"Making Room" for change: Community sentiment for natural flood management (NFM) in coastal catchments of New South Wales (NSW), Australia

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Key points

- Global NFM discourse is largely positive to neutral and concentrated in established "hot spots" (e.g., UK, EU), with emerging shifts toward hybrid approaches combining nature-based solutions with traditional flood mitigation techniques.
- Mixed-methods analysis (content mapping and sentiment analysis) reveals evolving conceptual clusters and trends in the global NFM literature.
- Community surveys in NSW coastal catchments show generally positive attitudes towards NFM, influenced by prior flood experience and levels of participation in catchment management.
- Academic knowledge and community sentiment are strongly place-dependent, shaped by local flood risk perceptions and participatory dynamics.
- Integrating community insights with scholarly discourse is critical for developing adaptive, socially acceptable flood management strategies in changing environments.

Abstract

Contemporary flood management increasingly demands adaptive frameworks capable of responding to accelerating environmental and social change. This paper examines evolving global and local discourses surrounding Natural Flood Management (NFM). It employs a mixed-methods approach that integrates content and sentiment analysis with empirical community insights. A global literature review analysed via Leximancer identified core, emerging, and novel conceptual clusters. Sentiment towards NFM varied across regions, yet was predominantly positive to neutral, with the majority of discourse originating from established NFM "hot spots", such as the United Kingdom (UK) and the European Union (EU). Findings indicate a discernible shift in the literature toward "hybrid" paradigms that integrate nature-based measures with more traditional approaches to flood mitigation.

To contextualise the global narrative and to "ground-truth" scholarly discourse, community surveys were undertaken in coastal catchments across New South Wales (NSW), Australia. Results demonstrated generally positive sentiment towards NFM, moderated by prior flood experience and the degree of community participation in catchment management. This analysis reveals that both knowledge production and public sentiment towards NFM are inherently place-dependent, shaped by local risk perceptions and participatory dynamics. The study underscores the significance of qualifying academic knowledge bases with community, "on-the-ground" contexts to foster adaptive and socially resilient approaches to flood management: an essential strategy for living and evolving with changes in NSW.

Keywords

Natural flood management, nature-based solutions, adaptive management, risk perception, stakeholder engagement, sentiment analysis, social-ecological systems, place-based knowledge

Introduction

Flood risk is intensifying as the combined pressures of climate change, land development, and socio-environmental transformation reshape ecosystems and increase the frequency of flood events

(Kundzewicz et al., 2014; Hirabayashi et al., 2013). In response, flood management paradigms are shifting away from traditional, infrastructure-dominated engineering approaches toward more adaptive, integrated, and nature-based strategies (Brown et al., 2015; Sayers et al., 2013). Nature-based approaches to flood management, called Natural Flood Management (NFM), work with catchment and river processes to store, slow, and filter water, have emerged as an integral component of this transition and are increasingly promoted within both policy and scientific discourse as a sustainable alternative (Dadson et al., 2017; Lane, 2017; Fryirs, 2026).

Despite growing global momentum, the effectiveness of NFM cannot be determined solely by its biophysical performance, but also by its social acceptability and alignment with local values and lived experiences (Buijs, 2009; Cook et al., 2016a; Waylen et al., 2018). There is increasing recognition that community perceptions, place-based knowledge, and lived experience play a critical role in shaping the uptake and long-term success of flood mitigation interventions (Adger et al., 2009; Lane et al., 2011; Thaler & Levin-Keitel, 2016). This paper seeks to connect global NFM discourse with the lived experiences of communities in coastal catchments of NSW, where exposure to flooding intersects with diverse social, cultural, and environmental contexts (Alexander et al., 2016; Head et al., 2019; Parsons et al., 2021). By examining relevant content and community sentiment, this study demonstrates that effective and enduring flood management must integrate scientific knowledge with lived experience, ensuring that strategies are not only technically robust, but also socially legitimate and contextually grounded (Raymond et al., 2017; Wyborn et al., 2019; Mach et al., 2020). In this study sentiment is defined as “a view or opinion that is held or expressed”. For the global literature review, this is sentiment expressed through the writing of the paper/report. For the community survey, this is the sentiment of the people who completed the survey.

What is Natural Flood Management (NFM)?

