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### Publication date

2025

### Document Version

Final published version

### Citation (APA)

Esteban, T. A. O. E. (Author), Mehvar, A. (Author), Lucia Bayer, M. F. (Author), Pompoes, R. (Other), Fonseca Cerda, M. (Other), Oerlemans, C. (Other), & Rijcken, T. (Other). (2025). Resilient waterfronts or risky promises? Financial, institutional, and infrastructural challenges in the Dutch Delta. Web publication/site, Redblueclimate.

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## Resilient Waterfronts or Risky Promises? Financial, institutional, and infrastructural challenges in the Dutch Delta



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The Dutch Delta is one of the world's most carefully managed water landscapes, built over centuries of adaptation. However, this system is now under increasing strain as sea levels rise, rainfall intensifies, and subsidence compromises the stability of its built environment. These pressures are especially acute in *unembanked areas*, where exposure to flooding is inherently higher and protective infrastructure is limited. This context underscores the need for adaptation strategies across multiple scales, from building-level interventions to large-scale flood-risk infrastructure and financial instruments capable of distributing risk more fairly. Insurance is becoming more significant in this debate, not only as a means of recovery, but also as a potential incentive for preventive measures.

Given this context, a critical question arises: How can we ensure equitable resilience in unembanked areas when climate risks and responsibilities to manage it are unevenly shared across sectors?

This question was central to the discussions during the 2025 Red&Blue Annual Symposium in Rotterdam, when urban planners, policymakers, financial institutions, area developers, and researchers gathered to explore how climate adaptation is being implemented in the Netherlands. The symposium highlighted the conflicts that occur when duties overlap, goals do not coincide, and actors have varying priorities and capacities in responding to climate risks. Throughout the sessions, participants emphasized that climate resilience is not only a technical issue, but also a communication, social, governance, financial, and political issue.

Drawing from the critical sessions during the symposium, this article highlights where viewpoints intersect, where tensions remain, and what these insights mean for the populations and places most susceptible to climate change.

## **1. Communicating Climate Risk Through Labelling**

One of the symposium's strongest insights was the challenge of communicating climate risk in an accurate, practical, and socially equitable manner. Research on risk communication has emphasized that the manner of communicating risks and the image associated with it influences public understanding and awareness, and policy responses.

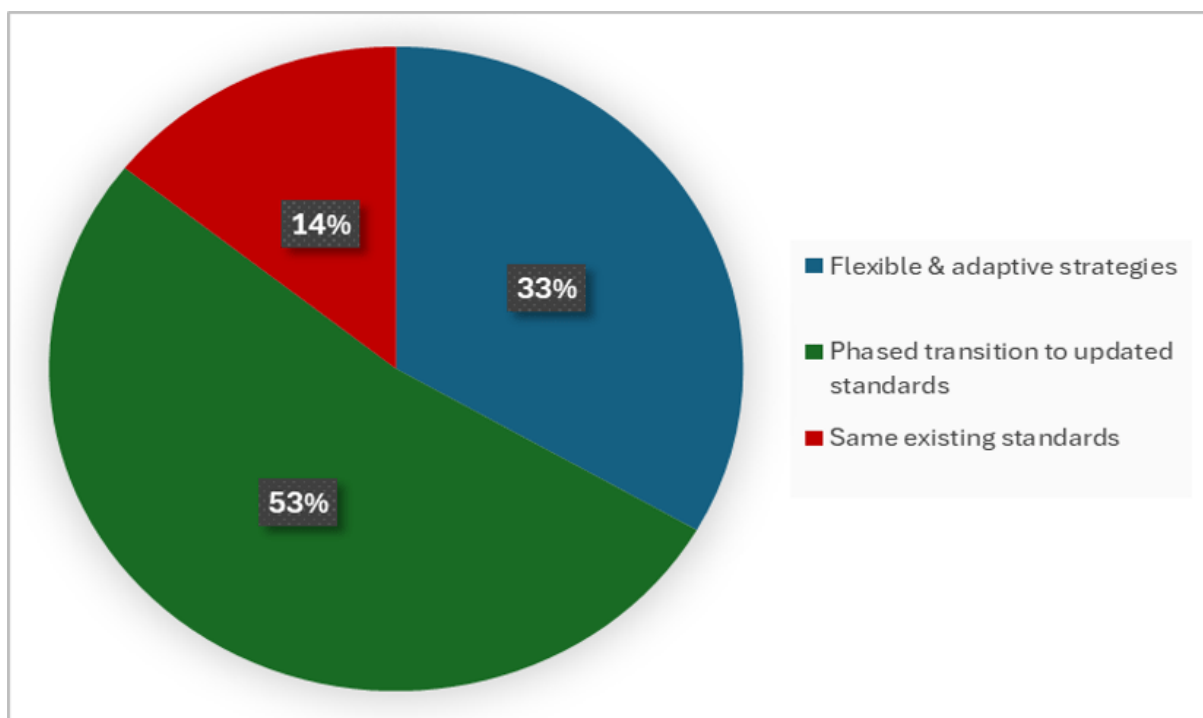
During the session "*Encouraging Climate Change Adaptation Through Climate Risk Labels*", participants debated whether frequent, low-impact flooding ("water nuisance"), and major flood events should be communicated through separate labels or combined into a single classification. While simpler labels may seem helpful, the underlying uncertainties of flood risk make any classification somewhat arbitrary. Classifying risk inevitably requires boundaries which participants highlighted can be easily misunderstood and misinterpreted.

