Making Natural Flood Management at the Landscape Scale a Reality:

An Investigation of the Barriers and Spatial Disconnection between NFM Investments and Beneficiaries

Andrew Tabas[1], Ian Pattison[1], Leo Peskett[1], Lindsay Beevers[2]
[1]School of Energy, Geoscience, Infrastructure and Society, Heriot-Watt University, EH14 4AS
[2]Institute of Infrastructure and Environment, School of Engineering, University of Edinburgh, EH9 3FG
adt2001@hw.ac.uk
www.hydronationscholars.scot

Scottish Government gov.scot

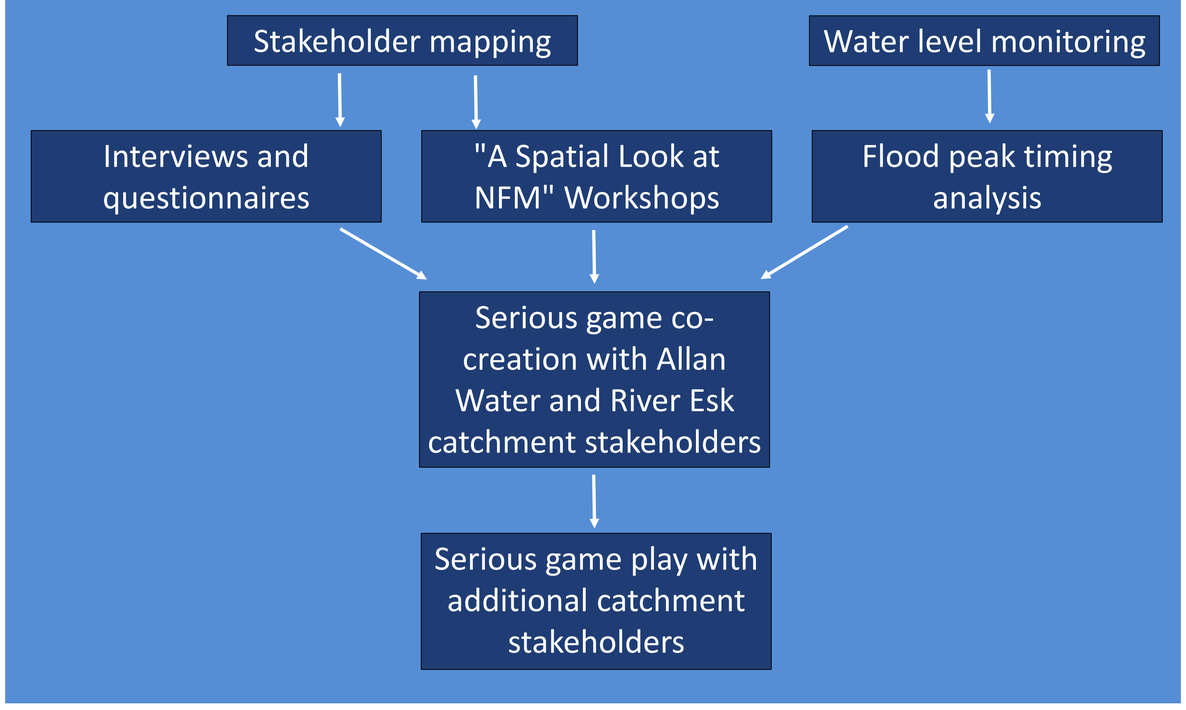
Hydro Nation Scholars Programme

Introduction

- Nature-Based Solutions (NBS) are practices that use natural processes to achieve environmental, social, or economic goals.[1] Under the “umbrella” of NBS, Natural Flood Management (NFM) aims to use natural processes to manage flood risk.[2] Flood peak timing is important for NFM effectiveness.[3]
- "Barriers" hinder upscaling of NFM, while "enablers" make it possible.[4, 5, 6, 7] I am investigating the ways in which upstream and downstream communities can cooperate to reduce flood risk and overcome these barriers.
- Decision-making in flood risk management is shared between local and national governments, whose relative power changes over time.[8, 9]

Figure 1: Leaky dams can slow the flow of water by storing it on the floodplain.