Natural Flood Management (NFM) refers to interventions that work with natural catchment processes to reduce flood risk by slowing flows and attenuating them downstream (Lane, 2017; Ellis et al., 2021; Zhu et al., 2024; Fryirs, 2026). NFM measures that have been implemented with varying levels of success include wetland restoration, riparian revegetation, floodplain reconnection, and small-scale structures that retain or delay runoff, thereby reducing peak flows and improving system resilience (Zhu et al., 2024; Ellis et al., 2021). Using nature-based solutions can diversify adaptive capacity, reduce risk, and deliver co-benefits including biodiversity and amenity (Dijkstra et al., 2020; Zhu et al., 2024; Chen et al., 2021). NFM also reframes flood management as a shared, place-based challenge, supporting greater community engagement and acceptance (Dufty, 2021; Chen et al., 2021).

NFM contrasts with conventional “grey” infrastructure (e.g., levees, floodwalls, embankments, channel modifications) that are designed to control or rapidly convey floodwaters away from assets (Chen et al., 2021; Zhu et al., 2024). While these may be effective in the short term, these approaches can transfer risk downstream, degrade ecosystems, and involve high construction and maintenance costs (Chen et al., 2021; Zhu et al., 2024). In response, there is increasing interest in hybrid “green-grey” approaches that combine nature-based solutions with more traditional methods (Dufty, 2021; Chen et al., 2021).

In coastal catchments of NSW, where climate change is intensifying rainfall and flooding, NFM is being considered as a complementary approach that aligns flood risk management with broader environmental and climate adaptation goals (Fryirs et al., 2023).

Global trends in NFM research

Global research on NFM has expanded significantly over the past decade, reflecting academic and policy interest in nature-based approaches to flood risk mitigation (Dadson et al., 2017; Lane, 2017; Thaler et al., 2019). To identify overarching patterns within this growing body of research, a structured literature review was conducted using Leximancer, a text analytics tool that maps relationships between frequently co-occurring concepts across large datasets (Smith & Humphreys, 2006; Angus et al., 2013; Crofts & Bisman, 2010). This approach enables the identification of dominant themes and

conceptual linkages in a systematic and reproducible manner, providing a high-level synthesis of research trends (Randhawa et al., 2016; Sotiriadou et al., 2014).

The results from this analysis highlight a strong geographic concentration of NFM research within the UK and the EU, where extensive policy support and pilot initiatives have driven both applied and theoretical advancements (Figure 1). These regions function as global "hot spots," contributing significantly and disproportionately to the empirical evidence base and shaping dominant narratives around NFM implementation and effectiveness.

Across the literature, core thematic areas consistently emerge in terms of flood risk management: reduction, governance, and adaptation. (Figure 1). Governance considerations, including stakeholder engagement, cross-sectoral cooperation and coordination, and institutional capacity, also feature prominently, reflecting the socio-political complexity of implementing NFM across diverse landscapes.