Participants also reflected on findings from the [risk-label project](#) indicating that more information does not always lead to more adaptation. In some cases, risk communication unintentionally reduces willingness to act, especially when the message emphasizes government responsibility or systemic solutions. Labels inevitably send signals about who should act: the homeowner or the government. Participants questioned whether labels should emphasize object-level measures, systemic infrastructure, or both. This tension mirrors broader behavioral economics debates about the "I-frame" (individual responsibility) and the "S-frame" (systemic responsibility). In the context of climate adaptation, this raises a fundamental question: should households take measures themselves (I-frame), or should adaptation be organized at higher spatial scales by institutional actors (S-frame).

The distinction between embanked and unembanked areas also raises practical challenges: while labels and advisory standards aim to clarify risk, legacy vulnerabilities in low-lying zones complicate how responsibility and action are assigned. Unlike

embanked areas, unembanked areas lack legally enforced flood risk standards. At the same time, the municipality of Rotterdam strongly advises that new developments be built at a flood design elevation of 3.8 m+NAP, while 70% of existing buildings fall below this elevation. This dual approach raises a critical question: is it sustainable in the long term, particularly as flood design elevations are expected to increase over time?

In the survey sent to participants after the symposium, responses highlighted three approaches: 53% favored a **phased transition**, where existing buildings gradually meet updated standards rather than imposing immediate uniform requirements (see figure 1). Another 33% of respondents argued **flexible and adaptive strategies specifically for unembanked areas**, recognizing that uniform standards cannot effectively address all circumstances. Only 14% supported applying **the same standards to both existing and new buildings** to prevent large disparities in flood risk. These results suggest that most respondents recognize the unique character of unembanked areas and prefer pragmatic approaches over rigid uniform standards. Rather than imposing uniform requirements that may be technically or financially unfeasible for existing buildings, participants favored solutions that acknowledge historical development patterns while still working toward improved flood resilience over time. How this phased transition may look like in practice, including timelines and adaptation pathways, remains an open question for unembanked urban development.



**Fig. 1** Results of the survey indicating how participants allocate their preferences across the three options for developing adaptation measures and the associated requirements and standards for unembanked areas.

These results emphasize that one-size-fits-all approach may be inadequate, while phased or adaptive strategies require careful coordination and clear signals about who is responsible for action. This leads to a broader question: if clearer communication does not automatically motivate action, then how should governance structures distribute responsibility for adaptation? The symposium's next discussions shifted from risk labels to the deeper institutional debates shaping who is expected to act, who is equipped to act, and who ultimately bears the consequences when action falls short.

