The Coalition of Finance Ministers for Climate Action

Improving the inclusion of nature and ecosystem service impacts in assessments of the economic impacts of climate risk by Ministries of Finance and economic decision-makers: the experience of Finland

Finland—Prime Minister's Office

Dr. Saara Tamminen and Kristiina Niikkonen

A contribution to the 'Compendium of Practice from a Global Community of Ministries of Finance and Leading Organizations: Economic analysis and modeling tools to assist Ministries of Finance in driving green and resilient transitions'

Topic: Addressing the climate policy questions facing Ministries of Finance: the economic and fiscal impacts of climate change

June 2025

Access the full Compendium at www.greenandresilienteconomics.org

---

This contribution was prepared at the request of, and with guidance from, the Ministry of Finance of Denmark as Lead of the Coalition's Helsinki Principle 4 initiative 'Economic Analysis for Green and Resilient Transitions' and its Steering Group, with input from its Technical Advisory Group. The views, findings, interpretations, and conclusions expressed are those of the authors. While many Coalition members and partners may support the general thrust of the arguments, findings, and recommendations made in this contribution, it does not necessarily reflect the views of the Coalition, its members, or the affiliations of the authors, nor does it represent an endorsement of any of the views expressed herein by any individual member of the Coalition.

Human activities, such as land use changes and fossil fuel combustion, have altered the Earth's surface and atmosphere, leading to biodiversity loss and climate change. To address this, strategies for climate mitigation must consider biodiversity impacts, and reciprocally, conservation efforts should adapt to climate change. Sound natural processes, influenced by biodiversity, affect the ability to adapt to climate change. Balancing these factors jointly is crucial for a sustainable future (Roy et al., 2022; IPBES-IPCC, 2021). Even if climate change is limited to below 2°C, the functioning of ecosystems and survival of different species will likely change in many countries, with potentially significant impacts to economies and public finances. Ecosystem services cover provisioning, regulating, cultural and supporting services by nature. Anticipation of both sudden and gradual, cascading economic risks associated with ecosystem services is important, especially for countries such as Finland, whose economy is heavily reliant on ecosystems.

Some of the potential ecosystem-related economic risks for Finland were analyzed, with forest and agricultural models combined into a macroeconomic model (the regional, dynamic general equilibrium model: RegFinDyn). The research project started with a review of the most relevant climate change effects. Future economic risk levels for selected sectors were then assessed using the sector models, and their results were fed into the macroeconomic model to obtain partial national and regional economic estimates. Based on the results, the cascading risks in Finland are expected to be larger than damage from extreme weather events (Perrels et al., 2022). Just in forest ecosystems, the impacts of changing climate and disturbances may be substantial, and new modeling approaches have been developed to cover both carbon sequestration and biodiversity-related impacts for forests (Honkaniemi et al., 2024; Forsius et al., 2021).

Wider assessments on nature-related economic risks from the United Kingdom find that incorporating nature-related risk amplifications into climate scenarios would double the estimated economic impact of climate change in the UK (Avery et al., 2024). Further, water purification was found to provide the highest economic value by ecosystem services in the European Union in 2012, based on a pilot of ecosystem accounting (Vysna et al., 2021). Global pressures—changes in air pollution, climate change, land-use, their interactions, and effects on soil processes—have also decreased water quality and increased water treatment costs (McDonough et al., 2020; Härkönen et al., 2023). In Finland, organic carbon concentrations in previously clear lakes have increased by up to 500% over the past 30 years. This browning by organic carbon can also affect aquatic greenhouse gas emissions (Härkönen et al., 2023).

Yet, the abovementioned studies revealed several gaps in knowledge and modeling approaches to obtain wider and better estimates on the economic risks related to ecosystems. In the Finnish case, only some of the identified relevant risks could be assessed. Most ecosystem service impacts could not be quantified. Only the forest and agriculture sector–related provisioning service risks were included in the calculations (Perrels et al., 2022). The extensive UK assessment also found a need for more scenario assessments and concluded that current modeling frameworks for understanding systemic risks are inadequate as they fail to account for feedback processes between the economy and nature. In addition, nature-related financial risk assessment is in its infancy (Avery et al., 2024). Often there are also data limitations. For example, the new UN statistical standard–based ecosystem accounting (a statistical method to account for ecosystem capital) is still under development and being piloted in many countries, including Finland. In order to benefit from ecosystem accounting, it needs to be adopted in a sufficiently comprehensive form (Leinonen et al., 2024).

For example, the discrepancy in measuring restoration expenses and benefits complicates and biases old-fashioned cost-benefit analysis. The EU's ecological restoration law accelerates the recovery of human-altered environments (such as forests and wetlands), bringing them closer to their original natural condition. Restoration supports several essential ecosystem services for human well-being, such as soil vitality (improving soil health, crucial for food production), carbon sequestration (capturing carbon dioxide from the atmosphere), flood protection (enhancing natural flood control), and resilience to extreme weather (strengthening ecosystems' ability to withstand extreme weather events). The European Commission estimates Finland's restoration costs €930 million per year (0.39% of gross domestic product) and the estimated partial benefits, primarily related to improved inland

water quality, amount to €10 billion annually, but the calculations cannot account for the many benefits that are not directly marketable (Ministry of Environment, Finland, 2024; Artell and Kniivala, 2024).

