Polder2C's: Lessons from a living lab approach to flood resilience building

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Introduction

Polder2C's is an Interreg-funded project that aims at flood resilience building through fieldwork in the Living Lab Hedwige-Prosperpolder (LLHPP). LLHPP consisted of a 3 Km-long levee where various large-scale surveys, superstorm simulations and emergency response exercises took place in the winters period 2020-21 and 2021-22. The levee was recently removed to facilitate the expansion of an adjacent intertidal area.

Fig 1. Aerial view of the living lab location with the 3-Km levee highlighted.

Polder2C's objectives

1. Advance and share knowledge on the **design and maintenance of levees**.
2. Advance and share knowledge and experiences in **flood emergency response**.
3. Develop a sound **knowledge infrastructure** that facilitates knowledge transfer across countries, generations and organisations.

Polder2C's context and work method

- **15 partners from 4 countries** (UK, France, Belgium and the Netherlands) and a network of >30 observer organisations. **2 winters of experimentation** in the living lab.
- No prescribed work method in the initial proposal. A **work method developed organically** during execution. Process constrained by parallel activities of the contractor of the de-poldering project.
- Exploratory fieldwork in the **1st year: process dominated by constraints** in availability and effective use of resources.
- More systematic fieldwork in the **2nd year, informed by literature** and experts' feedback
- **Co-creation** with external parties in an **ad-hoc fashion**

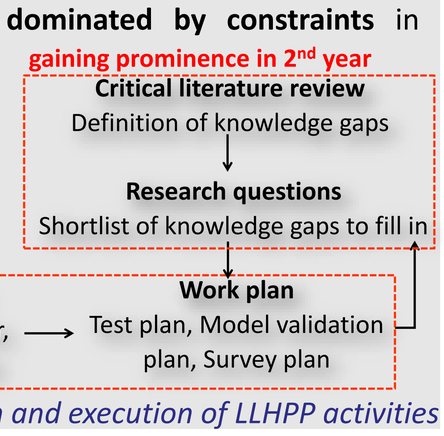

Fig 2. Work flow for the design and execution of LLHPP activities

Selected 'success stories'

1. Levee guard trainings

- Exchange of knowledge and experiences among professionals
- Validation of inspection app 'App2C'

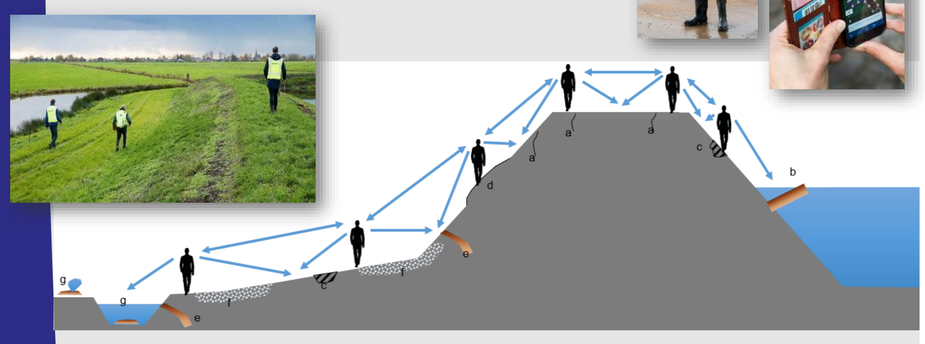

Fig 3. Pictures and graphical representation of levee inspections.

2. Testing of innovative survey and monitoring techniques

- Development of a low-cost technique with smoke-bombs to detect animal dens in the subsurface of a levee.
- Technique improved based on repetitive trials in the living lab.
- Setting up for the first time Electric Resistivity Tomography monitoring of overflow experiments.
- Unique timeseries datasets from levee subsurface during overflow.

Fig 4. Subsequent trials of the smoke-bomb technique.

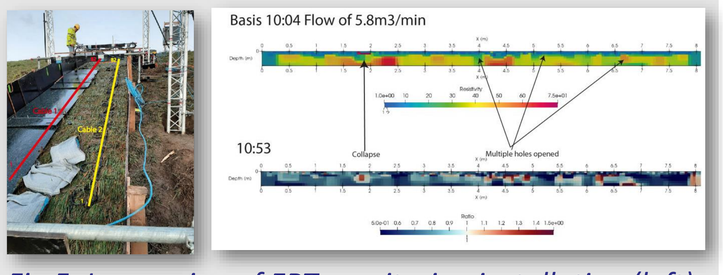

Fig 5. Impression of ERT monitoring installation (left) and indicative results (right).

3. Collecting evidence for investigation of unresolved technical questions

- Successful development of evidence-based knowledge agenda on the management of harmful animal activities on levees.
- First steps to document tacit knowledge and coordinate actions with ecology experts.

Fig 6. (Left) Foxhole on the Hedwige levee after overflow testing, 23 November 2020. Test conditions: 180 l/s discharge, 1h 13 min overflow duration. (Right) Excavated grout of mole tunnel, indicating that damage of small rodents is larger than originally thought by civil engineering experts.

4. Breach-defender proof-of-concept

- Successful closure of an artificial breach with a military pontoon in the living lab.
- This required the construction of a pool surrounded by a new earthen levee in the Hedwige polder.

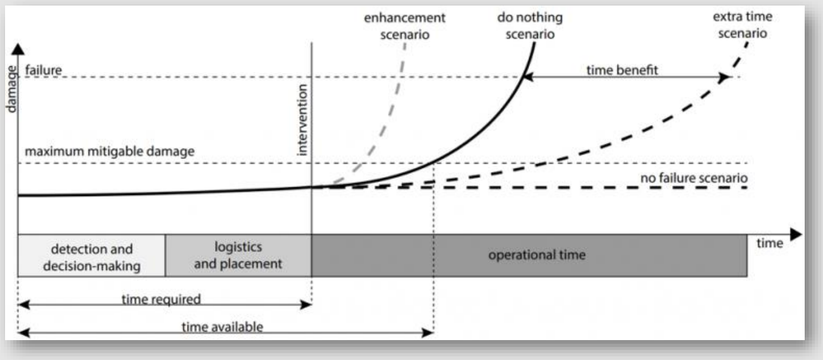

Fig 7. Breach-defender intervention scenarios

Fig 8. The Hedwige pool and the Breach-defender.

Drivers of success

- **Clustering of expertise and resources**: the design and execution of most activities in the living lab required a constant effort to creatively combine resources and knowledge of partners and observers. This allowed for collective growth of parties involved.
- **Flexibility in the work plan**: Since there was no prescribed work plan, partners could meaningfully seize opportunities that appeared in the course of the project, for new collaborations, courses of action and studies.
- **Motivation and trust**: The planning and execution of exploratory activities in the first year played a significant role in the development of trust among partners, which played a significant role in their motivation and effective collaboration.
- **Accountability:** Activity leaders are held responsible for reporting and delivery of results.

Challenges and next steps

- **Availability of the living lab**: All activities were conditioned by the planning of the contractor that executed the depoldering project. This posed multiple limitations, including the fact that the living-lab levee had to be demolished in the summer period of 2022.
- **Covid-19 restrictions**: Many activities were postponed, cancelled or delayed due to covid-19. Thanks to the flexible work plan and the extra time of 6 months that Interreg granted to the consortium, this problem was tackled in a satisfactory manner.
- **Documentation of activities** is a laborious and time-consuming process due to the complexity of activities.
- **Availability of data for future studies:** Only a fraction of collected data has been analyzed thoroughly so far. Finding a platform for their sustained, open-access availability is a top priority.