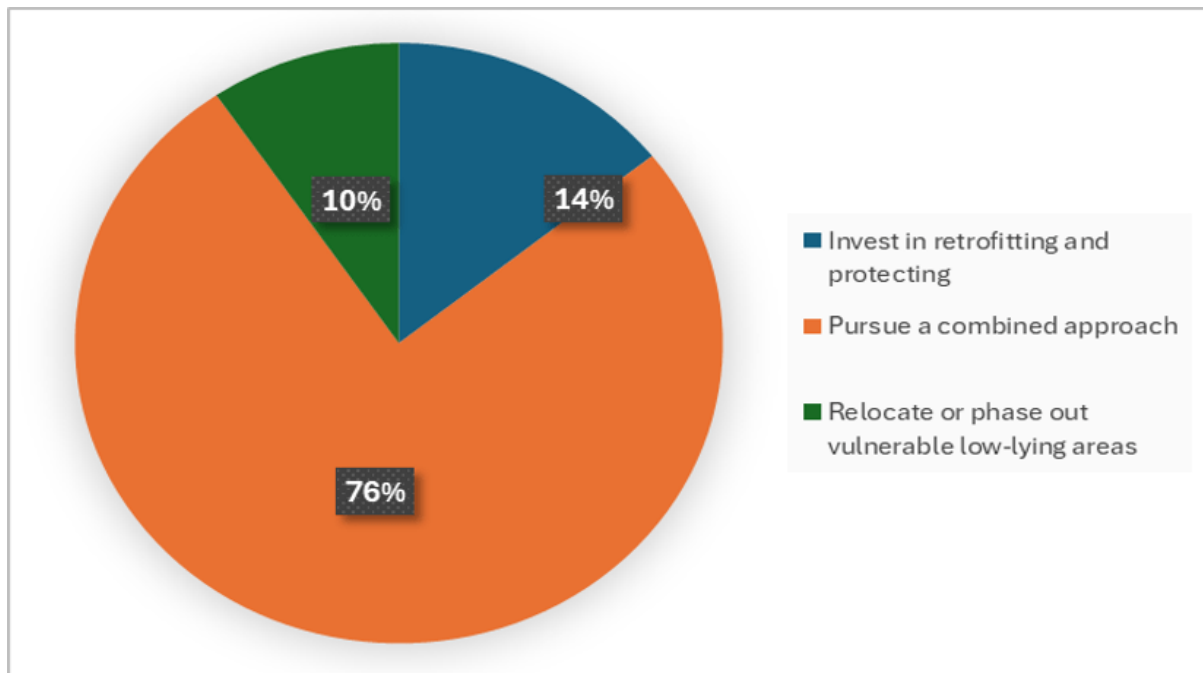
## 2. Don't pass the buck! Or should you?

Few topics revealed the politics of climate adaptation as clearly as "*Water en Woningnood — Niet afwentelen! Of toch wel?*" (*Water and Housing Shortage — Don't pass the buck! Or should you?*). The Netherlands is increasingly confronted with climate risks that spill across neighbourhoods, municipalities, and institutions, yet responsibility remains fragmented. Are the key actors carrying their own share of the burden, or are they passing the buck? Also, are our expectations unrealistic in a delta where risks and capacities are deeply uneven?

These questions came to the forefront of the symposium's most pointed discussions about the governance of climate risk. In principle, *niet afwentelen* (no shifting of burdens) aims to ensure fairness and avoid negative spill-overs. In practice, it exposes a deeper policy dilemma. Mandating local solutions can raise costs, delay construction, or create uneven obligations across municipalities. Shifting responsibility upward risks stretching regional capacities or weakening incentives for local innovation.

The dilemma is especially acute in historically low-lying neighborhoods such as Dordrecht, Delfshaven, and Veerhaven, where older structures sit at vulnerable elevations while new developments can be built higher. This raises a central challenge: *how should adaptation strategies address places where the existing built fabric cannot simply be elevated, yet future construction can?* Post-symposium survey results shown in figure 2 highlight how participants grappled with this tension:

- **10%** supported long-term relocation or phasing out of the most vulnerable zones.
- **0%** favored focusing solely on making new developments climate-resilient.
- **14%** supported investing primarily in retrofitting existing historical buildings and public spaces.
- A clear majority, **76%**, preferred a **combined approach**, reinforcing that resilience must encompass both new and existing areas.



**Fig. 2** Post-symposium survey results illustrating how participants believe adaptation strategies should be addressed in places where the existing built fabric cannot simply be elevated, yet future construction can.

These results reveal a broad recognition that adaptation cannot be solved by simply choosing between prioritizing old or new neighborhoods. Instead, it signals a preference for an approach that distributes responsibility pragmatically, protecting heritage where possible while ensuring future development does not compound existing vulnerabilities.

In many ways, the governance challenge mirrors the communication challenge explored earlier: climate risks rarely fit within neat institutional or physical boundaries. They cut across sectors, policies, and jurisdictions. These tensions become even more visible when the conversation shifts from governance to finance, where banks, insurers, and pension funds operate under different institutionalized logics. How these actors interpret, price, and distribute climate risk shapes not only opportunities for resilience, but also new vulnerabilities. This leads directly to the next theme of the symposium: the financial sector's role in supporting fair and effective climate adaptation.