Due to the various limitations and challenges in the analyses of the nature-related economic risks, there have been increasing requests to also use simpler, but more comprehensive methods to analyze them (such as storylines, narratives, causal networks, and participatory systems mapping) in addition to improving the more complex quantitative modeling (e.g., Shepherd et al., 2018; Oliver et al., 2021; Barbrook-Johnsson et al., 2023). The Finnish Prime Minister's Office has started conducting annual societal sustainability assessments to scope research results and knowledge gaps relating to the ecosystem-related risks to the Finnish economy and society in the short to medium term as well as the various other sustainability challenges. The assessments use a five-dimensional approach to sustainability: 1) ecological, 2) human capital and culture, 3) social and health, 4) economic, and 5) security, the rule of law, and democracy. They aim to clarify interlinkages between different sustainability challenges; identify key opportunities and risks, impact channels and leverage points; and build a better knowledge base on the current state of the different sustainability challenges. The assessments are based on a wide participatory approach and systems thinking, starting with qualitative system mappings. The slow progress toward ecological sustainability highlights that conventional, tried-and-tested problem-solving methods are ill-equipped to address systemic issues. Additionally, overlooking diverse perspectives on complex problems and the inherent challenges of governing multifaceted, systemic issues undermines the credibility of any move toward sustainability (EEA, 2024).

In addition, Finland's new €50 million EU-funded Priodiversity LIFE project is innovating strategic, new, and more effective means to combat biodiversity loss and improve policy coherence with strategic leadership of the Prime Minister's Office and an exceptionally broad group of actors including the Ministry of Environment and Ministry of Finance, and a number of research partners and other stakeholders. This project involves building national capacity and monitoring how various national processes and policy measures affect the achievement of EU biodiversity strategy objectives. Additionally, it includes an evaluation of the biodiversity impacts of key national policies, and a network is being developed to identify, evaluate, and monitor funding sources relevant to Finnish biodiversity targets in order to address financing gaps.

Furthermore, efforts in Finland have been backed by high-level considerations. Namely, a high-level Working Group on Financing the Green Transition (Finnish Government, 2023) identified the need to reconcile the objectives and timeframes of economic policy with those of the climate and environmental policy, with the following key recommendations linked closely to economic impact assessment and modeling:

- First, prepare a plan for creating an assessment, monitoring, and analysis framework to evaluate the overall economic and fiscal impacts of climate and biodiversity loss as well as the policy measures required to reach them. Such a plan would address the need to identify and monitor risks associated with the transition, investment and financing needs, and the links to climate and environmental policy objectives.
- Second, build up a knowledge base of economic policy decision-making in the green transition.
- Third, step up economic research, especially by increasing the resources allocated to applied economic research studying the links between climate change, biodiversity loss, and the economy, and by creating cooperation networks in which better use can be made of economic and natural sciences as well as cross- administrative expertise and cooperation. To this end, the usefulness of international scientific and research networks was identified.

Finally, to develop the economic analyses and modeling related to ecosystem services, MoFs and other economic policymakers could consider, for example:

- Widening the systemic risk reviews of potential climate change–related sudden and cascading economic risks related to ecosystem services
- Developing better databases on the economic value of ecosystem services, such as UN standards–based ecosystem accounting
- Incorporating ecosystem-related impacts to macroeconomic risks assessments, starting potentially with simpler qualitative methods and the development of quantitative modeling tools for the task; as many countries seem to be facing limitations on conducting such quantitative analyses, international cooperation in model development could be considered.

References

Artell, J., and Kniivala, M. (2024). We Need an Assessment of the Benefits of the EU Restoration Regulation That Is Appropriate for Finnish Conditions. https://www.luke.fi/fi/blogit/tarvitsemme-eun-ennallistamisasetuksen-hyotyjen-suomen-oloihin-soveltuvaa-arviointia

Avery et al. (2024). *Assessing the Materiality of Nature-Related Financial Risks for the UK*. Green Finance Institute.

Barbrook-Johnsson, P., Sharpe, S., Pasqualino, R., Senra de Moura, F., Nijsee, F., Vercoulen, P., Clark, A., Peñasco, C., Diaz Anadon, L., Mercure, J.-F., Hepburn, C., Doyne Farmer, J., and Lenton, T. M. (2023), *The What, Why and How of New Economic Modelling*, The Economics of Energy Innovation and System Transition (EEIST) Project Report.

EEA (2024) *Governance in Complexity, Sustainability Governance under Highly Uncertain and Complex Conditions*. EEA Report 05/2024. https://www.eea.europa.eu/publications/governance-in-complexity-sustainability-governance.

