

# Mekong Delta Living Lab

An open air laboratory for coastal protection and nature-based solutions



December 2023





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01

# Project Introduction



## Introducing the project

### Background

The Mekong Delta in Vietnam is facing a dire threat of near-complete submersion by the end of the century unless urgent actions are taken throughout the river basin. Without intervention, this delta, home to nearly 20 million people, could see up to 90% of its land underwater, with profound local and global consequences. Land subsidence, accelerated by human activities like excessive groundwater extraction and aggravated by sea level rise, is causing the delta to sink below sea level. To address this crisis, it is essential to implement measures that harness natural processes to protect against devastating and recurrent flooding. Collaboration from national governments, international organizations, the private sector, and civil society is crucial.

The submersion of the Mekong Delta is threatening and affecting the vulnerable communities, particularly those situated near the six estuarine river mouths, but also local fishermen and women, the local agricultural and aquacultural sector and indirectly the global seafood importers and consumers. Furthermore, the decline of the mangrove ecosystems is a direct threat to the biodiversity in this area. Historically, these coastal and estuarine mangrove

shields, dissipating wave energy and capturing sediment. They have been indispensable in safeguarding the provinces' inhabitants. Furthermore, these mangrove ecosystems have nurtured rich ecological diversity and supported lucrative tourist and fishery industries. However, the ongoing degradation of Mekong coastal habitats raises significant concerns regarding their continued ability to provide these vital services in the future. Urgent action is needed to preserve these critical ecosystems for future generations and to improve the biodiversity in the Mekong Delta.

Mangrove restoration and planting is a complex undertaking that requires political, social, economic and biophysical enabling conditions. Therefore, the implementation of these types of nature-based solutions, to preserve the mangrove ecosystems and biodiversity in general, should be conducted on the basis of local knowledge and expertise and involve participatory decision-making, communities and long-term monitoring and data collection. A long-term physical living lab in the Mekong Delta will be able to validate these conditions and strengthen this with actual data and evidence-based understanding.

#### The surge level with mangroves

The mangrove forests decrease the surge level at the back, nearshore, and increase the surge levels at the front, offshore.

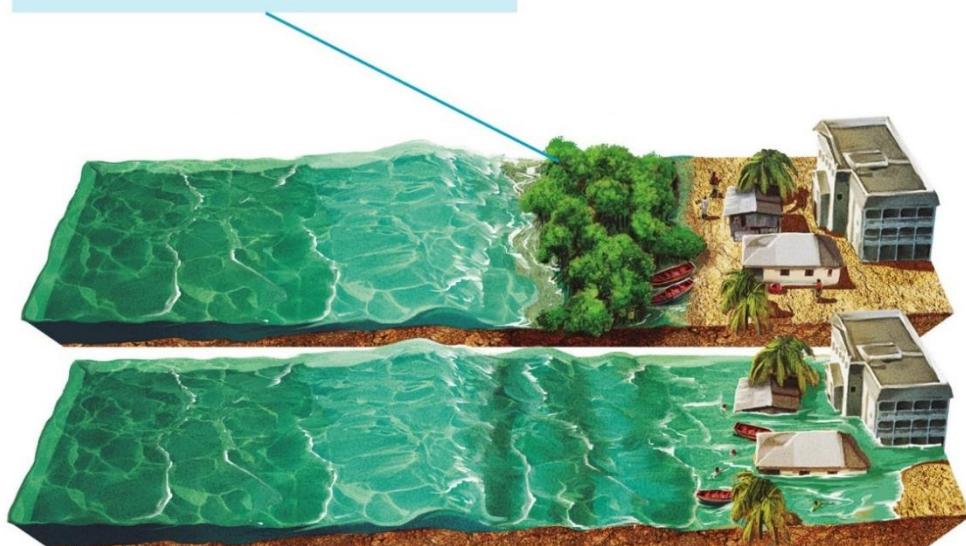


Fig. 1: Flood and coastal protection benefits of mangroves

#### The surge level without mangroves

Absence of mangrove ecosystems results in the gradual movement of the coastline towards inhabited communities, posing a significant and imminent threat to coastal populations.

## The rationale behind a living lab

### What is a living lab?

We define a living lab as a physical space in which to study and solve complex (bio-)physical and societal challenges by bringing together various stakeholders for collaboration and collective ideation and learning.

Living labs serve as a crucial link between knowledge developers and innovation users, facilitating the development of research projects, pilot initiatives, and field experiments. This dynamic involvement in practical projects helps raise awareness of innovative practices. As a result, universities become more integrated with society and have greater influence when providing advice to various partners.

At TU Delft, living labs like The Green Village and Flood Proof Holland play pivotal roles in accelerating innovation and building support for climate-adaptive solutions. These living labs offer real-time experimentation and validation of innovations through monitoring, making it easier for public entities to adopt new solutions.

In contrast, traditional Vietnamese responses often lean towards hard engineering solutions and permanent structures, influenced by a

historical tradition rooted in river and estuarine training structures. This approach is exemplified by the widespread use of sea dikes, which have been an official strategy in many coastal regions for years. Unfortunately, these sea dikes often lead to coastal and estuarine constriction, adversely affecting precious mangrove forests. Currently, a lot of mangrove understanding is produced in hydraulic laboratories on laboratory scales. The physical complexity of mangrove systems is difficult to mimic in the laboratory, let alone the socio-cultural and socio-economic aspects. Therefore, we propose to create a permanent living lab in the Mekong Delta that will be centered around **2 main pillars**:

1. Gaining better insight and knowledge through conducting of in-field measurement campaigns, long-term monitoring and a wide variety of research experiments;
2. Demonstrating and showcasing various lessons learned and potential (nature-based) solutions for coastal management in Vietnam

Next to this permanent field lab, we will also invest in a set of mobile monitoring equipment to conduct short-term measurement campaigns in various places in the Mekong Delta.

Setting up such a living lab requires a substantial amount of time and resources. This initiative represents the first phase of the living lab setup.

**“**Living labs are a new way of developing and applying knowledge. Living labs involve all the different parties required for identifying solutions to social issues. It is not just about technical progress, but also about social innovation. We often see multiple problems come together, and living labs are a particularly suitable tool for addressing these types of complex problems **”**

**Jasper Deuten**, Coordinator Rathenau Institute

## Our team of experts

At Thuy Loi University (TLU) and the various research institutes in Vietnam, there are a dozen of young researchers who have obtained their PhD at TU Delft in the field of coastal protection and nature-based solutions, specifically mangrove related research in the Mekong Delta. They are eager to apply their knowledge and skills for better mangrove and coastal projects in Vietnam. As two renowned universities in the field of coastal management and long-term partners (TLU and TU Delft) and together with the research institutes in the North and South of Vietnam, we developed together the idea of a mangrove living lab in the Mekong Delta. We see a clear need for a field site where long-term monitoring and research can be done and potential solutions can be monitored, improved and demonstrated to a variety of stakeholders (e.g. national, provincial and district government, media, artists, donors, communities, students, researchers etc.). This permanent field site will be strengthened and complemented by a variety of short-term measurement campaigns in the form of a mobile lab.

As a team, the Vietnamese colleagues who obtained their PhD at TU Delft, with financial support of both the Vietnamese Ministry of Education and the NUFFIC, will play a leading

role in the development and daily operations of the living lab. Since the living lab will be in the Mekong Delta, an important implementing role will be played by the Institute of Coastal and Offshore Engineering (ICOE) in the South and the Institute of Civil Engineering (ICE) under Thuyloi University (where also some of the TU Delft alumni are currently working). The Vietnamese team will be supported by a renowned team from the TU Delft, existing of coastal experts, water management and monitoring experts and technology policy and management experts whom all bring in extensive experience in Vietnam. Throughout the project we also foresee to involve a lot of TU Delft and other students (e.g. WUR, HBO etc.) that can team up with Vietnamese students and staff. In the past years, this student exchange has proven to be a very effective way of conducting research together and gaining better insight into the challenges in Vietnam. In the annex of this document we have included an overview of all involved staff members, including their expertise and role in the project. It is noted that the collaboration that **has developed over the last 20 years** between the Thuy Loi University (MARD founded) and Hanoi University of Natural Resources and the Environment (MONRE founded) can be developed further in this project. The collaboration between the two ministries is of high strategic importance.