Methods



Preliminary Results

Literature Review

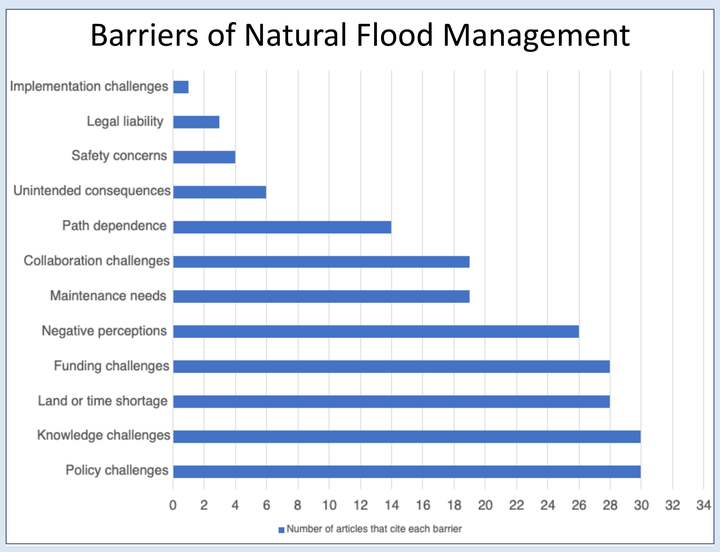


Figure 2: Number of academic articles that cite each barrier (n=34).

Interviews: Emerging Themes

- The interplay of national and local policies is critical for NFM implementation. National-level policies like National Planning Framework 4 and the Flood Resilience Strategy (recently under consultation) promote NFM, while requirements of how many houses to protect and funding challenges reduce opportunities for NFM.
- Insufficient long-term maintenance funding is the most important barrier to NFM, according to a ranking exercise with interviewees.
- Co-benefits such as biodiversity improvements, carbon storage, and recreation opportunities are the most important motivators of NFM, according to the same ranking exercise.

Water Level Monitoring

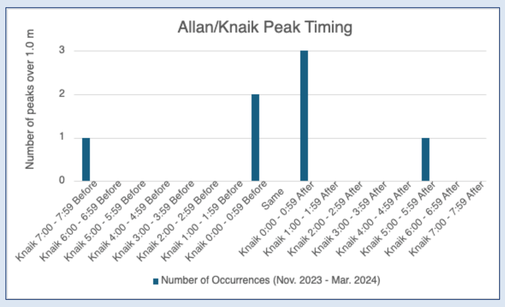


Figure 3: At the Allan Water-River Knaik confluence, 7 storms exceeded the threshold[10] of 1.0 m between Nov. 2023-March 2024. The time difference was up to 7.25 hours.

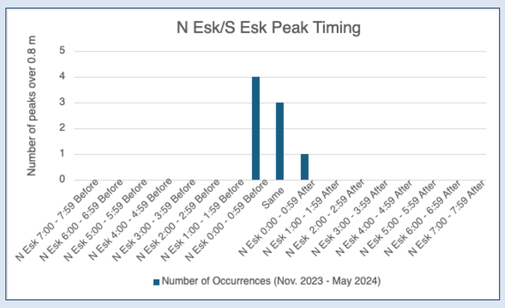


Figure 4: At the North Esk-South Esk confluence, 8 storms exceeded the threshold of 0.8 m between Nov. 2023-May 2024. The time difference was up to 1 hour.

