several international agreements now further support accelerated action on adaptation. 2005 marked an important year, with the agreements around the 2030 Agenda agreements, including The Paris Agreement on Climate Change, the Sendai Framework (UNISDR, 2015), the Addis Ababa Action Agenda on Financing for Development, the New Urban Agenda. Both the Sustainable Development Goals and the Sendai framework have concrete objectives and targets by 2030, the Paris Agenda by 2050.

Under the Paris agreement (UNFCC, 2019), Art. 7 establishes a global goal for adaptation, having a greater weight since Cancun, particularly referring to the three elements of ***resilience, vulnerability,*** and ***adaptive capacity.***

The Paris Agreement defines the global goal on adaptation –as *“to enhance* ***adaptive capacity and resilience,*** *to reduce vulnerability, with a view to contributing to sustainable development; and ensuring an adequate adaptation response in the context of the goal of holding average global warming well below 2 degrees C and pursuing efforts to hold it below 1.5 degrees C”*[8].

The Sendai framework calls for *“The substantial* ***reduction of disaster risk and losses*** *in lives, livelihoods and health and in the economic, physical, social, cultural and* ***environmental assets*** *of persons, businesses, communities and countries”*[9]

However, from the point of view of policy coherence with these international conventions the EU has also recently adopted a series of strategies that should also

[8] https://unfccc.int/topics/adaptation-and-resilience/the-big-picture/new-elements-and-dimensions-of-adaptation-under-the-paris-agreement-article-7

[9] https://www.undrr.org/implementing-sendai-framework/what-sendai-framework

be aligned with these objectives of climate change adaptation (Paris) that is geared to the reduction of risks (Sendai) to ensure the wellbeing of European citizens (2030 Agenda-SDGs). The “Green Deal”, the “Farm to Fork”, the “Biodiversity Strategy”, the “Circular economy strategy” have to be mindful of avoiding maldaptation, helping to reduce current and future risks by transforming our systems into climate resilient development pathways that are sustainable and equitable.

Future Adaptation Strategy: The value of Prevention

The EEA regularly reports on losses and damages in the EU. However as stated in the Damage explanation of data page, these are an underrepresentation on the true costs since “many impacts, such as loss of human lives, cultural heritage and ecosystems services, are difficult to value and monetise, and thus they are poorly reflected in estimates of losses” (EEA, 2019).

In view of the increased number and costs of hydro-meteorological risks due to both increased hazard and to a higher exposure (Quevauviller and Gemmer, 2014; Ruangpan et al 2020) it is crucial to take proactive actions and measures, to reduce the impact of a hazardous event. Thanks to Sendai, policies have shifted towards a comprehensive, integrated risk approach. Although the full disaster cycle — prevention, preparedness, response and recovery — should be taken into consideration, NAIAD makes the case for the investment in prevention to avoid losses and damages, which bring also a number of very valuable co-benefits (Dottori et al, 2020; Le Coent et al, 2020). The investment into green assets to protect and recover natural functions as a natural assurance scheme for cities and regions. It is an opportunity in view of the new EU Strategy on Sustainable finance.

“Green” prevention when incorporated into adaptation to climate change and disaster risk management provides a range of complementary approaches for managing the risks of climate extremes and disasters. This also links to the potential for investment - also by the insurance sector - together with other actors like public authorities as allies for climate, as analysed in the report by Sandberg et al (2020). This looked at the

natural perils compensation and insurance schemes in operation in a number of countries, to assess the degree to which they provide incentives for the implementation of preventive measures rather than for the restoration of buildings and infrastructure following a natural perils event.

NAIAD argues that nature should also be part of the solution, by incorporating the investment in nature for its prevention value (its assurance value) (Lopez-Gunn et al, 2020). NAIAD has aimed to show the effectiveness and limitations, which adds more robust evidence to other reports and analysis on this area (Beck et al, 2018, Beck et al, 2019, Menendez et al, 2020, Narayan et al, 2017; Narayan et al, 2019, Reguero et al, 2018)

3 Leveraging NAIAD Learning for Climate Adaptation

Climate change is evident across and beyond European regions, and in many sectors important to our society. It is also increasingly complex and affecting all citizens' quality of life in far-reaching ways, including the recovery from the Covid-19 crisis, which is an opportunity to "build back better". Therefore, the European Commission seeks to gather insight into the challenges, objectives, and priorities for the new EU Adaptation Strategy. The following section gathers feedback on these elements through a synthesis of key points raised in the response of (a part of) the NAIAD consortium on a selection of the open questions from the EU Adaptation Strategy Consultation.

When asked about the drivers for the EU Adaptation Strategy, experts pointed at the growing speed of climate change impacts and insufficient private sector investment and action on adaptation as the most important drivers, closely followed by insufficient public sector investment and the slow adoption of local adaptation strategies.

As key barriers, NAIAD experts highlighted the weak mechanisms and indicators to monitor and report on the implementation of adaptation strategies and actions, together with insufficient involvement of businesses and the financial sector in

adaptation efforts. This was closely followed by the insufficient financial support for adaptation to climate change.