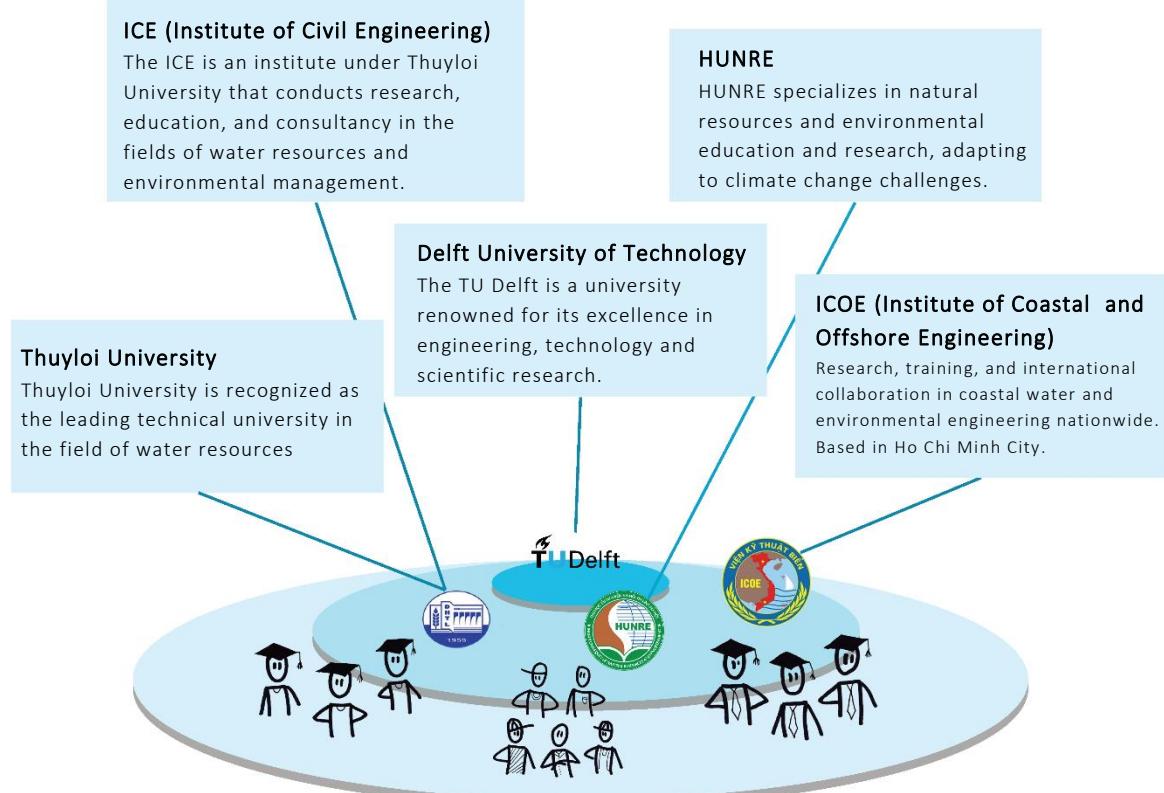
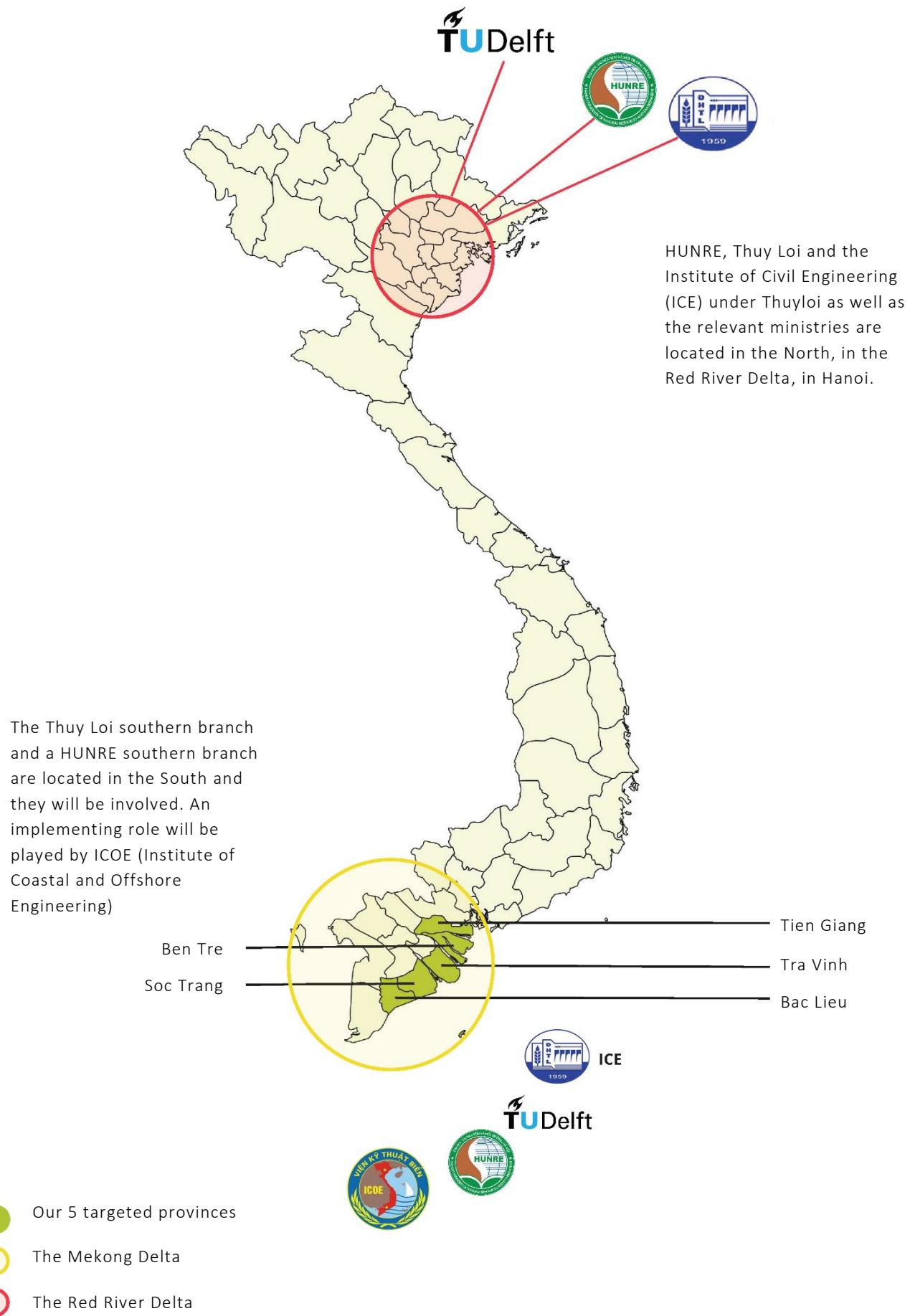


Fig. 2: The involved partners and stakeholders within this project

## The location of our research and experiments

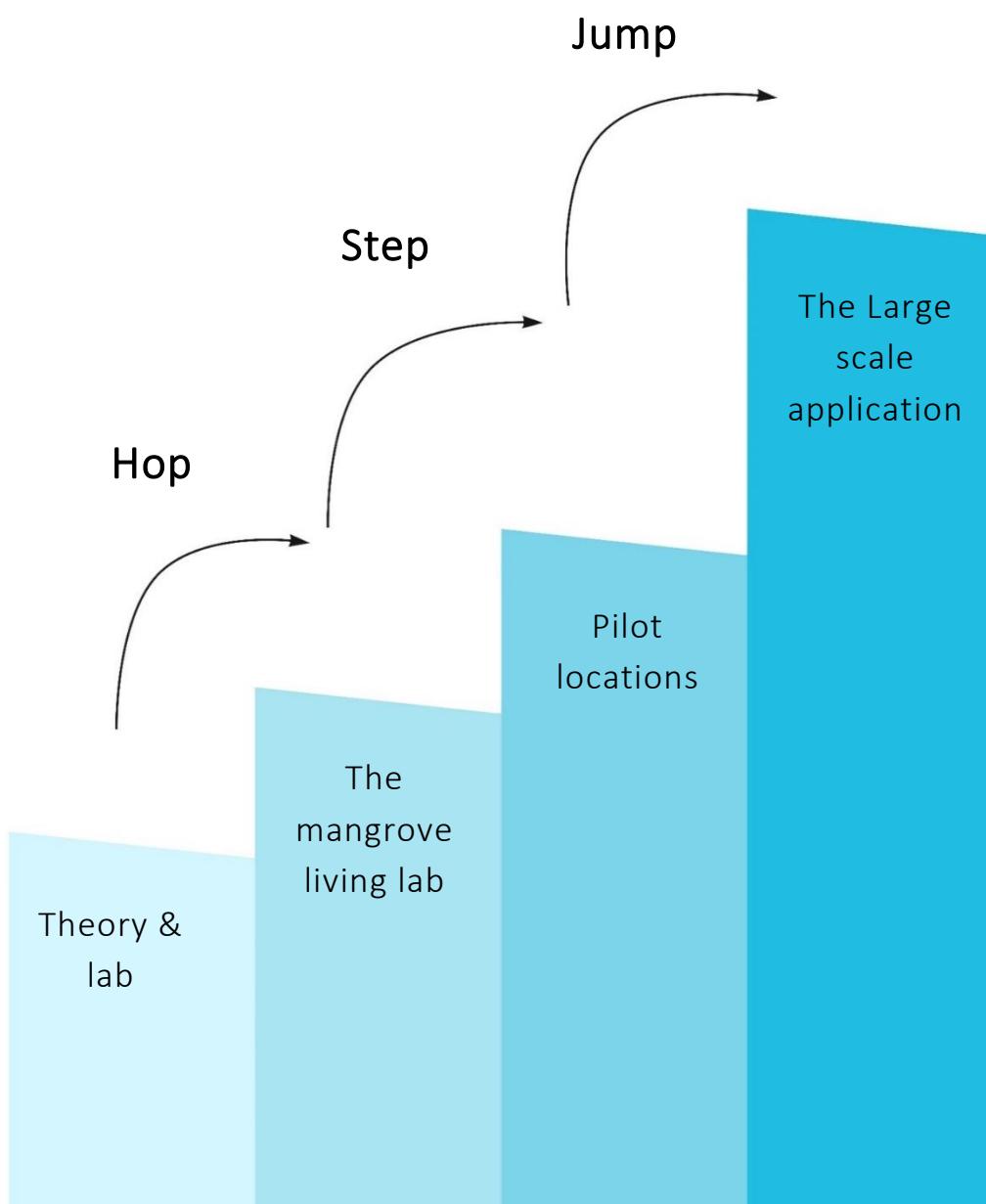


### The 'hop' to large scale application

The primary goal of our living lab is the acceleration of sustainable innovation to scale up to large scale application. We form the 'hop', the first location for the researcher/entrepreneur to test their innovation in a real-life environment. Our living lab's primary goal is to demonstrate alternative coastal protection solutions in Vietnam and share knowledge, while the second objective is to conduct research and gather data. The approach starts from lab and theory research and proceeds with real-life testing in the living lab (the 'hop') and share the data and information on a platform. We foresee

that the coastal protection innovation will expand to pilot location and become a part of existing programs and projects. Finally, the 'jump' phase involves implementing the innovative solution on a larger scale by the responsible stakeholders who have been convinced by the results in the living lab and pilot phase.