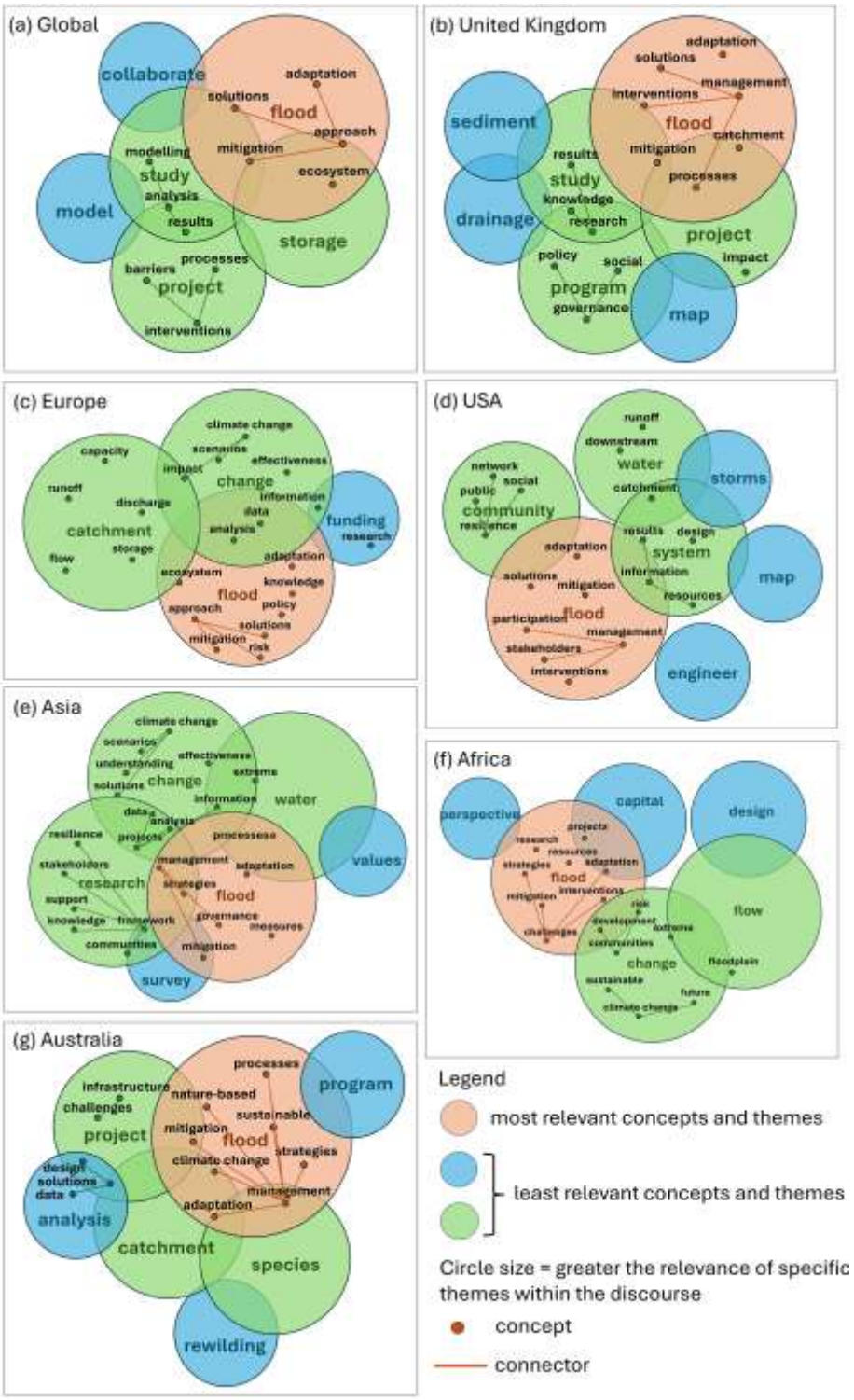

Figure 1 Concept mapping results from region-based analysis of global NFM literature