### **3. How Insurance Exposes the Fault Lines of Climate Resilience**

The earlier discussion highlighted how assigning responsibility for adaptation is rarely straightforward. These complexities surface even more sharply in the insurance sector, where climate risk is expressed through premiums, coverage limits, and questions of insurability. The first round of the session *"Insurance in a Climate-Adaptive Delta"*, focused on insurance and climate adaptation in the Dutch Delta, and highlighted how financial dynamics influence real estate, business resilience, and public decision-making. Insurance not only raises the political issue of who bears the financial burden



when climate-related disasters strike, but it also demonstrates how these risks fundamentally alter financial foundations in real estate, business continuity, and public policy.

A refined approach to estimating flood-related damages to residential buildings was presented by Daan van Ederen (Climate Finance Academy and Vrije Universiteit van Amsterdam), who drew on detailed data from recent floods in Limburg. The research developed refined depth–damage function by closely reflecting actual homeowner experiences. This more accurate function has important implications for financial institutions, insurers, and policymakers, as it can substantially influence their risk assessments and pricing strategies. By improving the precision of damage estimations, the research helps ensure that risk analyses, insurance models, and adaptation policies are based on realistic data rather than outdated assumptions. The study represents a significant step forward in integrating empirical evidence into the financial and insurance frameworks that underpin climate resilience in the Netherlands.

Complimenting this perspective, Michiel Ingels (Climate Finance Academy) explored the growing [challenges of flood insurance for businesses](#). As climate change drives more frequent and severe flood events, insurance markets are grappling with rising premiums and increasing uncertainty about which risks are insurable. Many businesses face a widening gap between the risk they theoretically could insure and the coverage they can practically access, highlighting both financial and behavioral barriers to adaptation. A simulation model presented in the session integrates three interlinked components—risk assessment, premium calculation, and insurance uptake—to capture the interplay between physical exposure, financial pricing, and behavioral decision-making.

Using financial data from 490,000 companies obtained through the Dutch Chamber of Commerce, the model simulates a cost–benefit decision process for each firm. The analysis explores how individual businesses might respond to flood risk by choosing to insure, invest in protective infrastructure, combine both approaches, or take no action at all. Through this lens, the study estimates the expected annual damage for different types of businesses and assesses how economic behavior influences overall flood resilience.

The findings point to a clear discrepancy between the amount of risk that could be insured and the amount that is actually insured in practice. This difference, an “adaptation gap”, reflects both financial and behavioral barriers to widespread insurance uptake. This gap highlights how theoretically insurable risks go unaddressed in practice, as companies may choose not to act due to lack of favorable policies or financial incentives.

Finally, Stefany Moreno Burbano (University of Maastricht), extended the discussion through a comparison with the United States, showing similar pressures are reshaping commercial real estate markets internationally. Insurance costs have surged from

comprising 2.5–3% of expenses in 2000 to as high as 20% in risk-laden areas today. Several factors contribute to this upward trend. Reinsurance markets have become more cautious, transferring higher costs down to primary insurers and policy holders. At the same time, rising construction costs and inflation further amplify premium levels. However, firms with geographically diversified property portfolios tend to experience lower insurance costs, as they can spread risk across regions.

Finally, state-level regulations that cap premium increase, though designed to protect policy holders, can inadvertently reduce market efficiency by discouraging insurers from fully pricing in risk. This regulatory constraint complicates the balance between maintaining affordability and ensuring the long-term viability of insurance markets under intensifying climate pressures.

Overall, the findings highlight the growing vulnerability of commercial real estate to climate-driven financial pressures, calling for new strategies to manage insurability and enhance resilience in the face of escalating climate risks. This brings us to the question: how do residents, developers, insurers, and policymakers navigate these trade-offs in real decision-making? To probe this question in a more experiential way, a serious game was used to simulate the challenges of climate adaptation in the fictional yet highly recognizable municipality of Maasveen.