After the jump phase there will be monitoring and evaluation of the large scale application and implementation of a solution to protect coastal areas in Vietnam. Following this monitoring and evaluation, the solution will be adapted and improved.





02

# Our Approach



Our trip to Vietnam last October, 2023, as well as the workshop – RVO Support to MARD



## Proposed approach

### Objective of the living lab

The envisaged living lab in the Mekong Delta will serve as a **1) platform and collection of relevant knowledge** and lessons learned based on a variety of in-field scientific measurement campaigns in the Mekong Delta, and **2) demonstrating a variety of solutions** to relevant stakeholders on a permanent physical site.

The relevant stakeholders include:

- Government authorities, both local/regional as well as national
- Community representatives and community members in general
- Environmental NGOs and conservation groups
- Academic and research institutions: this regards big research institutions as well as local/regional institutions (e.g. CTU, TVU and local TVET).
- International organizations and financial institutions
- Media and communication outlets: to ensure broader coverage of the project, the progress and the outcomes.

Indoor flumes focus on scientific pursuits, whereas field measurement campaigns emphasize real-life solutions. Therefore, the aim of this living lab is: bridging the gap between theory and practice, from the indoor lab of Thuy Loi and the other institutes to the complex outdoor reality in the Mekong Delta. Especially since in the past years, many project efforts have been implemented to improve the coastal

system, but had limited success, caused by a lack of evidence-based decision making and awareness. The main aim of the living lab is to allow for showcasing the various mangrove restoration methods and as such support improved and more evidence-based decision-making with a more long term commitment.

The main problem is that many of these structural interventions suffer from a lack of understanding of the system and concerns about mangrove loss, coastal erosion and soil subsidence. The effects of this problem are stated in the last chapter, the starting point of the research. Through the mangrove living lab, we aim to convey a crucial message that we need to understand the (bio-)physical system dynamics better, gather learnings, evaluate and minimize short-term interventions that could harm mangroves and overall biodiversity in the long term. Alongside, we will build a data platform where the data can be collected, summarized and shared throughout. This data platform serves the purpose of informing and supporting the decision-making process of ongoing and new projects. With the living lab we also address another crucial factor for learning, namely to showcase the learnings and results 'in the wild' and to connect with and make sure the communities are involved. This demonstration effect of the envisaged living lab will be instrumental in ensuring uptake of the gained insights and knowledge.



Showcasing different solutions and their effects through data collection and research

*Scoping for locations in Tra Vinh province together with NL Embassy and Invest International and discussions with the local authorities in the Mekong Delta*



*On Flood Proof Holland, various parties investigate, test, and demonstrate temporary water barriers and other solutions for flooding. Flood Proof Holland has had an important role as a field lab and showcase for solutions to flood problems since 2013. Visitors from all over the world attend demonstrations in Delft. Flood Proof Holland stands as a beacon of innovation, seamlessly aligning with the envisioned Living Lab in Vietnam's Mekong Delta.*



### The benefits of a living lab

The benefits of the living lab can relate to the following three:

1. Research
2. Showcasing
3. Education

Below, a detailed list can be found.

#### Interdisciplinary collaboration

Understanding the challenge requires interdisciplinary collaboration, fostering active stakeholder participation through co-creation within the living lab framework. Our primary goal is to generate and share knowledge for continuous innovation. Involving key stakeholders - public entities, private organizations, end-users, and knowledge institutes - ensures ongoing decision-making influence throughout development.

#### Community engagement

Enhancing research relevance involves engaging the local community by providing them with essential local information, fostering a mutually beneficial knowledge exchange and creating an understanding.

#### Experiential learning

A living lab offers a unique opportunity for deep engagement with the challenges of coastal protection. It provides a tangible opportunity to acquire practical, real-world insights and expertise. Moreover, this immersive environment nurtures the cultivation of critical thinking skills for both staff, students and professionals in the field.

#### Knowledge transfer

Knowledge cultivated within the permanent and mobile living lab can be effectively distributed to educational institutions and students, enriching learning experiences within the Vietnamese communities. Furthermore, the living lab's versatile infrastructure provides an ideal venue for hosting various events, thereby contributing to sustainability efforts by addressing critical issues like climate change and resource management.

#### Innovation and prototyping

Given its role as a platform for experiential learning and fostering interdisciplinary collaboration, the living lab functions as a natural incubator for pioneering ideas. The solution development process within this framework follows an iterative approach, with the continuous collection of feedback a living lab enables refining and advancing the proposed solutions.

#### Data collection and analysis through research

A living lab serves as an environment for conducting in-depth studies and thorough analyses of the findings. This dynamic setting allows researchers to immerse themselves in real-world scenarios, gather data, and apply various methodologies to scrutinize and interpret results effectively. It offers a unique opportunity to bridge the gap between theory and practice.

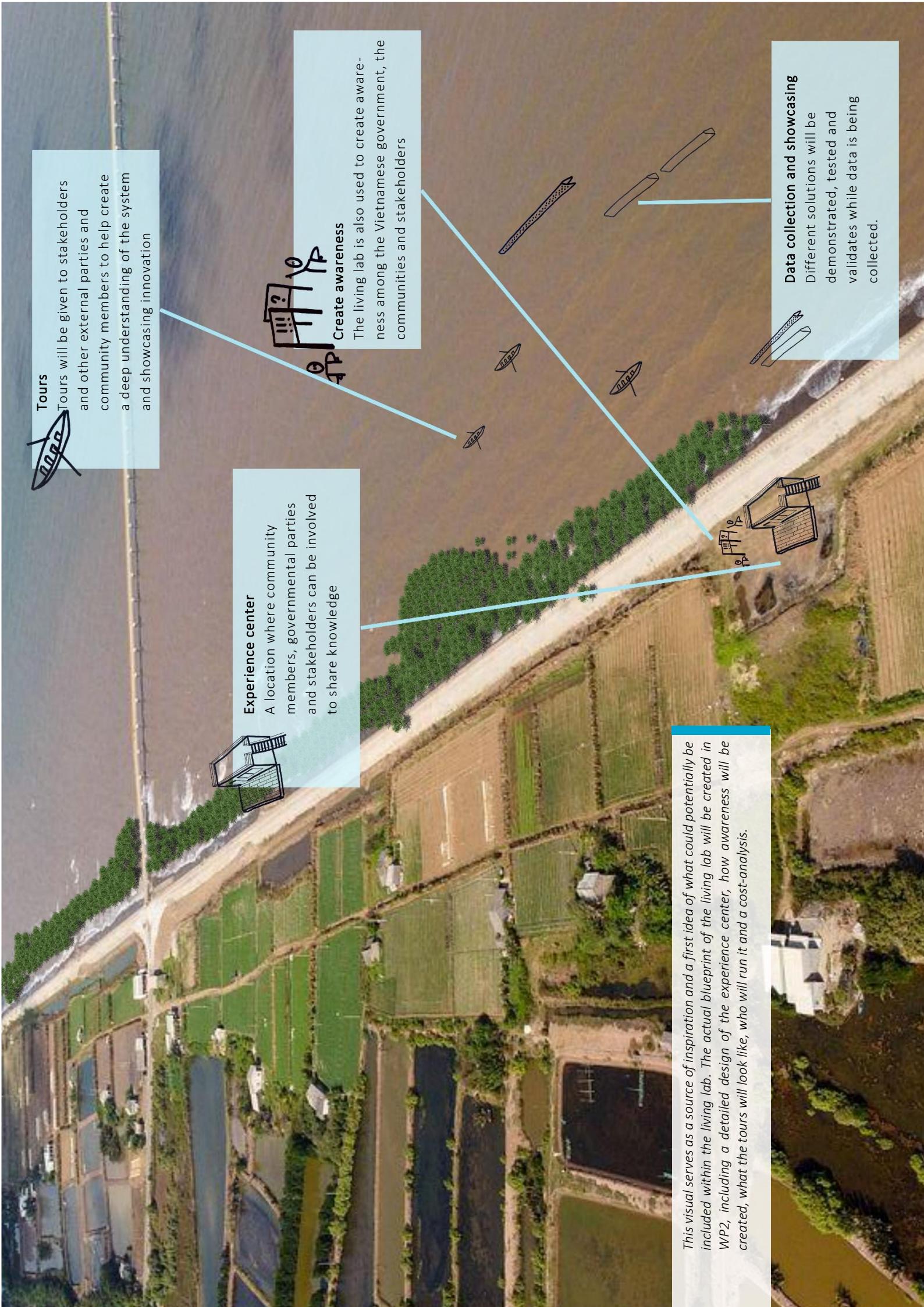
#### Policy influence

Collaborating with the local government empowers us to shape policies and regulations, directly contributing to well-informed governance measures and fostering an environment conducive to sustainable initiatives and projects.