Regarding the objectives and ambition of the adaptation strategy, emphasis is put on an increased focus on prevention (in addition to ex-post action) and implementation (in addition to planning).

The EU Adaptation strategy problem definition might target the following drivers (1) lack of awareness on the need to adapt to climate change. Even if climate is moving fast awareness is not keeping pace; (2) slow adoption of local adaptation strategies even if knowledge is increasing and portfolio of cost-effective solutions such as NBS that are now available. Improving the information and knowledge about NBS effectiveness in coping with loss prevention and hazard reduction with monitoring aspects; (3) insufficient investments from public and private sectors.

The following potential actions were rated as the most important (1) supporting a more open access to climate loss and disaster risk data from private and public sources to allow all actors to take an active role in adaptation action and to help integrate climate risks in decision-making; and (2) increase private investment in adaptation via increased public-private investment opportunities or incentives through e.g. the EU Taxonomy or the EU Green Bond Standard.

NAIAD knowledge supporting implementation of adaptation strategies

The NAIAD project produced a wide range of research outputs, including scientific papers, briefs and practical guidance materials that are publicly available on the project website (www.naiad2020.eu) as well as on EU research data repository. Also some specific tools and methods to help build capacity e.g.. on physical, economic or social assessment methods[10]. Several of those analyses, instruments and policy

[10] http://naiad2020.eu/media-center/resources/

guidelines provide valuable information for the targets covered by the 2020 Public Consultation of the EU Adaptation strategy and can be of practical use in further implementation for increased climate resilience. For example:

- In support of *"public awareness of the need to adapt to climate change",* the NAIAD ambiguity and social risk perception analysis[11] provides a sound methodology for eliciting, structuring and analysing the stakeholders' perception of risk and the cause-effect chain (i.e. from the climatic drivers, to the main risks, and, finally, to the primary and secondary impacts) affecting the stakeholders' risk perception and consequently their actions. The ambiguity analysis can support the convergent thinking phase to facilitate the debate among the different stakeholders towards a satisfactory level of consensus over the main goals to be achieved through the implementation of the risk management action, the measures that need to be implemented and the criteria for the evaluation of the measures' effectiveness (Giordano et al, 2019, Giordano et al 2019b; Giordano et al 2020a, Giordano et al, 2020b; Pagano et al, 2019, Santoro et al, 2019; Bokhove at al, 2019; Bokhove et al, 2020).

- In support of "*cost-effective solutions and skills to adapt to climate change",* the NAIAD demos[12] provide a wide range of NBSs responding to different climate challenges and applicable at different scales in diverse physical, social, and economic environments across Europe. Promoting these examples along with others provided by other NBS projects (European Commission, 2015) can

[11] http://naiad2020.eu/wp-content/uploads/2020/06/Results-in-Brief_Participatory-Modelling-for-NBS-design-and-assessment.pdf and http://naiad2020.eu/wp-content/uploads/2018/11/D3.1_REV_FINAL.pdf

[12] http://naiad2020.eu/wp-content/uploads/2019/01/Newsletter03.pdf

help reach a wider audience to inspire communities for higher effective interventions in local contexts.

- In response to "*slow adoption of local adaptation strategies*" (a major challenges to which the EU Adaptation strategy must respond to the report on enhancing social acceptance of the NAIAD tools and models aggregates the lessons learned in NAIAD *concerning the role of risk perception and* ***stakeholders' engagement in NBS[13] co-design and implementation*** *addressing s*pecifically, stakeholders' perceptions of NBS effectiveness and, thus, contributing to enhancing their social acceptance.

- In support of "*improving climate risk and impact assessment*" for adaptation, the Eco:Actuary Policy Support tool kit[14] which includes an open access Cat model for natural capital, an investment planner, and a series of IoT Smart river systems to help provides data on (natural) flood storage, flood risk, damage costs for the current baseline and a range of possible user scenarios representing climate change, land use change/management and asset adaptation (Mulligan et al, 2020).

NAIAD knowledge supporting financing of adaptation measures and NBS

NAIAD dedicated research towards evaluating the assurance value of ecosystems (Denjean et al, 2017) addressing active involvement of businesses and the financial sector (in particular, but not limited to, the insurance sector) in adaptation efforts.

[13] http://naiad2020.eu/wp-content/uploads/2020/06/Results-in-Brief_The-Stakeholder-engagement-protocol-2.pdf

[14] http://naiad2020.eu/wp-content/uploads/2020/06/Results-in-Brief_Ecoactuary-Toolkit-1.pdf

Comprehensive surveys and the continued dialogue with the insurance sector resulted in clear recommendations for activating agents of change and new instruments and policies, institutional collective arrangements or funding and financing mechanisms based on successful demonstration and assessment.