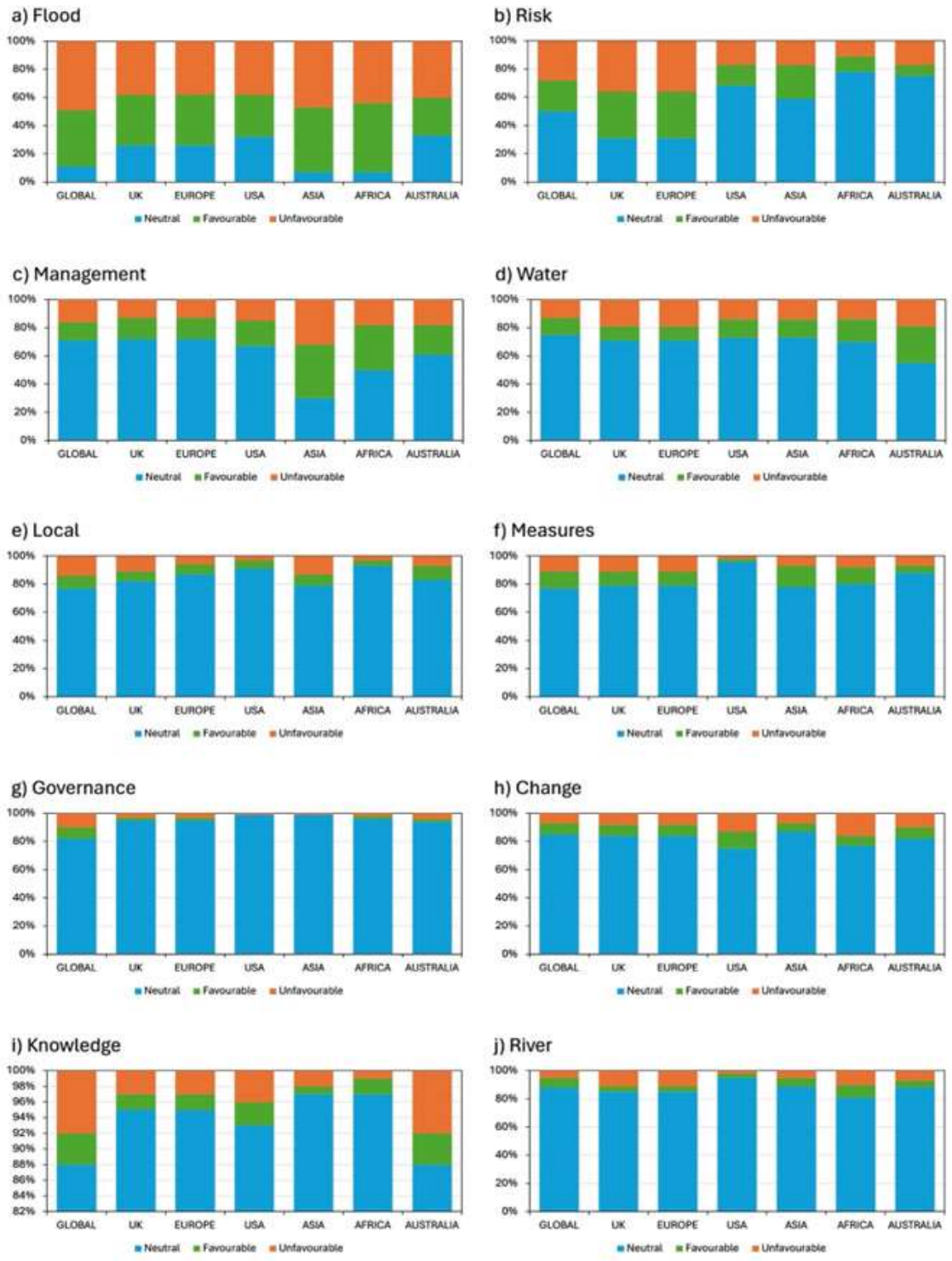

Figure 2 Sentiment analysis results from region-based analysis of global NFM literature

In terms of sentiment in the literature, this is generally characterised by a positive to neutral orientation, with many studies highlighting the multiple benefits of NFM alongside ongoing uncertainties related to performance, scalability, and long-term maintenance. However, sentiment varies across regions, often influenced by differences in policy frameworks, institutional support, and levels of community acceptance (**Figure 2**). This variability underscores the importance of contextual factors in shaping both the perception and implementation of NFM, reinforcing the need for place-based research, such as that undertaken in coastal catchments of NSW.

A notable trend identified is a shift toward hybrid flood management models that integrate nature-based and traditional approaches. Rather than positioning NFM as a replacement for conventional infrastructure, recent studies increasingly emphasise complementary strategies that enhance overall system adaptability and community resilience under changing climatic conditions. This shift reflects a more pragmatic orientation within the literature, acknowledging both the potential and limitations of NFM when implemented in isolation.

Why place matters: Limits of global knowledge

While the global evidence base on NFM has expanded, it remains geographically concentrated, with a strong emphasis on case studies from the aforementioned "hot spots" (Short et al., 2019; Wilkinson et al., 2019; Lane et al., 2011). This concentration has shaped dominant understandings of NFM effectiveness, governance, and implementation pathways, often reflecting the specific hydrological regimes, land use practices, and institutional arrangements characteristic of these regions (Dadson et al., 2017; Hartmann et al., 2019; Thaler et al., 2019). As a result, the global knowledge base is highly uneven and inherently conditioned by place-specific empirical and policy contexts (Lane, 2017; Anderson & Spratt, 2021; Waylen et al., 2018).