Future

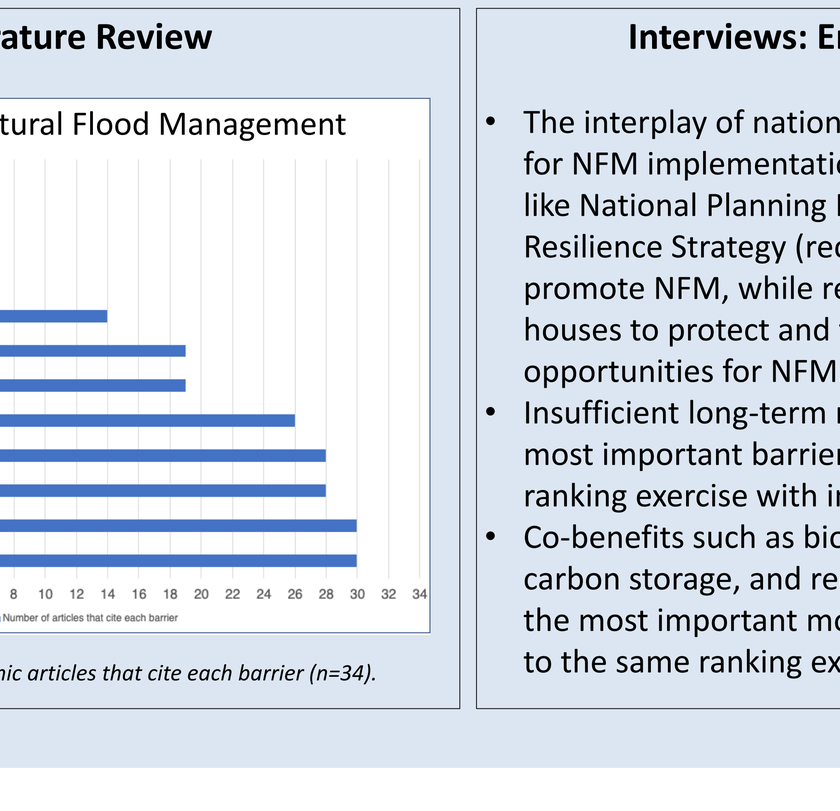


Figure 5: A serious game co-created with catchment stakeholders will simulate decision-making in the face of uncertainty and trade-offs.[11, 12] The game will incorporate Reality, Meaning, and Play.[13] Initial ideas shown here will be developed further with stakeholder input.

References

[1]Cohen-Shacham, E. et al. (eds) (2016) Nature-based solutions to address global societal challenges. *International Union for Conservation of Nature*. Available at: https://doi.org/10.2305/IUCN.CH.2016.13.en.

[2]Forbes, H., Ball, K. and McLay, F. (2015) ‘Natural Flood Management Handbook’. *Scottish Environment Protection Agency.* Available at: https://www.sepa.org.uk/media/163560/sepanatural-flood-management-handbook1.pdf.

[3]Pattison, I. et al. (2014) ‘The role of tributary relative timing and sequencing in controlling large floods’, *Water Resources Research*, 50(7), pp. 5444–5458. Available at: https://doi.org/10.1002/2013WR014067.

[4]Wingfield, T. et al. (2021) ‘Barriers to mainstream adoption of catchment-wide natural flood management: A transdisciplinary problem-framing study of delivery practice’, *Hydrology and Earth System Sciences*, 25(12), pp. 6239–6259. Available at: https://doi.org/10.5194/hess-25-6239-2021.

[5]Waylen, K.A. et al. (2017) ‘Challenges to enabling and implementing Natural Flood Management in Scotland’, *Journal of Flood Risk Management*, 11, pp. S1078–S1089. Available at: https://doi.org/10.1111/jfr3.12301.

[6]Holstead, K. (2014) 'Natural flood management from the farmer’s perspective: criteria that affect uptake', *Journal of Flood Risk Management.* Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/jfr3.12129.

[7]Sarabi, S.E. et al. (2019) ‘Key enablers of and barriers to the uptake and implementation of nature-based solutions in urban settings: A review’, *Resources*, 8(3). Available at: https://doi.org/10.3390/resources8030121.

[8]Penning-Rowsell, E. and Johnson, C. (2015). 'The Ebb and Flow of Power: British Flood Risk Management and the Politics of Scale', *Geoforum*, 62, pp. 131-142. Available at: http://dx.doi.org/10.1016/j.geoforum.2015.03.019.

[9]Swyngedouw, E. (1997). 'Excluding the Other: The Production of Scale and Scaled Politics.' In: Lee, R., Wills, J. (Eds.), *Geographies of Economies*. Arnold, London, pp. 167-176.

[10]NRFA (2024). ‘Peaks Over Threshold (POT).’ Available at: https://nrfa.ceh.ac.uk/peaks-overthreshold#:~:text=Definition,FEH%20Volume%203%2C%20section%2023.5.

[11]Mendler de Suarez, J. et al. (2012) *Games for a New Climate: Experiencing the Complexity of Future Risks*. Boston: The Frederick S. Pardee Center for the Study of the Longer-Range Futuree, Boston University: Pardee Center Task Force Report.

[12]Garcia, C.A. et al. (2022) ‘Strategy games to improve environmental policymaking’, *Nature Sustainability*, 5(6), pp. 464–471. Available at: https://doi.org/10.1038/s41893-022-00881-0.

[13]Harteveld, C. (2011) *Triadic Game Design*. London: Springer. Available at: https://doi.org/10.1007/978-1-84996-157-8.

Thank you to the Hydro Nation Scholars Programme funded by the Scottish Government and managed by the Hydro Nation International Centre for funding this research. Thank you to Forth Rivers Trust for building connections in the field.

Scottish Funding Council
Comhairle Maoineachaidh na h-Alba

HERIOT WATT UNIVERSITY

THE UNIVERSITY of EDINBURGH