Some mechanisms with potential to help fund and finance climate adaptation through NBS have been identified within NAIAD such as:

- Public support mechanisms: feed-in tariffs, tax credit programs, renewable energy quotas, standards, repealing support for “brown” sectors, grants, subsidies, project aggregation
- Public financing mechanisms: project lending, debt funds, bonds, concessional/flexible loan terms, direct capital investment, loan guarantees, insurance foreign exchange/liquidity facilities.
- PPPs and blended finance that have a high potential of investment for projects providing public and private benefits, which is a typical characteristic of NBS projects, although business models need still to be defined and legally implementable, like the NAIAD natural assurance scheme canvas (Mayor et al, 2020).[15].
- Payments for Ecosystem/Watershed Services and Water Funds are an existing business model that fit particularly well with NBS for DRR. The number of examples is growing worldwide, with water funds being an example that can be applied for NBS in DRR. In some cases, the particular social structure can determine the success of the instrument, and some legal or regulatory changes may be needed.

[15] http://naiad2020.eu/wp-content/uploads/2020/06/Results-in-Brief_NAS-Canvas-1.pdf

- Environmental and social impact along with green and climate bonds can be designed to finance climate adaptation measures. CatBonds have special interest to implement NBS after a natural hazard has occurred, as preparation for future events. It can serve as an incentive to the bond borrower to implement DRR measures, and therefore using NBS for it. Resilience bonds have also high potential, but still legal and regulatory changes are needed at an EU and/or national scale.

Additionally, NAIAD developed several instruments addressing private sector investment and action on adaptation as well as public finance for adaptation to climate change. Valuable evidence is provided by the project for Natural Capital Market integration[16] and transition from bankability to suitability including business models to catalyze implementation of nature assurance strategies[17]. NAIAD also developed a Handbook for the Implementation of Nature-based Solutions for Water Security and guidelines for designing implementation and financing arrangements (Altamirano et al, 2020)[18] supported by a review of international good practices in financing and funding nature restoration[19],.

[16] http://naiad2020.eu/wp-content/uploads/2018/11/D7.1_REV_FINAL_2NDREV.pdf

[17] http://naiad2020.eu/wp-content/uploads/2020/07/D7.2.pdf

[18] http://naiad2020.eu/wp-content/uploads/2020/06/D7.3.pdf

[19] http://naiad2020.eu/wp-content/uploads/2020/07/D7.4-NAIAD_International-Good-practices_FINAL.pdf

4. Climate Protection, Investment, and Information Gaps

Following interviews and surveys with relevant authorities, experts and stakeholders in the insurance and re-insurance sector in Europe (Marchal et al, 2019), and after discussion with DG Clima, three priority challenge areas to build climate resilience and ensure sustainability of insurance systems were identified as the focus for the roundtables: the protection gap, the investment gap and the data sharing gap. A series of specific issues and questions were identified and discussed by invited experts and authorities in each country's national context for each of the three topics. In addition, several key questions that cut across each theme were highlighted, such as:

- how to facilitate and strengthen dialogue across sectoral and multi governance level stakeholders interested in resilience to adverse climate-related impacts.
- how to improve the understanding of climate related disasters impacts at the local level and of the challenges of building resilience to climate impacts including through increased climate related financial risk management at local level.
- how to collect and use locally relevant data, assess costs, and perform modelling of these impacts.
- how to co-design adaptation investments and financial risk management solutions able to future-proof local communities.
- what lessons could be learnt from success stories of public private cooperation between the insurance industry and local authorities?

The Roundtables were both recorded and had notes taken by each roundtable leader. A summary of these results was prepared and codified under each of the three themes

organised on a grounded theory approach. These codes gathered the main issues identified in the different roundtables in these countries and in the EU level discussion as critical for the future EU Adaptation strategy(see Box 2). The following sections provide a summary of key messages in each of these areas, followed by a summary of points raised during the roundtable discussions.

Box 2: Codes emerging from data in each theme

THEME 1: PROTECTION GAP	THEME 2: INVESTMENT GAP	THEME 3: INFORMATION GAP
➢ Insurance Models ➢ Insurability of the system ➢ Governance, PPP and collaboration between actors ➢ Role for the EU ➢ Regulation: EU, national authorities, regional and local authorities ➢ Role of Public authorities, specially municipalities	➢ Investment in Prevention ➢ Type of investments and effectiveness ➢ Nature of the Risk/Climate proofing investments ➢ Investment in NBS, Green Assets ➢ Innovative financing ➢ Public participation/ end user involvement	➢ Data and Planning, Risk data ➢ Data and Knowledge Gaps ➢ Data and capacity building ➢ Data Access and Sharing