 Research related benefit

 Showcasing related benefit

 Education related benefit



**Tours**  
Tours will be given to stakeholders and other external parties and community members to help create a deep understanding of the system and showcasing innovation

**Experience center**  
A location where community members, governmental parties and stakeholders can be involved to share knowledge

**Create awareness**  
The living lab is also used to create awareness among the Vietnamese government, the communities and stakeholders

This visual serves as a source of inspiration and a first idea of what could potentially be included within the living lab. The actual blueprint of the living lab will be created in WIP2, including a detailed design of the experience center, how awareness will be created, what the tours will look like, who will run it and a cost-analysis.

**Data collection and showcasing**  
Different solutions will be demonstrated, tested and validates while data is being collected.

## The plan for developing this living lab

To develop this living lab, we foresee four main work packages, these are as follows.

1

### Scoping & selection



#### Involved players

Team lead and team participants: TU Delft, Thuy Loi, the Institute of Coastal Engineering and the ICOE. External consultations: MARD, several provincial DARDs, HUNRE, SIWRP

#### Deliverables

Written documentation/feasibility study including photos of possible living lab locations using historical data and existing analyses based on physical criteria, but also based on practical, social and institutional criteria.

**Duration:** 12 months, since the selection of the permanent location will take time. Within this period we will already start with the mobile monitoring activities/the mobile lab.

#### Activities

- Conducting measurement campaigns and analysis in the different provinces and understanding the differences between the provinces, their difficulties and their coastlines.
- Complete a comprehensive scoping report for each province highlighting key findings and potential sites for both mobile monitoring campaigns and a possible permanent site.
- Researching current solutions for coastal protection and developing an extensive database of findings regarding the different solutions that have already been tested.

- Organising at least two meetings and workshops on the idea of a living lab with the responsible local authorities and communities to gather their input. We strive to enable equal access to these meetings regarding the gender of the participants. We also strive to ensuring representation of Khmer minorities within the participants and engage them in community events.
- Involving big donors like Asian Development Bank, Invest International and Worldbank by organising an event where we can present our first research. Secure expression of interest from at least one major donor before the end of the project period.
- Based on the scoping of possible living lab locations in the Mekong Delta and the results of the stakeholder workshop, our team will make the selection of a suitable site, by means of a comparative analysis, in one of the provinces in the Mekong Delta, in collaboration with WWF and Ramsar.
- Permission needs to be granted for the chosen location of the living lab. Complete a comprehensive report of the local policy, law and regulations. Engage with local authorities and follow due process for obtaining permits.
- Involving the local communities with the search of a location for the living lab by organizing at least one focus group session and creative session. We strive to enable equal access to these meetings regarding the gender of the participants. We also strive to ensuring representation of Khmer minorities in the audience and participants.
- Make a decision on the location of the living lab together with the Vietnamese colleagues. Ensure alignment with local expertise and perspectives.
- Utilize this inception phase to further structure and specify the work plan.

## Institutional and physical design



### Involved players

Team lead and team participants: TU Delft, Thuy Loi, the Institute of Coastal Engineering (ICOE)

and the Institute of Civil Engineering (ICE)

External stakeholders involved: MARD, DARD,

MONRE, DONRE, Dutch Embassy Hanoi (but

perhaps also other donors like the ADB, the

World Bank and Invest international).

### Deliverables

Written documentation on the consultations

and discussions with relevant institutions and

the resulting agreements/permission.

**Duration:** 6 months

### Activities

- Make the design of the living lab. Produce detailed design documents and plans for both the experience center and solution showcase. Ensure the design is practical and aligns with the overall project goals.
- Plan and design the interior layout of the lab, considering factors like equipment placement/storage, workstations, and safety measures to create a functional and efficient workspace and create a comprehensive interior layout plan.
- Establish a partnership agreement with a reputable local contractor who will be in charge of building/adopting the living lab. Our Vietnamese colleagues will assist in finding a suitable local contractor and supervising the works. Ensure local expertise and supervision during the construction.

- Build and complete construction of the living lab on the chosen location following granted permission.
- Conduct the first few experiments in the living lab together with students and staff of our partner universities/institutes.
- Organize a demonstration/opening event in the living lab for the Vietnamese government, the community members and other important stakeholders. We strive to enable equal access to these events regarding the gender and ethnic background of the participants.
- Develop and establish a (joint) research agenda to advance knowledge on nature-based solutions in the Mekong delta, together with other important stakeholders such as the ADB, WWF, Wetlands International, the Worldbank, Invest International and others that are working on the implementation of NBS in the Mekong Delta.
- Embedding the field lab in the various relevant institutions and programs through educational activities. Partner with universities, colleges, or schools to incorporate the field lab's activities into their curriculum. Besides the educational organizations, we will work closely with relevant local government department, agencies and local knowledge institutes (e.g. CTU, TVU and local TVET) as well. We also had first discussions with local universities such as Tra Vinh University.
- Develop and launch a digital platform in which we will share our research findings, provide input on policies, and support decision-making processes and ongoing projects.
- Engaging the local community by offering at least one workshops, educational programs or public event. We strive to enable equal access to these activities regarding the gender of the participants. We also strive to ensuring representation of Khmer minorities in the audience and participants.

## Experimentation and research



### Involved players

Team lead and team participants: TU Delft, Thuy Loi, ICOE, ICE and the TU Delft (also students). External consultations: MARD, DARD, MONRE, DONRE, Dutch Embassy Hanoi (but also other donors like the ADB, the World Bank and Invest International), and NGOs (Wetlands, WWF and Ecoshape)

**Duration:** 24 months, this includes experiments to validate the efficacy of the lab

### Activities

- Identify a comprehensive set of and implement appropriate research methods and monitoring protocols required for the actual design and construction of the living lab.
- Evaluate the suitability of existing instrumentation. Create a list of required equipment and assess the need for new acquisitions
- Purchasing the necessary equipment and materials for monitoring and evaluation. Procure all identified equipment and materials within the allocated budget. This activity also involves setting up the measurement protocols and the platform in which we will collect the data gathered from the physical living lab and the short-term measurement campaigns.
- Carry out the experiments and the tests In the living lab. Execute a minimum of six experiments involving various stakeholders and students. The experiments and the tests can be carried out with the relevant stakeholders and in collaboration with different students.
- Create and develop a specialized data platform for the physical permanent

living lab location and the mobile measurement campaigns. These platforms are essential for efficiently collecting, storing, and analyzing the data generated by the experiments and measurements conducted in the living labs. We will also ensure that we make the data accessible to researchers and stakeholders for research and decision-making purposes.

- Exploring and engaging with possible donor parties and large programs, such as the ADB mangrove project and Invest International, to ensure that our living lab can be incorporated in such a larger project to ensure the establishment of the living lab when the 3 year-period is finished. This is a crucial step to allow for a sustainable project after the subsidy ends. Secure commitment or incorporation into larger projects of at least one party for sustainability.
- Forging partnerships with at least three relevant parties or companies active in the Mekong Delta and offer them access to the living lab but also involve them and gain access to their resources, expertise, and possible coastal solutions.
- Engaging the local community by offering at least two workshops, educational programs, and public events. We strive to enable equal access to these activities regarding the gender of the participants. We also strive to ensuring representation of Khmer minorities in the audience and participants.

## Demonstration of the living lab



### Involved players

Team lead and team participants: TU Delft, Thuy Loi, ICO and ICE, HUNRE and the TU Delft.  
External consultations: MARD, HUNRE, Dutch Embassy Hanoi and other donors

**Duration:** The whole project duration (in total 36 months)

### Activities

- Promotion material about the living lab, online as well as on site through visible sign posts and markings. Utilize various channels for promotion, including social media and physical signage and artist collaborations.
- Documentation and communication material in which we share at least three experiments and research set-ups in the living lab. Use visual aids, reports, and online platforms to communicate findings.
- Set-up demos for validation and testing purposes, organise tours/communication/YouTube/X, educational and artistic projects as well as events to share our findings and insights with the communities, government staff, donors, colleagues and other relevant stakeholders. Conduct at least four validation demos and three events within the first year. Plan and execute engaging activities for diverse audiences.

## Foreseen planning of the project

The duration of the project is 3 years. We have already started the first work package by conducting some initial site investigations and having exploratory meetings with MARD and the various DARD offices in the provinces. Officially, the project will start on January 1, 2024. Our ambition is to select the field site within one month, so that we can start with the design of the living lab. This means that end of March, we aim to have already some monitoring installed and we can conduct the first experiments and have the official opening ceremony with VIPs.

Around the end of the first year, in December 2024 the report will be delivered concerning the first year activities. This report will entail a summary of the activities that have been implemented and the insights that have been gained over the first

year of experimenting, research and demonstration.

Furthermore, it is important to already explore funding options for when the subsidy ends, to ensure a sustainable project. Already before the start of the project, initial discussions have taken place with important stakeholders such as the AdB and Invest International who also joined our first scoping mission in December 2023. This living lab will fulfill a crucial role in their larger plans for the Mekong Delta and the ambitions of the Vietnamese government. Therefore, throughout the entire project period we will ensure (through involvement and alignment with these important actors), that this living lab will be incorporated and embedded in these large and long-term initiatives. We are very positive about the prospects for the institutional embedding and sustainability of the living lab.



NG - ĐỒNG THUẬN - SÁNG TẠO - PHÁT TRIỂN



Our Vietnamese team members have had numerous knowledge sharing sessions and consultations already with the local governments and communities in the Mekong Delta.