Finnish Government (2023) *Working Group on Financing the Green Transition: Final Report*, 12 December. https://julkaisut.valtioneuvosto.fi/bitstream/handle/10024/164654/VN_2023_5.pdf?sequence=1&isAllowed=y.

Forsius, M., Kujala, H., Minunno, F., Holmberg, M., Leikola, N., Mikkonen, N., Autio, I., Paunu, V.V., Tanhuanpää, T., Hurskainen, P., and Mäyrä, J. (2021) Developing a Spatially Explicit Modelling and Evaluation Framework for Integrated Carbon Sequestration and Biodiversity Conservation: Application In Southern Finland. *Science of total Environment* 775, Paper 145847. https://doi.org/10.1016/j.scitotenv.2021.145847.

Härkönen, L. H., Lepistö, A., Sarkkola, S., Kortelainen, P., Räike, A. (2023) Reviewing Peatland Forestry: Implications and Mitigation Measures for Freshwater Ecosystem Browning. *Forest Ecology and Management* 531, Paper 120776. https://www.doi.org/10.1016/j.foreco.2023.120776.

Honkaniemi, J., Albrich, K., Repo, A., Aalto, J., Graf, L., Haikarainen, S., Huitu, O., Hantula, J., Hynynen,J., Jantunen, A., Kolstela, J., Lehtonen, I., Matala, J., Nikula, A., Poutanen, J., Salminen, H., and Vauhkonen, J. (2024) *Multifunctional Forests and Their Risks under Climate Change*. Natural Resources and Bioeconomy Studies 28/2024. Natural Resources Institute Finland. Helsinki.

IPBES-IPCC (2021) Scientific Outcome of the IPBES-IPCC Co-Sponsored Workshop on Biodiversity and Climate Change. https://files.ipbes.net/ipbes-web-prod-public-files/2021-06/2021_IPCC-IPBES_scientific_outcome_20210612.pdf.

Leinonen, T., Puroila, S., and Valkeapää, A. (2024) Luontopääoma Kartalle ja Euroiksi -Ekosysteemitilinpito Vastuullisen Talouspolitiikan Työkaluna. https://www.sitra.fi/julkaisut/luontopaaoma-kartalle-ja-euroiksi/.

McDonough, L. K., Santos, I. R., Andersen, M.S. et al. (2020) Changes in Global Groundwater Organic Carbon Driven by Climate Change and Urbanization. *Nature Communications* 11, 1279. https://doi.org/10.1038/s41467-020-14946-1

Ministry of Environment, Finland (2024). *Ennallistamisasetus*. https://ym.fi/ennallistamisasetus. Retrieved 1 August 2024.

Oliver, T. H., Boazman, K., Doherty, B., Dornelles, A., Gilbert, N., Greenwell, M. P., Harrison, L. J., Jones, I. M., Lewis, A. C., Moller, S. J., Pilley, V. J., Tovey, P., Wilde, S., and Yeoman, A. M. (2021) *Systemic Environmental Risk—Protocols to Appraise Interventions for Complex Risks*. SysRisk Project Final Report, December.

Perrels, A., Haakana, J., Hakala, O., Kujala, S., Láng-Ritter, I., Lehtonen, H., Lintunen, J., Pohjola, J., Sane, M., Fronzek, S., Luhtala, S., Mervaala, E., Luomaranta, A., Jylhä, K., Koikkalainen, K., Kuntsi-Reunanen, E., Rautio, T., Tuomenvirta, H., Uusivuori, J., and Veijalainen, N. (2022). Assessment of the Cost of Inaction Regarding Climate Change. *Publications of the Government´s Analysis, Assessment and Research Activities* 2022:37, Finnish Prime Minister's Office.

Roy, P. S., Ramachandran, R. M., Paul, O., Thakur, P. K., Ravan, S., Behera, M. D., Sarangi, C., and Kanawade, V. P. (2022) Anthropogenic Land Use and Land Cover Changes—A Review on Its Environmental Consequences and Climate Change. *Journal of the Indian Society of Remote Sensing* 50(8), 1615–1640. https://doi.org/10.1007/s12524-022-01569-w.

Shepherd, T. G., Boyd, E., Calel, R. A., Chapman, S. C., Dessai, S., Dima-West, I. M., Fowler, H. J., James, R., Maraun, D., Martius, O. and Senior, C. A. (2018). Storylines: An Alternative Approach to Representing Uncertainty in Physical Aspects of Climate Change. *Climatic Change* 151, 555–571.

Vysna, V., Maes, J., Petersen, J. E., La Notte, A., Vallecillo ,S., Aizpurua, N., Ivits, E., and Teller, A. (2021). *Accounting for Ecosystems and Their Services in the European Union (INCA): Final Report from Phase II of the INCA Project Aiming to Develop a Pilot for an Integrated System of Ecosystem Accounts for the EU*. Statistical Report, Publications Office of the European Union.