4.1 THE PROTECTION GAP

NAIAD KEY MESSAGES ON PROTECTION GAP

- *The EU has a rich diversity of insurance models. This is a strength. However, it is important for the EU and each country to reflect on the weakness of each model to strengthen them in view of climate change. For example, in the solidarity schemes for example addressing the issue of moral hazard, and in the risk-based schemes addressing the issue of affordability or diffusion rate.*
- *The climate change consequences on natural hazards are already there. It is necessary for the insurance sector to continue to understand risk exposure but also take a step further to also look at the role of preventive measures (e.g. collaboration with scientists) to ensure the insurability of the system in the long term. It could be performed through the availability of insurance options against climate change.*
- *The EU benefits from the full engagement of many actors around the table, however often their efforts are fragmented. Thus, it is important to unlock the discussions and the interdisciplinary aspects to clarify roles, synergies and potential collaborations between actors. It will improve governance effectiveness and public-private partnerships.*
- *The EU has strong regulatory opportunities to speed adaptation efforts across countries as first priority. The role for the EU might be to harmonize linkages between CCA, DRR policies from national to local scales, to offer the opportunity for collaboration between different partners under adaptation efforts. We recommend a clear coherence between policies, as well as the clear roadmaps towards climate change actions that stakeholders are asking for. It could be inspired by the format of Flood Directive which has been effectively applied in all countries. A kind of directive could be implemented for adaptation actions considering pluvial flood and nature-based solutions.*
- *The importance of public authorities in risk management is clear. Municipalities have been defined as the one of the most critical leverage points with a very important role in this arena (including the insurance of public assets). .*

4.1.1 Addressing common and different challenges within each insurance model

The application of insurance resources to increase resilience and improve adaptation strategies is currently unevenly applied across Europe, with different risk transfer schemes varying from country to country, thus there is an urgency to find a way to implement climate protection within each of the schemes. The NAIAD survey highlighted the current insurance roles in the integration of NBS for protection in DRR (providers, investors, innovators, and partners) (Marchal et al, 2019).

Active participation of the insurance sector in these roles is essential to cover the protection gap, but the means and priorities to do this is different within each country and is affected by differences in national insurance systems. There are different insurance models across countries, from national “solidarity systems” (Spain[20], France[21] and Romania) through to risk-based premium voluntary systems (Germany) or specific cases of semi-voluntary schemes (Denmark[22]), with particularities that need to be explored individually. Most of the systems are facing the issue of low diffusion rate which is a cross section issue. Some common pillars include the need to make the business model resilient and remove the feeling of “charity hazard”, by going to individual responsibility and solidarity at the household and business level. In countries with the mutualisation system the penetration rate is higher, and mechanisms of binding protective measures in building standards and penalisation for noncompliance are put in place to address the issue of “moral hazard” across these models . Some issues identified for insurance models are the coverage in overseas territories as well as for agricultural risks.

[20] http://naiad2020.eu/wp-content/uploads/2019/03/CountryFactSheet_Spain.pdf

[21] http://naiad2020.eu/wp-content/uploads/2019/03/CountryFactSheet_France_CCR.pdf

[22] http://naiad2020.eu/wp-content/uploads/2019/03/CountryFactSheet_Denmark.pdf and check http://naiad2020.eu/mooc/

4.1.2 Climate change impacts on the insurability of assets

If no loss prevention measures are implemented, climate related risk could become uninsurable since risks would not be quantifiable, since it would be difficult if not impossible to define the frequency of events and thus to calculate the premiums. Maintaining affordable insurance products is necessary to provide a protection cover for people, businesses, and public authorities. A sustainable insurance market will require not only new greener insurance products but also a more sustainable modus operandi with a longer-term vision to address challenges posed by climate change.

Current and potential future issues to provide affordable insurance coverage were identified as a major concern for insurance and public sector stakeholders. These include the increase in damage costs (Slovakia); the coverage in poorer neighbourhoods in high risk areas (e.g. Carpathian region); and the incapacity to offer insurance in certain risks due to climate change (Sweden). Spanish stakeholders raised the issue of insurability and the need of investment to avoid some areas will become uninsurable. For example, the evolution of premiums in Portugal, makes the need for prevention visible. In Sweden, the need was raised for insurers to be more active to inform the general finance sector that investments made may not be insurable due to climate change, leading to loss in values.

Actions to overcome these risks in the future were raised such as first the key importance to revisit current insurance models and adapt them to expand to the magnitude of future risks in order to allow insurability of assets, which is a great shared concern for both the insurance industry and public authorities. A second key area was the importance of focusing and investing on prevention in highly vulnerable and exposed areas, since mitigation-compensation will not be economically possible; transform uninsurable hotspots (houses, buildings…), through e.g. legislation, into

climate adaptation structures to release reiterated compensation pressures from insurance companies and keep the whole market insurable (Denmark).

4.1.3 Governance, PPPs and collaboration between actors

All countries stress the importance to develop Public-Private Partnerships (PPPs), organising the dialogue and pushing for a better understanding (or even consensus) on climate risks, costs of inaction, that benefits from the early identification of vulnerabilities, risk assessments, adaptation options and risk transfer mechanisms.

The building block for the governance system could start at the national level, identifying the roles and the mandates, as well as the climate protection products. This should be followed by a dialogue between SMEs, large companies, etc. Multilevel governance was also highlighted as an important model. Decentralization offers good opportunities to act at the basin or local level so that it is better tailored to each context under an overarching coordinated scheme like in Spain.

There is consensus that the governance system should build on cooperation of all the actors, including water authorities, the insurance sector and municipalities. This cooperation could pave the way for the exploration, implementation and replication of different models based on NBS. Examples of cooperation can be found in the updating of the River Basin Management Plans and Flood Risk Management Plans in Romania, or the strong cooperation between UNESPA and the Consorcio de Compensación de Seguros (insurance and reinsurance) in Spain, with clear roles and cooperative mechanisms. Cooperation may benefit from being backed by a legal basis.