#### **4. What a Serious Game Teaches Us About Shared Responsibility**

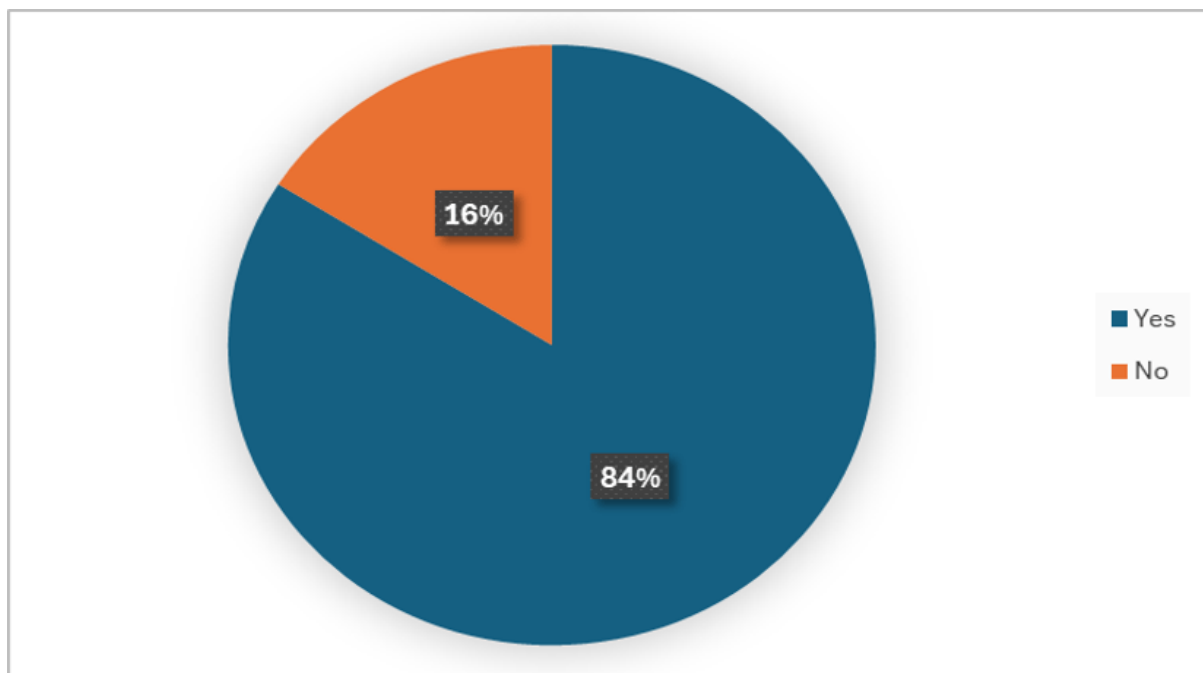
The serious game *“Decision-making on urban rainwater and soil subsidence measures”* made adaptation trade-offs tangible. This interactive and informative session invited participants to step into the shoes of key stakeholders in Maasveen, a fictional Dutch city facing rising threats from rainwater flooding and soil subsidence. Residents, municipal officials, and real estate developers navigated urgent questions: How should rainwater be managed on public and private land? Who is responsible for soil subsidence damage? And are existing legal frameworks the most effective and equitable? While deeply instructive, the game was also designed to be engaging and enjoyable, blending learning with playful, role-based negotiation.

Played twice over the afternoon, the game engaged a wide array of participants, including researchers, civil servants from Rotterdam and Dordrecht, members of the Kenniscentrum Aanpak Funderingsproblematiek (KCAF), and professionals from the real estate sector. By assuming and inhabiting different roles, participants were not only asked to negotiate solutions but to experience the tensions and trade-offs inherent in climate adaptation. Limited urban space forced choices between private interests and collective benefits, while debates over financing highlighted the friction between individual responsibility and shared action.

During the serious game session, participants emphasized that meaningful progress on climate adaptation hinges on collaboration: no single actor should address spatial



constraints, financing dilemmas, or risk managing trade-offs alone. This emphasis on [stakeholder collaboration aligns closely with core principles underlying the Multi-Layer Safety \(MLS\) framework](#), which similarly depends on coordination across public authorities at different levels, private actors, and civil society stakeholders. The importance of collaboration, highlighted throughout the discussions, also surfaced clearly in the post-symposium survey (see figure 3). Broadly, participants expressed strong support for multi-level, collaborative approaches: **84% of participants agreed that the MLS framework is appropriate for managing development in unembanked areas**, while **16% disagreed**. The strong support for a collaborative approach mirrors the multilevel decision making confronted in the game.



**Fig. 3** Post-symposium survey results showing strong support for multi-level, collaborative approaches: 84% of participants agreed that the MLS framework is suitable for managing development in unembanked areas, while 16% disagreed.

