Topic 2: Sustainability Benchmarking: LCA & LCC of Nature-Based vs. Eurocode Dike Reinforcements

Preliminary research question: Are green dikes truly cost-effective and carbon-efficient over their lifespan?

Background & Motivation

Flood protection across Europe, relies heavily on dikes and dams traditionally reinforced according to rigid structural codes (e.g., Eurocode 7). While vegetated and nature-based solutions are praised for eco-friendliness, infrastructure managers need hard numbers: What is the full cradle-to-grave carbon footprint? Do maintenance costs of vegetation outweigh the lower initial construction cost?

Research Objectives & Methodology

1. **Design Alternative Scenarios:** Define standard Eurocode/hard-engineered dike sections versus equivalent nature-based vegetated dike designs.
2. **Life Cycle Assessment (LCA):** Quantify environmental impacts (embodied carbon, resource depletion, biodiversity impact) using tools such as OpenLCA, SimaPro, or standard Environmental Product Declaration (EPD) datasets.
3. **Life Cycle Cost Analysis (LCCA):** Model capital expenditure, routine vegetation maintenance, inspection routines, and end-of-life rehabilitation.

What You Will Deliver

- A comparative matrix evaluating 2–3 standard dike profiles under both technical standards and green alternatives.
- An integrated carbon and financial balance sheet detailing break-even horizons for nature-based interventions.
- Recommendations for water boards and asset owners evaluating sustainable dike upgrades.

Key Skills You Will Gain

- Environmental LCA modeling and carbon accounting.
- Life Cycle Costing (LCCA) methodologies for public infrastructure.
- Understanding European design codes (Eurocode) and dike safety criteria.

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