Within this cooperation, the sharing of loss data is found as a critical point. An example of collaboration models is Denmark, where the Insurance and Pension umbrella organisation collaborated with universities and municipalities to use insured damage data to improve climate change adaptation planning. Meanwhile, in Norway data will be managed so that only cities and the insurance companies can access data at a granular level, while other actors can still access less restricted general data.

4.1.4 Regulation at EU, national, regional and local levels

The Insurance industry is involved nationally and locally as a partner and helps support local decision makers to understand to help risk exposure. It is important to start thinking at the local scale and further upstream in the development process. The building and land use authorities and actors have strong responsibility regarding first level exposure and has to build climate-wise. This must be complemented at the city scale, which requires robust infrastructure and networks resilient to disasters and working with nature for loss prevention. A fundamental challenge is to couple insurance and risk assessment/ planning with building codes, regulations and urban planning processes. There are major challenges to prevent new buildings from being constructed in potentially high-risk zones.

At the national roundtables, the clear needs for new regulations were highlighted, and their integration in the territorial planning policies is seen as a critical element and opportunity. In Spain, for example, a three-year warranty established by the Spanish law is compulsory for new and established buildings to raise awareness and action on their adaptation to be more resilient to climate change. Under the new adaptation national plan, the insurance sector will be important to inform the different economic sectors (for example, through certification labels on the risk levels of the buildings

based on their location). Regulatory incentives could be useful to support this initiative, if e.g. buying a house with a "type A" label with a tax reduction.

In Romania, the legislation on mandatory household insurance is in place but implementation is still challenging. In many cases the uptake is burdened by government compensations in the case of extreme events. In the case of Denmark, the land-use policy has been targeted as an opportunity to foster NBS implementation. However, the non-respect of the law (urban rules, risk prevention) is not often sanctioned and the correction of past actions is complex.

At the local level, whereas in countries like Norway there is a mandatory vulnerability assessment at the city level, in other countries like Slovakia integration of climate change in mid-long term territorial planning is still neglected thus new regulations are critical to change the system from a voluntary will of the mayor to a standardized compulsory requirement.

4.1.5 Clarifying gaps and risks to public authorities and municipalities

Municipalities are mostly not obliged to insure public goods, and the level of insurability depends on a voluntary basis. Insurance of large infrastructure is usually an oversight in the case of climate events, which raises important issues on how and where risk assessment for public infrastructure that are outside the insurance system are done. In some cases, municipalities do not have data on the vulnerability of the infrastructures since these are not connected to payment of damages. In France, the interest of the Ministry and CCR has increased in sharing this data. In Romania, the insurance of water infrastructure is in many cases linked to investments supported by EU finance, but climate events are not covered. In Spain this is another area that could be strengthened.

4.2 INVESTMENT GAP

NAIAD KEY MESSAGES ON INVESTMENT GAP

- *The EU is facing an investment gap in ex-ante preventive measures. Strengthened research, indicators, monitoring processes are required to measure against set targets, to assess effectiveness of prevention.*
- *There are some EU limitations for the insurance sector to invest around CCA/DRR or in long-term investments (Solvency II Directive). The Solvency II Directive must be redefined to incorporate the demands of the insurance industry to be able to undertake long-term investments in CCA/DRR. EU recommendations and definitions on climate-proof green investments and the effectiveness of innovative financing that considers the nature of the risk have to be developed to encourage and foster investments in nature-based solutions (e.g. clarification of investments towards NBS projects or other green assets, cat and resilient bonds).*
- *The insurance industry is greening its portfolios. However, the industry should be better prepared to target adaptation-green investments, as well as maintaining the insurability of risks.*
- *Decision-making is the key. Local decision making, public participation and end-users' involvement are the pillars to foster acceptance, knowledge and practical implementation of loss prevention measures.*

4.2.1 More investment in prevention needed

Investment in prevention is limited in the EU. Whereas the Barnier fund in France presents a good example of best practices, other countries face several barriers to invest in prevention. In Spain, investment in green assets and infrastructure is more relevant to agricultural insurance. In Romania, the Barnier fund is seen as a good example to learn from, but this would require sector consensus and political will. The

insurance sector in Sweden, as investors, would require further engagement and push to be more involved as a financial investor that influences resilience and risk reduction.

In Sweden, the following factors were mentioned as contributing to under investment in resilience/adaptation/risk reduction: (1) insurance assessment use a short time frame (often revised annually); (2) large infrastructure is uninsured but guaranteed by the government; (3) challenges to the investment model for paying back/earning revenues of investment (that provide risk reduction but not revenue flows); and (4) insufficient regulatory requirements for risk assessment/protection in building/planning codes.

This was echoed by Danish stakeholders, who also mention the Solvency II Directive as one of the key barriers to investment in prevention (and a role for the EU to overcome this). The fact that the limits of the Solvency II Directive have been raised around loss prevention, has made it impossible to invest in start-up companies involved in R&D with long-term investments are not allowed.