This uneven distribution raises significant challenges for the transferability of NFM knowledge to other settings, particularly in Australia (Thaler et al., 2020; Anderson et al., 2022; Hartmann et al., 2019). Coastal catchments in NSW differ markedly from Northern Hemisphere contexts in terms of hydroclimatic variability, flood regimes, soil characteristics, and ecological systems (Acreman & Holden, 2013; Thorslund et al., 2017; Pattison et al., 2014). Australia's distinct land tenure systems, governance structures, and policy frameworks shape how flood management strategies are interpreted, implemented, and integrated in practice (Cook et al., 2016b; Waylen et al., 2018; Thaler et al., 2019). Consequently, approaches that have demonstrated effectiveness in the UK or the EU may not translate and will require significant adaptation to align with local environmental and socio-political conditions (Lane et al., 2011; Burgess-Gamble et al., 2018; Anderson et al., 2022).

These limitations highlight the critical importance of place-based research that foregrounds local environmental, social, and governance dynamics (Waylen et al., 2018; Thaler et al., 2019; Hartmann et al., 2019). NFM is not solely a technical intervention, but a socio-ecological approach that depends on stakeholder engagement, institutional coordination, and community alignment (Cook et al., 2016a; Cohen-Shacham et al., 2016; Anderson & Spratt, 2021). Understanding how NFM is perceived, supported, or contested at the community level is therefore essential, particularly in regions such as coastal NSW where flood risk is intensifying and policy interest in nature-based solutions is increasing (Thaler et al., 2020; Lane et al., 2011; Anderson et al., 2022). By situating NFM within its local context, this study addresses a primary gap in understanding of how places and experiences shape both the opportunities and constraints associated with implementing NFM in practice (Waylen et al., 2018; Thaler et al., 2019).

NSW case studies: Community perspectives

This study presents preliminary findings from community-based case studies in coastal catchments of NSW, highlighting resident attitudes towards NFM and the conditions under which support emerges (Morris & Tippett, 2024). This research draws on data from community surveys conducted across the following flood-prone coastal sub-catchments in NSW: the Hunter Region, North Coast, and South Coast, including residents and local interest groups within these catchments (e.g., coastal hinterland towns, river-adjacent suburbs). We recognise that there may be inherent biases in the responses given the people who were attracted to and completed the survey. However, we believe the patterns in the data are real. These surveys used mixed-methods designs, combining Likert-scale items on NFM support, perceived effectiveness, and trust in managers with short open-ended questions on experiential and place-based concerns, thus enabling both quantitative trend analysis and qualitative narrative interpretation.

Overall community attitudes towards NFM

Survey results indicate broadly positive attitudes toward NFM among coastal catchment residents, with a majority agreeing that nature-based approaches (e.g., riparian restoration, floodplain reconnection, catchment-scale vegetation management) should form part of future flood risk management strategies. Support is particularly strong where NFM is framed as complementary to, rather than a replacement for, traditional measures, and where residents perceive clear co-benefits, such as improved river health, biodiversity enhancement, and recreational expansion. Nevertheless, a minority of respondents express scepticism about the protective capacity of NFM alone, reflecting ongoing preferences for traditional and engineered solutions where historical flood losses have been severe.

Influence of prior flood experience

Prior flood experience emerges as one of the strongest predictors of community sentiment toward NFM. Respondents who reported direct exposure to the catastrophic floods of 2021-2022 tend to express more nuanced and cautious support, weighing NFM's potential against the perceived efficacy of traditional infrastructure. Those with repeated flood histories often emphasise the need for "stronger" flood protection. Yet they also recognise the value of NFM in slowing flood waves and enhancing river resilience, provided that safeguards for housing and critical infrastructure are maintained. In contrast, residents with limited or no direct flood experience display higher baseline optimism about NFM and are more likely to endorse catchment-scale interventions that prioritise river recovery over immediate structural protection.

Role of community engagement in decision-making

Support for NFM is significantly higher in communities that have been actively engaged in local flood risk planning and decision-making processes. Where councils and catchment management authorities have facilitated participatory workshops, co-design of NFM pilot sites, and transparent communication about the conundrums of NFM (Fryirs, 2026), respondents report greater trust and interest in the legitimacy of NFM proposals and a sense of shared ownership over adaptation pathways. Conversely, in areas where residents perceive planning as technocratic or "top-down," support for NFM is more conditional and often linked to demands for stronger guarantees of property-level protection and explicit inclusion of community voice in monitoring programs. These patterns reinforce broader literature on "self-activating" communities, which shows that participation in decision-making increases disaster preparedness, perceived control, and willingness to accept nature-based strategies in flood risk management (Morris & Tippett, 2024; Wells et al., 2020).