## The scope of the project

The project's scope is centered on the demonstration and exhibition of diverse solutions within the living lab setting. It is important to also note what is **not** within the scope of the project and what is thus excluded. First of all, the actual large-scale implementation of these solutions is not within the project's scope. Instead, the project aims to offer recommendations and insights, leaving the comprehensive execution of solutions to be addressed outside its boundaries. Secondly, the project refrains from directly engaging in the formulation of new policies or legislation. Although it plays a role in supplying data and recommendations for decision-makers, the development of official policies is a distinct process typically carried out by government authorities.

Additionally, the project does not encompass the long-term maintenance and monitoring of implemented solutions on a large scale beyond its designated period. The sustainability of solutions necessitates ongoing maintenance and monitoring, tasks that may fall under the jurisdiction of relevant authorities outside the living lab's scope. Nevertheless, the project acknowledges the importance of addressing pertinent issues that could serve as a foundation for continued monitoring and evaluation. Local parties involved in the project from its early stages may play a role in further monitoring and assessing these solutions.

## Our impact strategy

Our foreseen impact will be centered around two main activities:

### **1. Performing experiments and research both in our own laboratory and at various locations within the Mekong Delta region.**

By collecting relevant information and data, we will develop a unique database of actual data and monitoring results. This database will be openly available and accessible and it will collect all relevant (research) experiments, publications, data and stories. It will be focused on the activities in the living lab, but also on the other ongoing experiments and research projects related to mangrove research in Vietnam.

### **2. Sharing knowledge and insights on the complex topic of mangrove restoration.**

By conducting field experiments, demonstrations and tours we will create a physical space and showcase for know-how related to mangrove ecosystems. This will be a truly unique space where theory and practice will meet and people can come together to learn and get inspired. This will accelerate the uptake of new knowledge and solutions and it will lead to more fact-based and practice-oriented understanding and decision-making.

## Involving local communities

Involving the local communities within the foreseen research has a lot of benefits. Local communities often have a deep understanding of the environment, culture, and specific issues that researchers may be studying. Incorporating this local knowledge can lead to more accurate and contextually relevant research outcomes. Furthermore, by involving local communities, researchers can address issues that are of direct concern to the community. This can lead to research that is more relevant and useful for both the community and the broader scientific community. Also, collaborative research with local communities can lead to more sustainable and long-lasting outcomes as mutual understanding is created. It can empower communities by building research capacity and facilitating community-based initiatives that extend beyond the duration of the research project. Research findings that emerge from collaboration with local communities may have a stronger impact on policy and decision-making, as community members can advocate for change based on their own experiences and the research results. Establishing trust with local communities is crucial for the success of research projects, therefore our living lab will be situated in a province where we already have good local contacts and experience and a relationship we can build upon.

Local communities will be involved early on in the process, in a variety of ways during the project:

1. Introducing ourselves to the local community: Connect with the local members in an informal

- way, such as organizing drinks, a picnic or a tour to connect.
2. Involving community members within the search of a suitable location as well as with the design of the living lab.
  3. Create awareness around the living lab and the research: This can be done by collaborating with local marketing agencies, presenting plans in community meetings, sending out flyers or promoting the lab on social media platforms that will reach local members.
  4. Invite community members to collaborate on the realization of the lab: Having people voice their opinions and collaborate effectively can be done by organizing workshops, creative sessions or by inviting local advisory boards. In order to make the lab more visually appealing, collaborating with local artists or other members can even be considered.
  5. Involve the members within the actual research: this can be established by creating focus groups and conducting surveys and interviews but also organising citizen science campaigns.
  6. Collaborate with local players: Involve local marketing agencies, local building partners, local inhabitants, users and government and furthermore, local knowledge institutes, e.g. CTU, TVU and TVET, other relevant players that are necessary to develop and implement the living lab.

Other important ways to involve are described in the next section, to also minimise the potential risks.

### **Communication of the living lab**

The communication strategy for the coastal protection living lab project in the Mekong Delta involves engaging diverse stakeholders through local media partnerships, community outreach, and educational collaborations with schools and universities. The project will leverage social media platforms to share updates and visuals. Government briefings and participation in local events, will ensure alignment with policies and broader community awareness. Regular newsletters, will contribute to a comprehensive and inclusive communication approach. All of the data that will be collected and analysed will also be shared with local partners and stakeholders. There are a few ways through which we aim to share the insights and findings throughout the project, they are as follows:

#### **1. Community Meetings**

Community meetings serve as a platform for direct engagement with local residents and stakeholders. These meetings facilitate open communication, allowing project organizers to share updates, findings, and progress directly with the community. Additionally, it provides an opportunity for community members to ask questions, express concerns, and contribute insights based on their experiences. These meetings are equally accessible to all genders as well as all ethnic backgrounds.

#### **2. Focus Group Sessions**

Purpose: Focus group sessions gather a selected group of individuals to discuss specific topics in detail. By convening focused discussions, these sessions allow for in-depth exploration of project-related matters. Participants can provide detailed feedback, share nuanced perspectives, and collaboratively brainstorm ideas. This approach is particularly effective in gathering qualitative data and understanding diverse viewpoints.

#### **3. Informal social activities**

Casual gatherings, such as informal drinks, provide a relaxed atmosphere for communication. In a more informal setting, participants may feel more comfortable sharing their thoughts. This can foster a sense of trust, enabling the exchange of information in a less structured manner. It encourages networking among participants, potentially leading to spontaneous idea-sharing and relationship-building.

#### **4. A Newsletter**

Newsletters offer a structured and periodic means of communication. It provides a formal channel to share project progress, results, and important updates with a wider audience. It can be distributed to various stakeholders, including community members, local authorities, and interested parties. The structured format allows for organized dissemination of information, ensuring that stakeholders are kept informed on a regular basis.



Above is an example of Vietnamese street art that could potentially be incorporated on the living lab container. Below, the societal and public recognition is displayed for all the work the TU Delft has been doing together with MARD for the Mekong Delta.



## **Gender and minority strategy**

Our gender and minority strategy concerns inclusive participation and communication and it can be identified as gender transformative. We aim to facilitate the active participation of individuals from all genders and cultural backgrounds, including Khmer minorities, in project participation and community engagements. We strive for diverse representation on project committees, ensuring that voices of men and women and ethnic backgrounds are equally valued and considered. When we involve local community members, we are sensitive about gender norms, roles, relations and ethnicity.

Within the project activities, we strive to enable equal access to all genders and cultural background when it comes to focus groups, individual interviews, community meetings as well as social activities. We do this by actively inviting a diverse group of community members to these activities.

## **Potential Risks**

There are quite some risks related to the implementation and potential success of the project, these risks are as follows

### **1.Institutional support**

It can be quite challenging to find a location along the coastline in Vietnam where we will be allowed to measure, monitor, conduct experiments and invite a wide range of stakeholders. This means that the site should not only be practical (easy to reach and safe), but also the local authorities and communities need to be willing to work together with us and grant us permission to use parts of the coastline as a living lab. To minimize this risk, we'll need a site that is not only practical in terms of accessibility and safety but also requires cooperation and permission from local authorities and communities.

Fortunately, we have an advantage in this regard as many of our Vietnamese colleagues possess extensive research experience and have established valuable contacts in various Mekong provinces. This pre-existing network and expertise will be instrumental during the scoping

phase, enabling you to minimize most of the associated risks. By leveraging these relationships and working closely with our colleagues, we can increase the likelihood of finding a suitable location where we will be granted the necessary permits and can establish workable agreements with the relevant authorities. This collaborative approach enhances the project's chances of success by building vital local support and ensuring the project's alignment with community and regulatory interests.

### **2. Delays**

Official rules are set in place that can cause the project to get delayed. This concerns filling out excessive or seemingly unnecessary paperwork, obtaining licenses and permits for the living lab location and the building of the lab. These regulations may slow down the project or hinder decision-making processes. In order to avoid any unnecessary delays, we need to make sure we are well-educated regarding the rules and regulations. The critical steps in paperwork need to be identified and the importance of the steps need to be clarified. Building relationships with relevant authorities can help in expediting processes as well as establishing clear and streamlined communication channels where issues can be addressed promptly and miscommunication can be avoided. Unavoidable delays will be anticipated for regarding the project planning and timelines.

### **3. Social acceptance**

The concept of a living lab and working together with various institutes and authorities is relatively new in the Vietnamese context. We know from experience that for a living lab to be successful, it is crucial that many different types of stakeholders are actively involved and can see the added value. In this context, communication should not solely target the scientific and political communities in Vietnam but also extend to economic and social actors who are relevant to the living lab. Achieving social acceptance

necessitates presenting the living lab concept in a manner that resonates with and attracts a broad spectrum of stakeholders. The following steps can be taken to minimise the risks involved. First of all, we should draft a comprehensive communication plan that outlines how the living lab concept will be effectively communicated to different stakeholders. The plan should address the specific concerns and interests of each group. Secondly, we should team up with social scientists who can conduct research into the local social and cultural dynamics to gain insights into the best ways to engage with and gain acceptance from different community groups. Thirdly, designers can aid us in making the lab more visually appealing and relatable. Design can help making complex topics and ideas engaging, understandable and actionable, transcending language barriers. Ultimately, we should utilize the network of the Vietnamese colleagues to build trust and understanding with the local communities.

#### 4. Safety risks

Since we will be monitoring and measuring out in the open there are security and safety risks involved. For example, flooding and storm damage to our experimental set-ups and equipment is a risk, but also theft and vandalism. These risks can be addressed in two ways. First of all, we need to explore whether some of the local communities can play a role in maintaining the living lab. Collaborating with community members to establish a sense of ownership and responsibility for the lab's security and upkeep. Their presence can act as a deterrent to theft and vandalism. We can engage in community dialogues to address concerns and promote mutual understanding.