While the ROI of investment is still a barrier (as will be discussed below) there are also examples of effective ROI in prevention coming from France (e.g. as mentioned in for building investment, when insurers do a prior risk exposure analysis, or investments into specific funds for climate). Investments in green assets (under shared indicators) must be encouraged by a gain and/or a reduction in the cost of capital. Danish stakeholders highlighted PPPs as a potential solution, whereas Romania sees that the insurance sector can stimulate investments in protection infrastructure via facultative insurance products, focusing on digitalization (digital interaction with consumers), the quality of the claims assessment and adding waivers or top up services to stimulate risk reduction measures. This can be further strengthened by making sure that there are good loss data and loss curves and CBA to be able to look at risk reduction options with the cooperation of the whole sector.

4.2.2 Scaling effective investment in NBS

Generally speaking, investments are increasing in climate adaptation and NBS projects in Europe. In Denmark, green solutions are brought forward to deal with cloudburst in urban areas as they are seen as cheaper than grey solutions (notably expanding the sewer system which is very expensive). Politicians and citizens favoured green solutions resulting in 300 cloudburst management projects, to be gradually implemented over 20-25 years. In Spain and Slovakia, the recovery funds are seen as an opportunity to invest in nature and prevention through NBS. The preparation of collaborative projects for massive investments with the recovery funds (mostly grants), will allow to prepare CC hotspots who currently have no capacity to do so (and adaptation is more an afterthought than done by design) (Slovakia).

The Spanish roundtable emphasized the importance for investors and insurers to be informed on the investment risk. In that sense pilot studies can prove critical to provide information on the role of NBS in prevention. The Romanian roundtable stressed that a better understanding of NBSs impact in risk mitigation as a standalone option or in combination with grey measures can stimulate the insurance sector involvement in climate resilience actions.

Experience exists with river basin adaptation investments, but approaches vary. In Spain, the Orvigo river restoration for flood protection is a successful NBS implementation case, which is now mirrored with other projects in the Duero river basin and other Spanish basins (e.g. in Navarre with the LIFE NADAPTA and Gan Nik[23]). These experiences show it is necessary to invest in NBS to deal with extreme events considering CC scenarios. Other basins hesitate between NBS / restoration of rivers and large infrastructure to generate water security in the face of droughts (Slovakia). The change of rainfall patterns has lowered groundwater levels and creates the need to store large amounts of water in a short period of time and there is a temptation to

[23] https://lifenadapta.navarra.es/en/

solve droughts with dams. However, knowledge is limited, and evidence shows dams are quite disruptive and do not provide water to the landscape. The evidence on NBS effectiveness needs to be shared to support discussions and find a good combination of green/grey infrastructure (e.g. experiences from e.g. Rotterdam- rainwater harvesting and pluvial floods management – see Dartee et al, 2020 or MAR in Medina for river floods). In France we can take the example of Romorantin, the Sauldre river flooded the neighbouring Matra without generating any damage. It exemplifies the possibility to work with nature and not against it and the changes of training and education programme of civil engineering to incorporate green and hybrid infrastructure (UNEP, 2014).

One key point here is the need for data on NBS effectiveness. For NBS to be prioritised there is still a lack of relevant data that should be used in the elaboration of vulnerability assessments, a missing national methodology, standards and other tools for cities and municipalities (including the weak/missing legislation framework) (Slovakia). Adaptation is very multidisciplinary, hence engineers, meteorologists, etc. need to be sensitised to the worsening climate conditions. There is no need for a new curriculum but to bundle the existing expertise but with the additional constraint. This was echoed by French stakeholders, who mentioned a lack of criteria to assess NBS as well as few communications on investments by insurers.

Another key point when trying to transfer NBS examples to other countries is that the business case is not easy, in part because robust investments in climate proofing have a long timeline. So when considering applying e.g. the Cypriotic wetlands experience to Slovakia, it is important to understand what is done with avoided damages at basin scale and to remember that not everything can be monetised.

4.2.3 Targeting investments, PPP’s and innovative financing

In terms of innovative financing, new types of products and new covered perils or assets, the insurance sector reports an on-going demand and discussion for insuring

dikes, dams or NBS (protective structures) (France). This relates to insurability as implementation and insurance of NBS can support the protection gap reduction because it reduces exposure, thereby maintaining risk insurable and insurance contracts affordable. In the Netherlands, a PPP has been implemented between insurers and municipalities to foster people to put in place green roofs. The municipalities were interested in reducing heat wave intensity in the urban area and insurers were interested in reducing the consequences of pluvial floods on damage. In Denmark for example the uninsurable damage from slow onset events like groundwater flooding must be addressed by creating funds to which both insurance companies and citizens can contribute. Innovation already exists in the financing of collective flood prevention solutions through water charges levied by the water utility company while implementation remains by the city of Copenhagen.

Additionally, innovation comes from blended finance; the hydraulic function of solutions can be financed through the water charges, while the money for urban space improvements can be found on an ongoing basis through the municipal budget (Denmark). Blending different financial instruments and stimulation of PPP to align the interest of different stakeholders are important at the local level (Romania). At the EU level there is currently work on new legislation to stimulate insurers to invest in infrastructure projects. The new legislation will require lower solvency capital when investing in such projects which may stimulate insurers to invest in nature-based solutions.