The immersive nature of the game allowed participants to encounter the practical consequences of policy decisions, echoing the broader challenges identified in previous sessions on risk labels, housing regulations, and insurance modeling. While the game was playful and engaging, it also underscored the seriousness of managing climate risk in Dutch cities. It showed that resilience is as much about human interaction and governance as it is about engineering or finance.


## 5. Financing Resilience – the Rotterdam Challenge

The serious game offered participants a hands-on experience of how challenging decision-making around rainwater management and soil subsidence can be in Dutch cities. The second round of the “Insurance in a Climate-Adaptive Delta” session focused

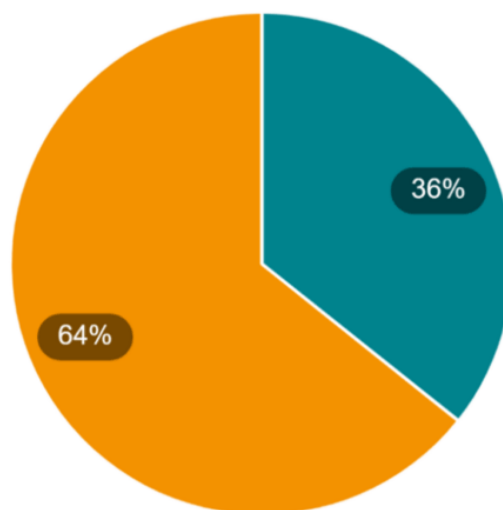
on Rotterdam, where Vera Konings (City of Rotterdam) showed how these challenges are very real, particularly in unembanked areas like Noordereiland and De Esch, where flood exposure is high and adaptation responsibilities are unevenly shared. Here it became evident that there is an urgency to align policy, investment, and governance.

The city navigates these complexities through a combination of crisis management, risk communication, and support for adaptive building practices. For neighborhoods outside the dike system, residents are informed that they live at their own risk yet this must be communicated carefully to avoid unintended consequences on property values or mortgage eligibility. New urban developments such as Rijnhaven and M4H are already incorporating adaptive measures, including elevated building platforms and levees, but climate inequality remains a pressing concern: many residents in high-risk areas lack the financial means to implement protective measures or access affordable insurance.

To deepen our understanding of public attitudes toward these challenges, a poll during the symposium plenary session was presented. When asked whether **residential development in unembanked areas should exclude social housing, a clear majority (64%) responded no**, emphasizing that vulnerable populations should not be excluded from these high-risk zones despite the inherent risks (see figure 4). This reflects a strong commitment to social inclusion in climate adaptation strategies.

 Residential development in unembanked areas should no longer include social housing.