Furthermore, we should implement safety measures that include securing equipment. Install lockable containers to protect valuable tools and instruments, reducing the risk of theft and damage during extreme weather events. These containers should be designed to withstand adverse environmental conditions, such as storms and flooding.

#### 5. Local disruption of environment

Local disruption of the environment refers to the potential negative impacts that our living lab might have on the immediate surroundings and ecosystem. This could include mangrove forests and the adjacent coastal environment. The construction and operation of the living lab may disrupt the natural habitats of local wildlife, including bird species, fish, and other flora and fauna that rely on mangroves. This disruption could lead to changes in species distribution, nesting patterns, and feeding habits. When conducting our research, we will carefully take into account the presence of local plant and animal species in the area. This consideration is essential to ensure that our activities do not pose risks to these organisms or their habitats. By being mindful of the flora and fauna, we aim to minimize any negative impacts and promote responsible and sustainable research practices that harmonize with the natural environment.

#### 6. Infrastructure failure

This risk pertains to the potential issues regarding the physical structures and facilities within our living lab. Coastal areas are prone to natural disasters such as storms, hurricanes, and flooding, which can cause damage to infrastructure like boardwalks and observation platforms. Over time, infrastructure may experience wear and tear due to the heavy foot traffic of visitors, exposure to saltwater and coastal elements, and the impact of weather conditions. Insufficient maintenance or insufficient funds for repairs and upkeep can lead to infrastructure deterioration over time. To mitigate the risk of infrastructure damage from natural disasters, we should invest in resilient design and construction. We should ensure that structures are built to withstand coastal conditions and are resistant to storms, hurricanes, and flooding. We should use high-quality, durable materials that can withstand the corrosive effects of saltwater and strong winds. Next to using the correct materials, we should implement regular maintenance schedules to proactively address wear and tear. This includes routine inspections and maintenance activities to

identify and address issues before they become significant problems. Regular upkeep can help extend the lifespan of our infrastructure and a portion of the project budget should be allocated for ongoing maintenance and repairs. This budget should be flexible and responsive to infrastructure needs, with the ability to address issues promptly.

## 7. Local policy, laws and regulations

Local policy, law and regulations may cause the project to be delayed. There are a few local laws to which we must abide. Fortunately, due to the many local team members, we will be able to foresee the implications of the laws in such a way that expected delays will be minimized. The local laws are as follows:

- Land and Resource Ownership: Clear agreements need to be made regarding the ownership of the piece of land. This becomes especially important when our living lab borders the land of another party or individual.
- Environmental Protection Policies: This can encompass marine conservation as well as erosion and flood protection activities.
- Infrastructure Development and Land Use Planning: This may include zoning regulations, ensuring that the implementation of the lab aligns with sustainability goals within the location in the Mekong Delta.
- Laws and Regulations Regarding the Construction of the Living Lab: This will take the form of determining the size of the living lab and the specific activities that need to be carried out. These regulations are crucial to map out before the implementation of the lab can start.
- Perhaps also: Sustainable Tourism: In our plan, we express our intention to organize events; thus, the impact on the climate must be minimized during visits by researchers, stakeholders, and possibly tourists. Within the realm of sustainable tourism, transportation to and from the location is also considered, especially if the living lab is situated in a somewhat remote location.



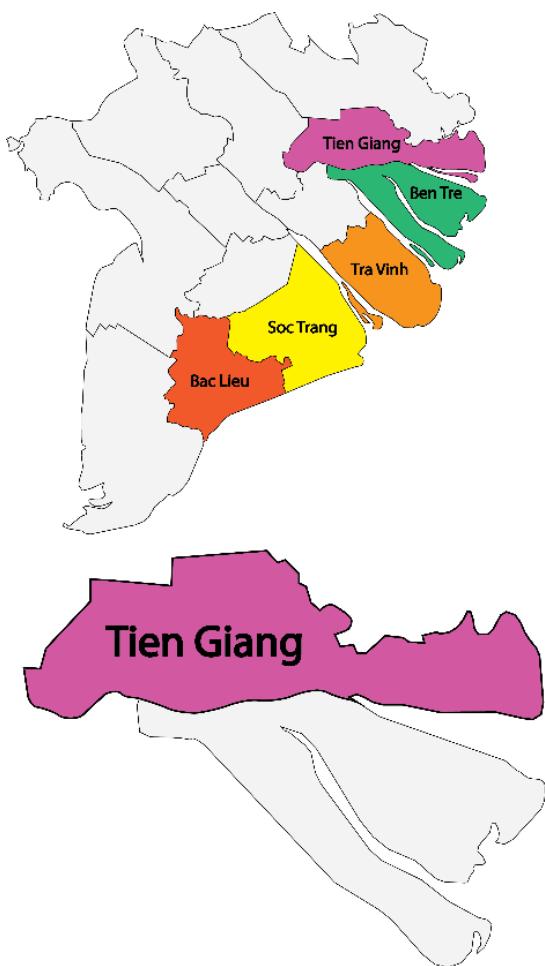


03

# Research starting point

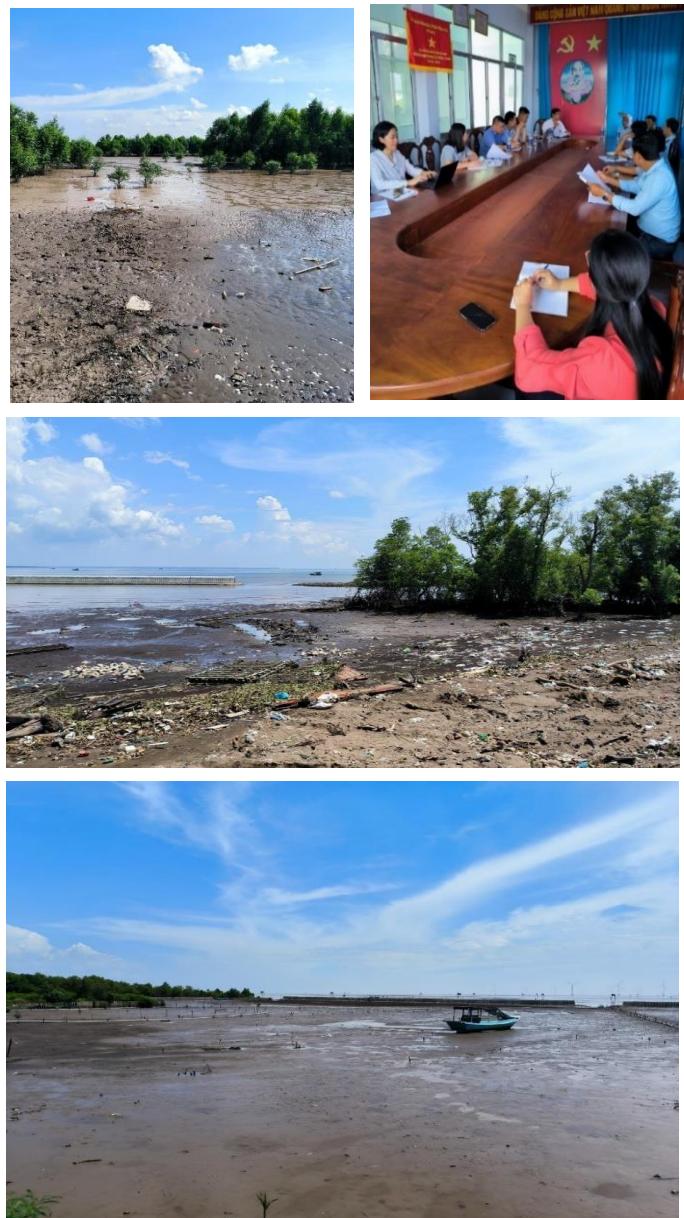
## Current status

A start with the project has already been made by visiting the 5 provinces in October 2023. An important insight is that each province comes with its own challenges and opportunities regarding mangroves. Below, the activities are shortly presented per province. The final selection of the location of the demo living lab will be in one of these provinces. However, we will conduct short-term measurement campaigns in the other provinces as well, making use of our mobile lab facilities and equipment. So in the end, we will gain insights and monitor in the various provinces of the Mekong Delta



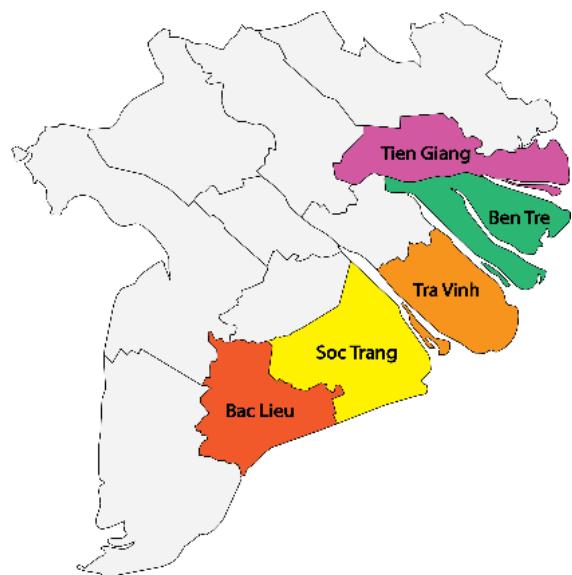
### 1. Tien Giang province

The mangrove degradation and coastal erosion are pictured below. In Tien Giang, we have conducted research with local farmers and officers. Below, the mangrove degradation is pictured as well as the coastal erosion that is seen in this province. Sedimentation is found behind the structures of Go Cong in Tien Giang. Behind the permeable dike, sedimentation and mangrove propagules is found.



