

Elaboration of Transparent, Fair and Sustainable Interspecies Habitability Composite Indicators

PhD Thesis topic at LAMSADE-University Paris Dauphine PSL

Funding: Doctoral contract

Application deadline: April 30th, 2026.

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Context and Objectives

This project is part of the Hotspot “Habiterrae” of the large PSL research program Terrae. A case study with Grand Paris may be considered, focusing on the Metropolitan Spatial Coherence Scheme (SCoT) [1, 4, 5].

In a world marked by ecological crises, territorial inequalities and rapidly transforming ways of life, the question of the habitability of spaces has become central. Inhabiting a territory no longer merely means residing in it: it implies the ability to live there with dignity, sustainability, and equity, both today and in the future.

Public decision-makers face complex trade-offs: environmental quality, access to essential services, social and spatial justice, resilience to climate change, local economic dynamics . . . These dimensions are multiple, heterogeneous, sometimes conflicting and difficult to synthesize.

To assist the decision-maker in forming their convictions regarding the best alternative, a decision model based on their preferences is generally developed. This model aims at representing the decision-maker’s decision strategies. Multi-criteria Decision Analysis (MCDA) (see for instance [2, 3, 8]), is a discipline in operations research that aims to achieve this goal. Indicators play a crucial role in the decision-making process by providing quantitative and qualitative measures that facilitate the comparison and evaluation of alternatives using measurement theory (see [7]). However, the development and effective application of composite indicators, seen as aggregated criteria, remain major challenges (see for instance [6]).

The aim of this research is to develop an MCDA-based methodological framework for constructing composite indicators of interspecies habitability, explicitly integrating requirements of transparency, robustness, territorial justice, and environmental sustainability. The expected results may be:

1. *Theoretical* : E.g.,

- ⊗ A rigorous formalization of the concept of habitability, including its social, environmental and economic dimensions;
- ⊗ A clear definition of transparent, explainable, robust, fair and sustainable indicators, as well as the legitimacy of a decision-maker or a decision;
- ⊗ A mathematical modeling of composite indicators integrating guarantees of transparency and robustness;
- ⊗ A study of the properties of a decision-maker’s preferences leading to a reliable and fair interpretation of results obtained from composite indicators.

2. *Algorithmic*: For example, the implementation of algorithms allowing

- ⊗ The identification of relevant indicators required to construct a composite indicator;
- ⊗ A robust interpretation of results to support effective decision-making.

3. *Applicative*:

- ⊗ Methodological recommendations for decision-makers to improve multicriteria decision-making with more interpretable and reliable tools;
- ⊗ An application to real-world case studies validating the effectiveness of the proposed methodology, for example with Grand Paris or with the Parc Naturel des Forêts.

Desired Skills and Prerequisites:

- ⊗ Hold a Master's degree (Master 2) in computer science, applied mathematics, or a closely related discipline. Master's degrees in sustainability sciences are also accepted if the student has a background in science or in economics at the L3 or M1 level.
- ⊗ Be motivated and interested in environmental-related topics.
- ⊗ Good programming skills (Python, R, etc.) and an initiative-taking spirit will be an asset.

How to Apply?

Please send an email (meltem.ozturk@dauphine.fr and brice.mayag@dauphine.fr) with a CV, a cover letter, transcripts from the Bachelor's, Master's 1 and 2, and optionally a recommendation letter.

References

- [1] N. Blanc, M. Ader, G. Berlantini, X. Coumoul, A. Depoux, M. Devès, J. Gaillardet, I. Hillenkamp, C. Magnan, A.-S. Milon, B. Reber, and S. Revet. *Vers une habitabilité de la terre*, 2025.
- [2] D. Bouyssou, Th. Marchant, P. Perny, M. Pirlot, A. Tsoukiàs, and Ph. Vincke. *Evaluation and Decision Models: A Critical Perspective*. Kluwer Academic, Dordrecht, 2000.
- [3] D. Bouyssou, Th. Marchant, M. Pirlot, A. Tsoukiàs, and Ph. Vincke. *Evaluation and Decision Models: Stepping Stones for the Analyst*. Springer Verlag, Berlin, 2006.
- [4] J.-M. Chevalier, C. Michelot, and S. Blangy. Habitabilité du monde et recherche en société. *Nouvelle revue de psychosociologie*, 39(1):7–20, 2025.
- [5] M. Delabarre and S. Marry. Habitabilité et natures urbaines : vers un outil d'évaluation des projets urbains. exemple de la métropole lyonnaise. *VertigO*, 12(2), 2012.
- [6] Salvatore Greco, Alessio Ishizaka, Maria Tasiou, and Giacomo Torris. On the methodological framework of composite indices: A review of the issues of weighting, aggregation, and robustness. *Social Indicators Research*, 141(1):61–91, 2019.
- [7] Fred S. Roberts. *Measurement Theory*. Cambridge University Press, Cambridge.
- [8] Bernard Roy. *Multicriteria Methodology for Decision Aiding*. Kluwer Academic Publishers, Dordrecht, 1996.