 42



 YES

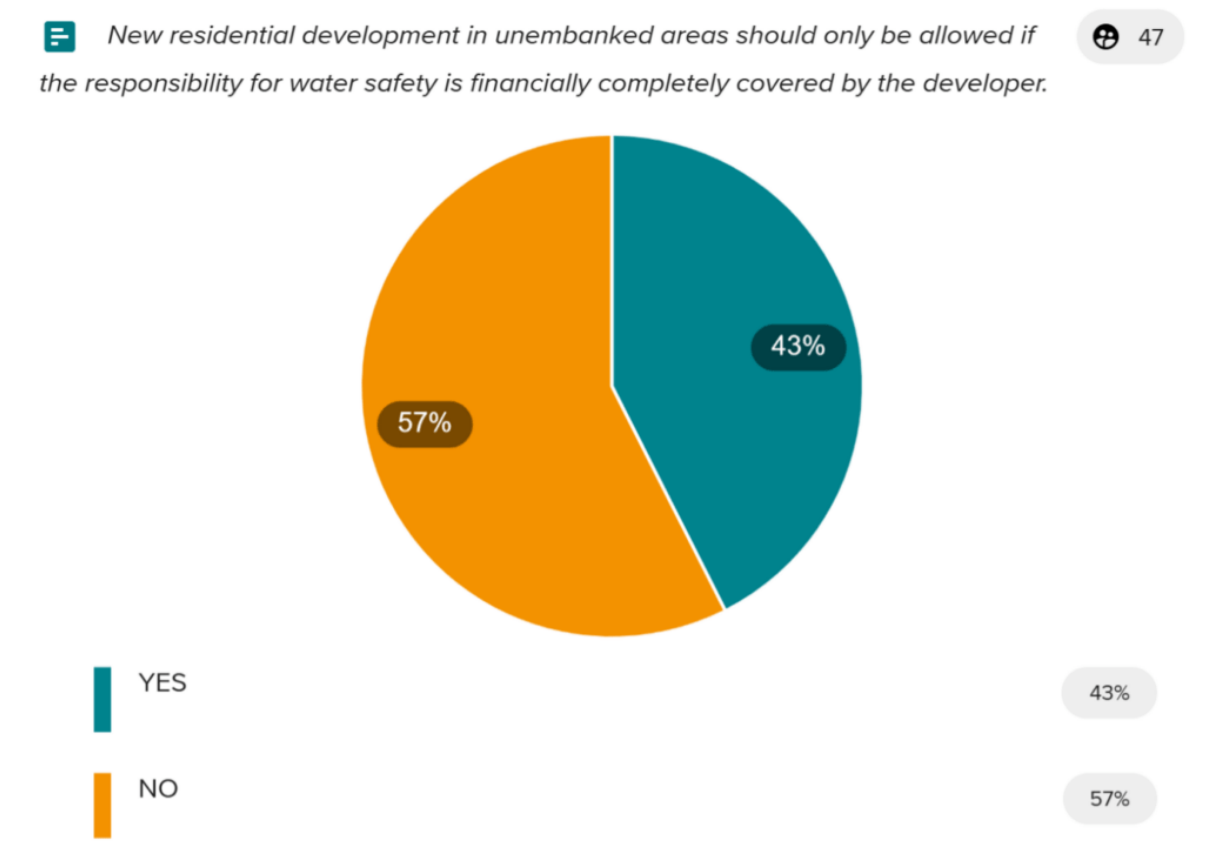
 NO

36%

64%

**Fig. 4** Symposium survey results highlighting whether or not residential development in unembanked areas should exclude social housing.

Similarly, participants were asked if **new developments should be permitted only if developers assume full financial responsibility for water safety**. As shown in figure 5, **57% opposed** placing the entire financial burden on developers, signaling skepticism toward this approach and underscoring the need for collaborative, multi-actor solutions that balance social equity with fiscal accountability.



**Fig. 5** Symposium survey results illustrating how participants believe whether or not water safety responsibility should be fully covered by developers.

These poll results illustrate the tension between ensuring equitable housing and distributing financial accountability fairly. They reinforce the need for balanced policies that neither exclude disadvantaged communities nor overburden single stakeholders, highlighting the importance of collaborative, multi-actor solutions in urban climate adaptation. Bridging social and financial responsibility concerns with practical mechanisms highlights the pivotal role that insurance plays in enabling effective and equitable climate adaptation.

Additionally, Vylom Ooms (Association of Insurers), illustrated how insurance plays a critical role in shaping adaptation. It can drive rebuilding, incentivize resilient construction, and provide essential risk information. Yet in unembanked areas, many

properties remain uninsurable due to extreme exposure, raising difficult questions about fairness and risk pooling. Efforts are underway to extend limited coverage to elevated zones, but navigating the tension between market viability and equity remains challenging. Premium discounts for homeowners who implement adaptive measures suggest a growing interest in leveraging financial incentives to encourage resilience, while tools like the EVO map help visualize flood probabilities to inform planning and investment.

The session emphasized financing climate resilience in Rotterdam requires an integrated approach linking urban planning, public investment, and insurance. Just as the serious game illustrated trade-offs between collective benefits and private responsibilities, real-world decisions involve balancing immediate costs, long-term benefits, and social equity. Insurance, when designed thoughtfully, can move beyond being a reactive mechanism to become a proactive tool for adaptation—stimulating protective actions and investments in both new and existing building stock.

## 6. Reflections

The discussions at the Red&Blue Annual Symposium provided an opportunity for the consortium to co-examine urban waterfront development and its implications for broader climate adaptation strategies. They underscore the critical role urban planning plays in shaping resilient waterfront projects through effective adaptation approaches within the spatial development processes.

These themes were echoed in the session about *"Institutionalized Logics for Climate Adaptation"*, where an AI-supported analysis of financial-sector climate-risk reporting revealed important insights into institutional barriers, opportunities, values, priorities, and lines of reasoning guiding climate-risk action. The discussions highlighted the challenges involved in producing disclosures that must simultaneously serve regulatory compliance, investor relations, reputation management, and issue advocacy. This raises a fundamental question about the extent to which such disclosures reflect genuine institutional intent and how messaging is tailored to diverse audiences.