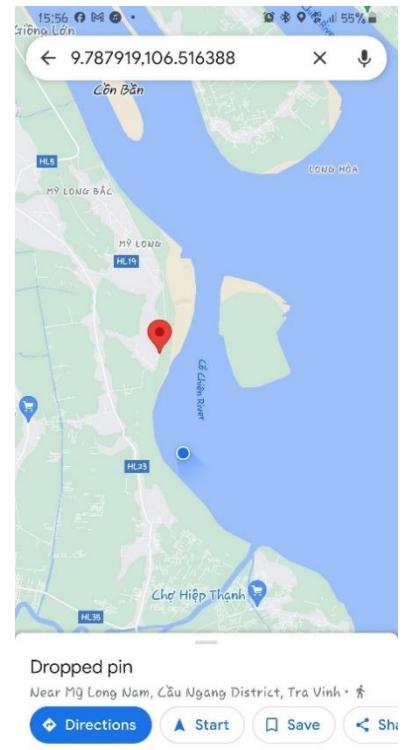
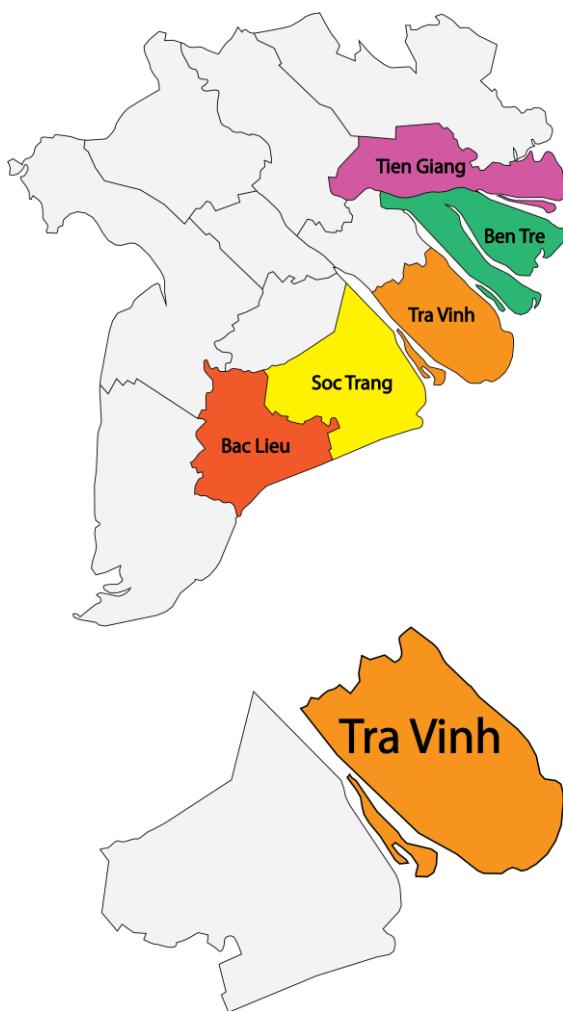
## 2. Ben Tre

In this province, we have collaborated with and exchanged information with local officials as well as residents. Data has been collected through a set of interviews and focus group sessions. During the field trip to this province, a sedimentation zone has been found in the Mudflats and pristine mangroves at Bai Lai, in the Ben Tre province. Below, these are pictured.



### 3. Tra Vinh

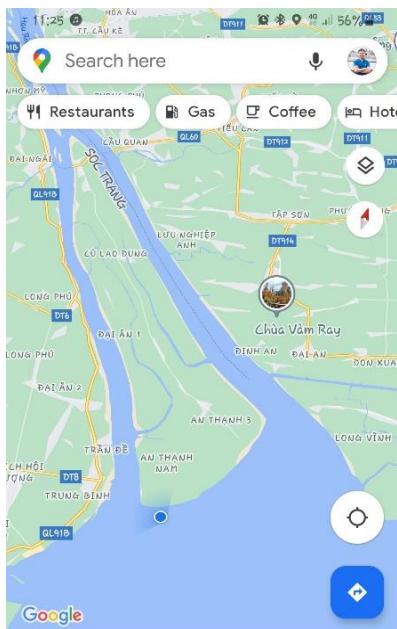
Field trip to Cau Ngan, My Long Nam (on map) where wooden fences (construct coconuts and bamboo branches) are partly destroyed. The mudflat elevation is increasing according to local officers. The small island (dune) has been developed since 1999. During our field visit to the Tra Vinh province, more data has been collected in information sharing sessions with officers as well as farmers.



#### 4. Soc Trang

The field trip was taken to southeast Cu Lao Dung where mangroves are well developing. Along the coast from south to north, young mangroves are growing quite well. Local government wants to build wooden fences at the location where the photo was taken to

increase sediment acceleration and larger mudflat for mangroves. Again, during our field visit here, additional data has been collected through knowledge sharing sessions and focus groups with local officers as well as local farmers.

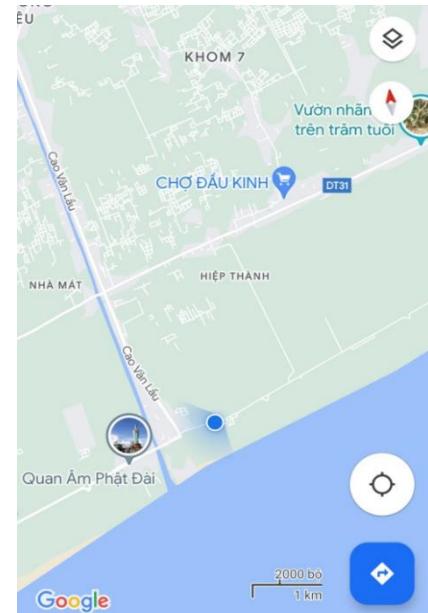


Latest in the area



## 5. Bac Lieu

In the Bac Lieu province we have been interviewing several local farmers. They have told us about their difficulties they have experienced with farming under the forest canopy. Below, a livelihood model and mangrove-based aquaculture of farmers is located behind the dike. We have also visited a Wind farm at the north Bac Lieu, right at the boundary with Soc Trang province. The photos below show the erosion at closer locations.





# Appendices

## Appendix I: Selection of Vietnamese and Dutch experts involved

<i>name</i>	<i>Thieu Quang Tuan (Thieu, Q.T)</i>
<i>MSc education</i>	Thuy Loi University, Hanoi and IHE Unesco
<i>PhD education</i>	Delft University of Technology, Delft 2007
<i>Present position</i>	Professor of Coastal Engineering, Thuy Loi University
<i>Research expertise</i>	Wave overtopping (VN sea dikes)
<i>Publication #1</i>	Breaching vulnerability of coastal barriers under effects of tropical cyclones: A model study on the Hue lagoon – Vietnam; <i>Ocean Engineering</i> 258, 111846
<i>Publication #2</i>	Monsoon wave transmission at bamboo fences protecting mangroves in the lower mekong delta; <i>Applied Ocean Research</i> 101, 102259
<i>name</i>	<i>Tran Thanh Tung (Tran, T.T)</i>
<i>MSc education</i>	Thuy Loi University, Hanoi and IHE Unesco
<i>PhD education</i>	Delft University of Technology, Delft 2012
<i>Present position</i>	Associate Professor of Coastal Engineering, Thuy Loi University, Vietnam
<i>Research expertise</i>	Hydrodynamic and Morphodynamic of coastal inlets (VN sea dikes)
<i>Publication #1</i>	Cross-sectional stability of tidal inlets: A comparison between numerical and empirical approaches, <i>Coastal Engineering</i> 60, 21-29.
<i>Publication #2</i>	Morphological modeling of tidal inlet migration and closure. <i>Journal of Coastal Research</i> , 1080-1084
<i>name</i>	<i>Nghiem Tien Lam (Nguyen, T.L)</i>
<i>MSc education</i>	Thuy Loi University, Hanoi and IHE Unesco
<i>PhD education</i>	Delft University of Technology, Delft 2009
<i>Present position</i>	Associate Professor Thuy Loi University
<i>Research expertise</i>	Estuarine dynamics, Numerical Modeling
<i>Publication #1</i>	Hydrodynamics and morphodynamics of a seasonally forced tidal inlet system
<i>Publication #2</i>	Morphodynamics of Hue tidal inlets, Vietnam
<i>name</i>	<i>Le Hai Trung (Le, H.T)</i>
<i>MSc education</i>	Delft University of Technology, Delft
<i>PhD education</i>	Delft University of Technology, Delft 2014
<i>Present position</i>	Associate Professor Thuy Loi University
<i>Research expertise</i>	Coastal Engineering; Sea Dikes
<i>Publication #1</i>	Quantification of changes in current intensities induced by wave overtopping around low-crested structures; <i>Coastal Engineering</i> , 55 (2), 113-124
<i>Publication #2</i>	Damage to grass dikes due to wave overtopping; <i>Natural hazards</i> 86, 849-875
<i>name</i>	<i>Mai Van Cong (Mai, V.C)</i>
<i>MSc education</i>	IHE, Delft
<i>PhD education</i>	Delft University of Technology, Delft 2010
<i>Present position</i>	Associate Professor Delft University of Technology
<i>Research expertise</i>	Probabilistic design, Coastal Protection Strategies
<i>Publication #1</i>	Coastal protection strategies for the Red River Delta, <i>Journal of Coastal Research</i> , 25 (1), 105-116
<i>Publication #2</i>	Distribution functions of extreme sea waves and river discharges. <i>Journal of Hydraulic Research</i> 46 (S2), 280-291
<i>name</i>	<i>Truong Hong Son (Truong, H.S)</i>
<i>MSc education</i>	Delft University of Technology (Erasmus Mundus EU program)
<i>PhD education</i>	Delft University of Technology, Delft 2018