In relation to the PPP models mentioned above, the Spanish Ministry is currently undertaking a participatory approach with meetings with farmers and citizens with surveys and questionnaires to understand their level of knowledge and awareness, and measures that could be taken.

The involvement of communities upstream and downstream is seen as crucial to cover the investment gap; not only to understand triggers and risks of investment but also

to highlight co-benefits that are sometimes more powerful (Romania). In addition, involving the general public can increase awareness of the value of nature. In doing so, it can steer insurers and banks toward NBS investment, as they usually offer what people demand (France).

4.3 INFORMATION GAP

NAIAD KEY MESSAGES ON INFORMATION GAP

- *Data improves knowledge and requires knowledge to collect data. These are the two faces of the information gap. It requires clear actors to collect data in a structured manner; if possible on a EU standardized structured approach.*
- *There is a large diversity of data around climate risk and cities. However, a clarification of what the end-users need and want is necessary and is important before collecting/sharing them.*
- *The construction sector should be better integrated around data sharing and in risk prevention (e.g. information on building, making building climate proof with build back better measures).*
- *The multitude of studies on the consequences of climate change and used databases should be publicly available.*
- *Climate related data contains personal information and elements for loss accounting and compensation. Then, data sharing must be in compliance with the General Data Protection Regulation, competition law, and the specificities of each insurance scheme.*
- *Once the needs are defined, the issue of data collection, data sharing, access to data, in the area of risk assessment, have to be seen as a window of opportunity to structure the framework of exchanges between different actors through standardized methods, mechanisms, indicators and monitoring processes (e.g the Covadis standard under the Flood Directive has been effectively applied).*
- *Pioneer examples of data sharing (e.g. in Norway Denmark and Spain) might be replicated and tested under proof of concept to check enhancement of capacity building and local decisions-making especially on planning*

4.3.1 Planning with risk and loss data

In this section the information gap is addressed with respect to (i) the barriers to and enablers of adaptation-relevant data sharing from the insurance sector towards the public sector; (ii) which data are available and should be shared and how are cities and regions able to use this data to inform better decision making; (iii) how can the EU support the sharing of geospatial climate disaster loss and risk data at various spatial resolutions to inform resilience measures and the design of nature based solutions.

Urban and regional authorities require reliable risk mapping tools and data to manage climate risks and assess resilience within the system. Although authorities usually have access to physical and socio-economic data needed for risk modelling, data from the insurance sector on the magnitude of insured damage, as well as geospatial data on where damage has occurred, can be critical to improve the planning of measures and investments to reduce future losses and risks. Historical data on insured damages and the location of damage can greatly support risk modelling and management since this knowledge can be included in designing and implementing climate proofing measures. Insurance data can to a high extent be used to derive damage functions by combining physical (e.g. hydrological modelling) and spatially distributed damage data. This way indicators for local decision making to help mitigate and/or adapt to the effects of extreme, but also slow onset natural hazards

The knowledge gaps on the data needed for developing, implementing, and monitoring climate adaptation measures must be addressed to ensure well informed decision making by authorities at various levels. The lack of robust and quality assured data constitute a large barrier to (i) performing the rigorous and credible risk modelling needed for designing and developing risk management strategies, like mitigation and climate change adaptation measures, including nature-based solutions which show high potential but still need further research and practical guidance on how to assess physically and economically their effectiveness supported by indicators,

to then implement, monitor and evaluate (Raymond et al, 2017). Measures for risk management need investment. A lack of credible information and therefore high perceived uncertainty are likely prevent authorities, and also other public-private institutions, to invest and thus cause inaction and even higher investment needs in the future as a vicious cycle of underinvestment (including in NBS). There is a clear need for a common risk management and knowledge taxonomy for facilitating communication between data users and data providers. The Knowledge gaps and therefore the uncertainty in the decision-making process can lead to inaction and higher costs. Meanwhile, identified known and acknowledged uncertainty e.g. structural deficiencies of used models and data, on the other hand can also help decision makers to invest in gathering specific data or improve physical models. In highly complex environments this may not be possible and in this case adaptation pathways or use of machine learning approaches can be applied instead. Insurance data can help here by supplying good quality data which ideally should be disaggregated into insured data because of different hazards, e.g. storm surge, extreme precipitation (cloudburst) or groundwater induced flooding. Access to insurance data may compromise GDPR and this must be considered.

4.3.2 Building capacity

Capacity building on how to increase resilience by protecting assets and sharing information is crucial to show both authorities and citizens at large, as well as data providers that risk management approaches really matter in a credible way. Development of guidelines tailored towards different end-users, as part of a capacity building strategy, is needed for target groups to understand why it is worth to invest and build resilience at the local level. Capacity building efforts can include tools and platforms to learn e.g. territorial planning, robust planning, and adaptation measures, including nature-based solutions (NBS), grey solutions and combinations of both (hybrid). For a common user platform, it would be an advantage to adopt standardization of the ISO and link to ongoing processes e.g. territorial planning.