Integrating global insights with local practice

The integration of global insights with local practice is central to translating NFM research into effective, place-specific action in coastal catchments of NSW (Ellis et al., 2021; Zhu et al., 2024; Bouw et al., 2023). Academic findings on NFM's effectiveness, co-benefits, and governance mechanisms must be "ground-truthed" against the biophysical conditions, land-use patterns, and social dynamics of particular catchments to ensure that interventions are realistic, contextually appropriate, and politically feasible (Ellis et al., 2021; Zhu et al., 2024; Fryirs, 2026).

Scientific models of flood risk and environmental benefit must be aligned with local community knowledge and values to build legitimacy and support (Ellis et al., 2021; Bouw et al., 2023). Communities often possess contextual, place-based understandings of flood behaviour, historical flood events, and land-use changes that can refine or challenge modelled scenarios and help identify where NFM measures are most acceptable and socially meaningful (Bouw et al., 2023; Chen et al., 2021; Dufty, 2021). When technical assessments are transparently nested within these lived experiences, managers can better reconcile mitigation goals with community priorities around amenity, safety, and environmental stewardship (Dijkstra et al., 2020; Bouw et al., 2023).

For practitioners, this integration demands concrete, practical strategies rooted in participatory and adaptive approaches (Dijkstra et al., 2020; Zhu et al., 2024; Ellis et al., 2021). Co-design processes, bringing together scientists, engineers, local governments, landowners, and community representatives to jointly define problems and select NFM interventions, have been shown to increase ownership, improve implementation feasibility, and strengthen long-term maintenance (Dijkstra et al., 2020; Zhu et al., 2024). Equally important is the deliberate integration of local knowledge into planning, including oral histories, local observations, First Nations and Indigenous knowledge, and traditional ecological knowledge (TEK), which can inform siting, design, and monitoring of NFM interventions (Dufty, 2021; Ellis et al., 2021; Zhu et al., 2024). Adopting adaptive, iterative planning cycles, where NFM projects are monitored, evaluated, and modified in response to new data and community feedback, ensures that global insights are continually recalibrated to local realities, allowing both scientific understanding and community sentiment to evolve together over time (Dijkstra et al., 2020; Zhu et al., 2024).

Conclusion

This paper has demonstrated that implementing NFM is not solely a technical challenge, but a fundamentally social one, shaped by community values, local knowledge, and perceptions of risk and responsibility. Efforts to implement NFM must therefore engage with the social dynamics that influence public acceptance, trust, and participation in risk management and governance.

The findings highlight hybrid, place-based approaches as a pragmatic pathway forward, integrating scientific expertise with situated, community-based knowledge to better reflect the complexity of coastal catchments in NSW. Such approaches enable more context-sensitive and adaptive flood management strategies while fostering local ownership and long-term engagement with NFM initiatives.

The findings from this study suggest that building flood resilience in NSW requires sustained collaboration between science, policy, and community members, supported by governance frameworks that value co-production and “on-the-ground” knowledge (i.e., lived experience). Creating space, both materially within landscapes and institutionally within decision-making processes, for diverse forms of knowledge and participation will be essential to enabling adaptive, inclusive, and effective responses to future flood risk.

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References

Acreman, M. C., & Holden, J. (2013). How wetlands affect floods. *Wetlands*, 33(5), 773–786.

Adger, W. N., Lorenzoni, I., & O’Brien, K. L. (2009). *Adapting to climate change: Thresholds, values, governance*. Cambridge University Press.

Alexander, M., Priest, S., & Mees, H. (2016). A framework for evaluating flood risk governance. *Environmental Science & Policy*, 64, 38–47.

Anderson, C. C., & Spratt, P. (2021). Natural flood management and adaptive governance: Lessons from Europe. *Environmental Science & Policy*, 120, 1–10.

Anderson, C. C., Renaud, F. G., & Sudmeier-Rieux, K. (2022). Integrating nature-based solutions and grey infrastructure for flood risk management. *Sustainability*, 14(3), 1456.