<i>Present position</i>	Assistant Professor Thuy Loi University
<i>Research expertise</i>	Estuarine mangrove systems, Environment Fluid Mechanics, Nature-based solutions
<i>Publication #1</i>	Hydrodynamics of vegetated compound channels: Model representations of estuarine mangrove squeeze in the Mekong Delta
<i>name</i>	<i>Ms. Phan Khanh Linh (Phan, K.L)</i>
<i>MSc education</i>	Delft University of Technology (Erasmus Mundus EU program)
<i>PhD education</i>	Delft University of Technology, Delft 2019
<i>Present position</i>	Assistant Professor Thuy Loi University
<i>Research expertise</i>	Mangroves, Waves, Nature-based solutions
<i>Publication #1</i>	The effect of wave non-linearity on wave attenuation by vegetation. <i>Coastal Engineering</i> , Volume 147, Pages 63-74
<i>Publication #2</i>	Coastal mangrove squeeze in the Mekong Delta, Vietnam., <i>Journal of Coastal Research</i> , 31(23), pp.243-253.
<i>name</i>	<i>Phan Manh Hung</i>
<i>MSc education</i>	IHE Delft Institute for Water Education, The Netherlands, 2011
<i>PhD education</i>	Delft University of Technology, Delft 2020
<i>Present position</i>	Research specialist - Institute of Coastal and Offshore Engineering
<i>Research expertise</i>	Coastal Dynamics - Hydroinformatics - Remote Sensing and GIS in the Mekong Delta
<i>Publication #1</i>	Tidal wave propagation along The Mekong deltaic coast. <i>Estuarine, Coastal and Shelf Science</i> . 220, 73-98
<i>Publication #2</i>	Managing mangroves and coastal land cover in the Mekong Delta. <i>Ocean &amp; Coastal Management</i> . 219, 106013
<i>name</i>	<i>Dao Hoang Tung (Dao, H. T)</i>
<i>MSc education</i>	Thuy Loi University, Hanoi, 2014
<i>PhD education</i>	Delft University of Technology, Delft 2021
<i>Present position</i>	Assistant Professor HUNRE University
<i>Research expertise</i>	Coastal Engineering, Wave
<i>Publication #1</i>	Wave Damping due to Wooden Fences along Mangrove Coasts. <i>Journal of Coastal Research</i> , 34 (6), 1317-1327
<i>Publication #2</i>	Numerical and small-scale physical modelling of wave transmission by wooden fences. <i>Journal of Coastal and Hydraulic Structures</i> .
<i>name</i>	<i>Ms. Nguyen Thi Thu Ha (Ha, N.T.T)</i>
<i>MSc education</i>	Civil Engineering University, Hanoi.
<i>PhD education</i>	Delft University of Technology, Delft 2022
<i>Present position</i>	Assistance professor, Civil Engineering University, Hanoi
<i>Research expertise</i>	Wave, Coastal and Ocean Engineering
<i>Publication #1</i>	Wave Overtopping Discharge for Very Gently Sloping Foreshores. <i>Water</i> (Switzerland), 12(6), [1695].
<i>Publication #2</i>	The evolution of spectral wave periods at the structure toe over very gentle foreshores under extreme conditions
<i>name</i>	<i>Ms. Do Thi Kim Anh (Anh, D.T.K)</i>
<i>MSc education</i>	Da Nang University, Da Nang.
<i>PhD education</i>	Delft University of Technology, Delft 2019
<i>Present position</i>	Postdoc researcher at CEREMA, France
<i>Research expertise</i>	Coastal engineering, Morphodynamics and Hydrodynamic of coastal region.
<i>Publication #1</i>	The estimation and evaluation of shoreline locations, shoreline-change rates, and coastal volume changes derived from Landsat images. <i>Journal of Coastal Research</i> 35 (1), 56-71
<i>Publication #2</i>	Beach evolution adjacent to a seasonally varying tidal inlet in central Vietnam. <i>Journal of Coastal Research</i> . 34 (1), 6-25

<i>name</i>	<i>Marcel Stive</i>
<i>MSc education</i>	Civil Engineering, TU Delft
<i>Present position</i>	Professor Emeritus at TU Delft
<i>Research expertise</i>	Hydraulic Engineering
<i>Publication #1</i>	Managing mangroves and coastal land cover in the Mekong Delta. <i>Ocean and Coastal Management</i> . 219, 17 p., 106013.
<i>Publication #2</i>	Nature-based solutions for coastal engineering and management. <i>Water (Switzerland)</i> . 13, 7, 976.

<i>name</i>	<i>Thom Bogaard</i>
<i>MSc education</i>	Hydrology, Vrije Universiteit Amsterdam
<i>PhD education</i>	Universiteit Utrecht
<i>Present position</i>	Associate professor hydrology at Delft University of Technology
<i>Research expertise</i>	Civil engineering and geosciences
<i>Publication #1</i>	Effects of dynamic changes of desiccation cracks on preferential flow: experimental investigation and numerical modeling, <i>Hydrology and Earth System Sciences</i> . 27, 3, p. 783–808 26 p.
<i>Publication #2</i>	Recent advancements of landslide hydrology, <i>Wiley Interdisciplinary Reviews: Water</i> . 23 p.

<i>name</i>	<i>Bas van Maren</i>
<i>MSc education</i>	Physical geography, Universiteit Utrecht
<i>PhD education</i>	Utrecht university
<i>Present position</i>	Specialist at Deltares and TU Delft
<i>Research expertise</i>	Tides, sediment transport and morphology
<i>Publication #1</i>	The impact of channel deepening and dredging on estuarine sediment concentration, <i>Continental Shelf Research</i> 95, 1-14
<i>Publication #2</i>	Human impacts on morphodynamic thresholds in estuarine systems, <i>Continental shelf research</i> 111, 174-183

<i>name</i>	<i>Ellen Minkman</i>
<i>MSc education</i>	Civil engineering, TU Delft
<i>PhD education</i>	Erasmus University Rotterdam
<i>Present position</i>	Assistant professor TU Delft
<i>Research expertise</i>	Water governance
<i>Publication #1</i>	Mismatches between policy planning and implementation on the actively living with flood approach in the Vietnamese Mekong Delta, <i>Water International</i> . 47, 2, p. 297-320 24 p.
<i>Publication #2</i>	From national vision to implementation: governance challenges in sustainable agriculture transitions in the Vietnamese Mekong Delta region, <i>Regional Environmental Change</i> . 22, 2, 35.

<i>name</i>	<i>Leon Hermans</i>
<i>MSc education</i>	Systems engineering, Policy analysis & management, TU Delft
<i>PhD education</i>	Delft University of Technology, Delft
<i>Present position</i>	Associate professor
<i>Research expertise</i>	Delta management
<i>Publication #1</i>	Evaluating behavioural changes for climate adaptation planning, <i>Journal of Environmental Planning and Management</i> . 66, 7, p. 1453-1471 19 p.
<i>Publication #2</i>	Assessing the societal adoptability of participatory water management: an application of the Motivation and Ability (MOTA) framework, <i>Water Policy</i> . 24, 5, p. 729-746 18 p.

<i>name</i>	<i>Jos Timmerman</i>
<i>MSc education</i>	Biology. Wageningen University & Research
<i>PhD education</i>	Wageningen University & Research
<i>Present position</i>	Senior expert water and climate adaptation
<i>Research expertise</i>	Climate change adaptation
<i>Publication #1</i>	Assessing management regimes in transboundary river basins: do they support adaptive management?, <i>Ecology and Society</i> 13 (1), 14
<i>Publication #2</i>	Adaptation to climate change: challenges for transboundary water management, <i>The Economic, Social and Political Elements of Climate Change</i> , 523-541
<i>name</i>	<i>Lindsey Schwidder</i>
<i>MSc education</i>	European Studies on Society, science and technology, University Maastricht
<i>Present position</i>	Project manager water
<i>Expertise</i>	Project coordinator of the OKP Climate Proof Vietnam project
<i>Experience</i>	More than 10 years of experience in Vietnam
<i>Role</i>	Project coordinator
<i>name</i>	<i>Marjan Kreijns</i>
<i>MSc education</i>	Development economics and international land and water development
<i>Present position</i>	Director of The Green Village, field lab for sustainable innovation
<i>Expertise</i>	Expert in the development of living labs and international research projects
<i>Experience</i>	More than 20 years of relevant experience in Vietnam in the field of water management and education
<i>Role</i>	Project director
<i>name</i>	<i>Paul Erfiemeijer</i>
<i>MSc education</i>	Biology, Radboud University Nijmegen
<i>PhD education</i>	Radboud University Nijmegen
<i>Present position</i>	Marine Scientist, Independent consultant
<i>Research expertise</i>	Marine science
<i>Publication #1</i>	Successful mangrove establishment along an artificially created tidal creek at Port Hedland, Western Australia
<i>Publication #2</i>	Parameterization of an optical model to refine seagrass habitat requirements in an urbanized coastline
<i>name</i>	<i>Charlotte Struijk</i>
<i>MSc education</i>	Strategic Product Design Engineering, TU Delft
<i>Present position</i>	Project Coordinator
<i>Research expertise</i>	Consumer market insights