Furthermore, capacity building is needed to understand exposure and vulnerability to climate related natural hazards. Capacity building guidance can include which methodologies, notably which physically based and socio-economic models are used and where in the risk management process and how to apply them while understanding the opportunities and limitations. As an extension of this, capacity building in the form of guidance is desirable on the issue of uncertainty, which types of uncertainty, limited knowledge (epistemic) or random variations (ontological) and uncertainty as a result of equally valid different views and perceptions by stakeholders (ambiguity). Aforementioned capacity building efforts including how to address uncertainties under various conditions of building resilience, and tailored to end-users, can be part of a platform that provides training material, including online guidelines and MOOCs, like the one developed by NAIAD[24].

4.3.3 Enabling access and sharing of data

Access to data is pivotal for all efforts to deal with climate resilience building. Several barriers for achieving this have been identified. Data sharing between data users and data providers must be realised to some extent to perform analyses and build climate resilience strategies. Data sharing from the point of view of the insurance sector can imply issues with confidentiality and competition. In addition, there may be legal barriers, including privacy laws like GDPR, but also nationally based legislation. Data sharing among insurers including data on loss accounting, loss compensation, modelling results and forecasting challenges is an issue of mutual competition, but data sharing under restricted conditions with authorities is possible and also practiced in several countries.

Data in this case may be shared at different spatial resolutions where e.g. insurers and municipalities can access at high resolution to maximise adaptation strategies whereas citizens can access data at a coarser level so as not to e.g. interfere in the real estate

[24] http://naiad2020.eu/wp-content/uploads/2020/06/MOOC.pdf

market. Research projects, both nationally and EU funded, may request data sharing with insurers to obtain a deeper insight in how and why physically and economic based modelling can simulate and predict the effects of climate related natural hazards. Data from such projects are often open access for the scientific community but should also be shared to a wider range of users to take full advantage of improved insights supported by data. The EU strategy to make big data sets available to the public is expected to maximise the impact of research activities and ease the efforts by authorities to conduct good quality risk management based on modelling and monitoring and targeted climate adaptation strategies.

5. Conclusion

Effective engagement of finance and insurance as allies for climate resilience

The gap in finance and insurance of adaptation measures for addressing climate change protection is a topic considered in all the main international conventions, namely the Sendai framework, the 2030 Agenda to implement the Sustainable Development Goals, and in the Paris Agreement (UN(2015)). The finance and insurance sector itself has been very active recently and produced a number of reports on the subject. The four areas identified below should be prioritized to support a more effective contribution from the finance and insurance sector to the future new EU climate adaptation strategy in Europe.

First, smart regulation is needed, but acting is urgent too

Many identify the main issue for adaptation is to move from commitments on paper to action and implementation on the ground. Moving to implementation can also help strengthen the required policy framework in a virtuous loop by helping to identify the limits to the implementation of actions, where the lack of stronger regulation may have devastating consequences for customer protection, insurer protection and government resilience.

Second, solutions for a diversity of insurance schemes

The application of insurance based resources to increase resilience and improve adaptation strategies is currently unevenly applied across Europe, with different risk transfer schemes varying from country to country, where there is an urgency to find a way to implement protection measures to adapt to climate change within each of the schemes. The NAIAD survey highlighted the current roles of the insurance sector in the integration of NBS for protection in DRR (providers, investors, innovators and partners).

Third, understanding that the insurability of the system is at stake

If no loss prevention measures are implemented, climate related risk could become uninsurable since risks would not be quantifiable since it would be very difficult if not impossible to define the frequency of events and thus to calculate the premiums. Maintaining affordable insurance products is necessary to provide a protection cover for people, businesses, and public authorities. The new vision is for a sustainable market that also includes new greener products and a more sustainable modus operandi, having a longer-term vision. In that respect, nature-based solutions are attractive measures for risk prevention as they are often cheaper than traditional grey solutions and provide substantial co-benefits, often exceeding the value of prevention

Fourth, supporting action and engagement with insurers at multiple levels

The insurance sector is involved nationally and locally as a partner and supports decision makers at the local administrative level to help understand risk exposure. It is important to start thinking at the asset scale, considering that the building and land use sectors have strong responsibility regarding first level exposure, electricity, water, and ICT networks. At the city scales robust critical infrastructure and networks are required, resilient to disasters and working with nature for loss prevention.

The role of the EU is critical in this equation, including in the following ways:

1. First, in promoting a call for a climate smart financial management and higher insurance penetration, while disseminating information on good practices across EU and supporting continued dialogue between experts and authorities as well as using the "bargaining power" with the insurance sector through supervisors, taxonomy and disclosures.
2. Second, in supporting the implementation of measures for climate resilient-smart cities and regions continuing through different programs to stimulate research and innovation, and supporting scaling-up of different nature restoration initiatives.
3. Third, in supporting or incentivizing insurance companies through a gain and/or a reduction of cost of capital in case of debts by the EU to invest more in green assets.
4. Fourth, through recommending a set of minimum parameters at EU level that should be monitored with respect to maintaining or changing required climate change strategies, especially in urban areas

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