Angus, D., Rintel, S., & Wiles, J. (2013). Making sense of big text: A visual-first approach for analysing

text data using Leximancer and Discursis. *International Journal of Social Research Methodology*, 16(3), 261–267.
Brown, R. R., Keath, N., & Wong, T. H. F. (2015). Urban water management in cities: Historical, current and future regimes. *Water Science and Technology*, 59(5), 847–855.
Buijs, A. E. (2009). Public support for river restoration: A mixed-method study into the relationship between support and framing. *Journal of Environmental Management*, 90(8), 2680–2689.
Bouw, L., Van der Veen, A., & Leroy, P. (2023). Investigating the public perception of green, hybrid and grey flood protection measures. *Journal of Flood Risk Management*, 16(2), e12876.
Burgess-Gamble, L., Ngai, R., Wilkinson, M. E., Nisbet, T. R., & Addison, P. (2018). *Working with natural processes – Evidence directory*. Environment Agency.
Chen, W., Wang, W., Huang, G., Wang, Z., Lai, C., & Yang, Z. (2021). The capacity of grey infrastructure in urban flood management: A comprehensive analysis of grey infrastructure and the green-grey approach. *International Journal of Disaster Risk Reduction*, 54, 102045.
Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). Nature-based solutions to address global societal challenges. *International Union for Conservation of Nature*, 97(2016), 2036.
Cook, B. R., Hall, S. J., & Larson, K. L. (2016). Residential landscapes as social-ecological systems: A synthesis of multi-scalar interactions between people and their home environment. *Urban Ecosystems*, 19, 1687–1703.
Cook, B. R., Spray, C. J., & McEwen, L. J. (2016). The uncomfortable truth? Public engagement in natural flood management. *Journal of Flood Risk Management*, 9(1), 3–12.
Crofts, K., & Bisman, J. (2010). Interrogating accountability: An illustration of the use of Leximancer software for qualitative data analysis. *Qualitative Research in Accounting & Management*, 7(2), 180–207.
Dadson, S. J., Hall, J. W., Murgatroyd, A., Acreman, M., Bates, P., Beven, K., ... & Wilby, R. (2017). A restatement of the natural science evidence concerning catchment-based 'natural' flood management in the UK. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 473(2199).
Dijkstra, J., Van der Meulen, J., & Bouw, L. (2020). Integrating blue-green and grey infrastructure through an adaptation pathways approach to surface water flooding. *Environmental Science & Policy*, 107, 111–121.
Dufty, N. (2021). Understanding and improving community flood preparedness and response: A research framework. *Australian Journal of Emergency Management*, 36(2), 19-25.
Ellis, N., Anderson, K., & Brazier, R. (2021). Mainstreaming natural flood management: A proposed research framework derived from a critical evaluation of current knowledge. *Progress in Physical Geography*, 45(6), 797–821.
Fryirs, K. (2026). Making sense of nature-based flood mitigation: A levers framework for conceptualising and communicating Natural Flood Management (NFM). *BioScience*.
Fryirs, K., Zhang, N., Ralph, T.J. and Arash, A.M., 2023. Natural flood management: Lessons and opportunities from the catastrophic 2021–2022 floods in eastern Australia. *Earth Surface Processes and Landforms*, *48*(9), pp.1649-1664.
Fryirs, K.. (2026). Making sense of nature-based flood mitigation: A levers framework for conceptualising and communicating Natural Flood Management (NFM). *BioScience*.
Hartmann, T., Slavíková, L., & McCarthy, S. (2019). *Nature-based flood risk management on private land: Disciplinary perspectives on a multi-functional land use*. Edward Elgar.
Head, L., Adams, M., McGregor, H. V., & Toole, S. (2019). Climate change and Australia. *Wiley Interdisciplinary Reviews: Climate Change*, 5(2), 175–197.
Hirabayashi, Y., Mahendran, R., Koirala, S., Konoshima, L., Yamazaki, D., Watanabe, S., Kim, H., & Kanae, S. (2013). Global flood risk under climate change. *Nature Climate Change*, 3(9), 816–821.
Kundzewicz, Z. W., Kanae, S., Seneviratne, S. I., Handmer, J., Nicholls, N., Peduzzi, P., ... & Sherstyukov, B. (2014). Flood risk and climate change: global and regional perspectives. *Hydrological Sciences Journal*, 59(1), 1-28.