A recurring challenge raised throughout the symposium is the question of shared responsibility. This has also been explored in the Dutch finance sector. Although banks, insurers, and pension funds increasingly frame climate adaptation as a collective effort involving government, private actors, and citizens, practical communication and coordination across these groups remain limited. **When responsibilities are unclear or not effectively communicated, roles become ambiguous and coordination falters.** Strengthening cross-sector communication is therefore essential to bridge these gaps.

One of the key messages is that adaptation in unbanked areas must explicitly address risks of inequality and exclusion. The open-ended question on social justice in the post-

symposium survey highlighted a consistent concern: **adaptation in unembanked areas risks deepening social inequality if policy does not explicitly address uneven capacities among residents.**

Participants pointed out that lower-income communities are more likely to live in high-risk areas yet have the least resources to retrofit homes, elevate structures, or recover from damage. Others warned that climate-resilient new developments may become unaffordable for existing residents, accelerating **gentrification, redlining, and displacement**. Several responses emphasized **unequal exposure to flood risk, gaps in insurability**, and the danger that adaptation costs fall disproportionately on households rather than institutions.

Participants also noted that [risk comprehension itself is uneven](#): new residents may not fully understand the implications of living outside the dike ring, and insufficient communication by municipalities may inadvertently heighten vulnerability.

Across the responses, one strong recommendation emerged: **responsibilities must be shared**, not shifted. Many called for dual approaches combining ambitious safety standards for new developments with targeted support both financial and technical for existing buildings that currently fall below flood-design elevations.

Together, these insights emphasize that climate adaptation must embed **equity and social justice directly into planning and investment frameworks**. To be able to do this will largely depend on how institutions interpret and operationalize key concepts like stewardship, sustainability, and ecological resilience. For example, in the financial sector, pension funds frame stewardship as long-term investor influence; banks emphasize shared governance; and insurers focus more on insurability and prevention. These variations may reflect genuine differences in institutional practice or simply divergent reporting languages shaped by regulatory requirements, including those related to biodiversity and nature. The result indicates a gap between what institutions communicate publicly and what shapes internal decision-making.

To address concerns that climate adaptation efforts in unembanked areas may contribute to gentrification and exacerbate social inequality, the final survey question offered clear guidance, there should be a clear prioritization of inclusive and socially equitable approaches. The most strongly supported recommendation (by a significant margin) is [to regulate and guide adaptation projects to include strong anti-displacement and social equity measures from the outset](#). This reflects a widespread recognition that without deliberate safeguards, adaptation investments risk excluding disadvantaged communities.

Following this, there is considerable support for shifting focus to community-led adaptation, [empowering local residents to actively shape the planning processes](#) and

outcomes of resilience initiatives. This approach promotes local agency and responsiveness to community needs, potentially mitigating negative social impacts.

Other responses indicate a more pragmatic acceptance that some level of gentrification may be an unavoidable consequence of resilience upgrades, though these views are less widely held. There is also support for treating **climate adaptation and housing justice as interconnected but distinct issues**, with the suggestion that broader social policies must complement climate planning to fully address inequality. Finally, a notable portion of participants recommend pausing or limiting adaptation investments in disadvantaged areas until inclusive strategies and safeguards are fully developed, underscoring the urgency of addressing social justice proactively.

These ranked perspectives suggest the need for a multi-faceted strategy that combines strong regulatory frameworks, community empowerment, and social equity considerations, ensuring that climate adaptation efforts in unembanked areas do not inadvertently exacerbate inequality or displace residents. Dutch financial institutions, in particular, appear to be taking a more climate-forward stance than counterparts in some other countries, showing a growing willingness to accept lower short-term returns in favor of long-term climate resilience. This ESG-driven trade-off highlights opportunities for comparative research across national and sectoral contexts.

At the same time, awareness and disclosure gaps persist. Many institutions do not explicitly recognize climate change as a potential disruption to core business models, and verifying internal priorities beyond official reports remains challenging, as internal policies, risk perceptions, and past experiences all shape public communication.

Understanding how institutionalized logics shape risk perception, responsibility, and decision-making is key to building an equitable and resilient Dutch delta. Resilience depends not just on technical solutions, but on clear communication, shared responsibility, and adaptive institutional practices that evolve alongside scientific knowledge. Without alignment across municipalities, financial institutions, developers, and residents, coordination falters and inequities persist. Ensuring that risks and responsibilities are fairly distributed will determine whether the Netherlands advances toward collective climate resilience.