Lane, S. N. (2017). Natural flood management. *Wiley Interdisciplinary Reviews: Water*, 4(3), e1211.
Lane, S. N., Odoni, N., Landström, C., Whatmore, S. J., Ward, N., & Bradley, S. (2011). Doing flood risk science differently: An experiment in radical scientific method. *Transactions of the Institute of British Geographers*, 36(1), 15–36.
Mach, K. J., Kraan, C. M., Adger, W. N., Buhaug, H., Burke, M., Fearon, J. D., ... & von Uexkull, N. (2019). Climate as a risk factor for armed conflict. *Nature*, 571(7764), 193-197.
Morris, S. A., & Tippett, J. (2024). Perceptions and practice in Natural Flood Management: unpacking differences in community and practitioner perspectives. *Journal of Environmental Planning and Management*, 67(11), 2528-2552.
Parsons, M., Nalau, J., & Fisher, K. (2021). Alternative approaches to co-design in climate adaptation research in Australia. *Climatic Change*, 168, 1–19.
Pattison, I., Lane, S. N., Hardy, R. J., & Reaney, S. M. (2014). The role of tributary relative timing and sequencing in controlling large floods. *Water Resources Research*, 50(7), 5444–5462.
Randhawa, K., Wilden, R., & Hohberger, J. (2016). A bibliometric review of open innovation. *Journal of Product Innovation Management*, 33(6), 750–772.
Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Calfapietra, C., & others. (2017). A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science & Policy*, 77, 15–24.
Sayers, P., Yuanyuan, L., Galloway, G., Penning-Rowsell, E., Fuxin, S., Kang, W., ... & Le Quesne, T. (2013). *Flood risk management: A strategic approach*.
Short, C., Clarke, L., Carnelli, F., Uttley, C., & Smith, B. (2019). Capturing the multiple benefits associated with nature-based solutions. *Journal of Flood Risk Management*, 12(S2), e12432.
Smith, A. E., & Humphreys, M. S. (2006). Evaluation of unsupervised semantic mapping of natural language with Leximancer concept mapping. *Behavior Research Methods*, 38(2), 262–279.
Sotiriadou, P., Brouwers, J., & Le, T.-A. (2014). Choosing a qualitative data analysis tool. *Qualitative Research Journal*, 14(2), 218–234.
Thaler, T., & Levin-Keitel, M. (2016). Multi-level stakeholder engagement in flood risk management—A question of roles and power: Lessons from England. *Environmental Science & Policy*, 55, 292–301.
Thaler, T., Hartmann, T., & Slavíková, L. (2019). Effective flood risk management: From adaptive to collaborative governance. *Journal of Environmental Management*, 250, 109453.
Thaler, T., Priest, S., & Fuchs, S. (2020). Evolving inter-regional co-operation in flood risk management. *Environmental Science & Policy*, 107, 1–10.
Thorslund, J., Jarsjö, J., Jaramillo, F., Jawitz, J. W., Manzoni, S., Basu, N. B., ... Chalov, S. R. (2017). Wetlands as large-scale nature-based solutions. *Environmental Research Letters*, 12(1), 014002.
Waylen, K. A., Holstead, K. L., Colley, K., & Hopkins, J. (2018). Challenges to enabling and implementing natural flood management in Scotland. *Journal of Flood Risk Management*, 11(S2), S1078–S1089.
Wells, J., Labadz, J. C., Smith, A., & Islam, M. M. (2020). Barriers to the uptake and implementation of natural flood management: A social-ecological analysis. *Journal of Flood Risk Management*, 13, e12561.
Wilkinson, M. E., Quinn, P. F., & Welton, P. (2019). Runoff management during the September 2012 floods. *Journal of Flood Risk Management*, 12(S2), e12458.
Wyborn, C., Datta, A., Montana, J., Ryan, M., Leith, P., Chaffin, B., Miller, C., & van Kerkhoff, L. (2019). Co-producing sustainability: Reordering the governance of science, policy, and practice. *Annual Review of Environment and Resources*, 44, 319–346.
Zhu, W., Ellis, N., & Brazier, R. E. H. (2024). A quantitative review of natural flood management research: Evidence, uncertainties, and research gaps. *Wiley Interdisciplinary Reviews: Water*, 11(3), e1711.