



**Final Technical Report  
Component 2.4**

**Innovation for Climate Adaptation and Resilience**

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<b>Name of Organization:</b>	Zephyr Consulting Limited
<b>Title of Project:</b>	CIC 359: SLAMDAM (water-filled flood barrier)
<b>Reporting Dates</b>	26 <sup>th</sup> of each month during the project
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### 1. Executive Summary

Zephyr Consulting's mission is to create sustainable societies where people and the environment can flourish. To realise its mission, the company offers innovative solutions to enhance resilience to floods and drought. One of Zephyr's core products is SLAMDAM, an easily deployable water-filled flood barrier.

Zephyr Consulting participated with SLAMDAM in the Climate Innovation Challenge (CIC) facilitated by the Asian Disaster Preparedness Center (ADPC). Zephyr was selected to implement a project in South Asia that centered aims to enhance resilience to floods using SLAMDAM.

Pakistan is a country that suffers greatly from flooding, which has exacerbated the last decades due to climate change. The country is actively looking for innovative measures to enhance resilience to floods. Pakistan was therefore a highly suitable country to implement the SLAMDAM pilot project as part of the CIC-program.

The project was implemented in the with the Passu community in Gilgit-Baltistan, located in the northern part of Pakistan. This region suffers from floods caused by seasonal melting of the various nearby glaciers. These floods impact the people, the environment and various assets such as housing and infrastructure.

SLAMDAM was manufactured, shipped and deployed to demonstrate the workings and effectiveness. In addition, the people were trained on how to operate the SLAMDAM technology independently.

The different stakeholder groups such as the local community, the Global Change Impact Studies Centre (project endorser), local NGO and disaster management organisation are convinced that SLAMDAM is an innovative and effective solution to help Pakistan enhance resilience to (climate change-induced) floods. They confirm that there is ample opportunity to scale-up / replicate SLAMDAM all over Pakistan

### 2. Background to Pilot

SLAMDAM is a mobile flood barrier made out of EPDM (a synthetic rubber). The flood barrier is rapidly built up by filling it with water. With merely two persons, you can build up a barrier of 100 meters in 1 hour.

The pilot entailed the deployment of SLAMDAM alongside the Hanzu river that flows through Passu in Gilgit-Baltistan. This river overflows periodically due to seasonal melt water from the nearby glaciers. SLAMDAM was deployed by the local flood response team to demonstrate its workings and to prevent flooding caused by the overflow of the river.

The overall goal of the project was to determine whether SLAMDAM is a scaleable

climate adaptive solution that can help Pakistan, and other countries in South Asia, enhance resilience to the negative impacts of climate change in the water sector. This goal resulted in two key objectives of the pilot, namely to:

- Demonstrate SLAMDAM as an effective solution to adapt to climate change by enhancing resilience and reducing vulnerabilities to (climate change-induced) floods in Gilgit-Baltistan in Pakistan.
- Enhance capabilities of local people and institutions to manage risk of floods independently using flood resilient measures

This project contributes to the overall goals of innovation in climate resilience by demonstrating the effectiveness of a climate adaptive solution that is not business-as-usual and has the potential to be scaled up. The success of this project is an important step in realizing the goal of innovation in climate resilience in the water sector for Pakistan.

Projects are as a rule community-driven, however they required involvement of different parties in the public and private sector across different layers of the society. An important co-benefit of SLAMDAM is to enhance collaboration between people and organisations from different backgrounds. The beneficiaries are ultimately local communities who are protected from the negative impacts of (climate change-induced) floods. Notwithstanding that beneficiaries are also public officials who are tasked with enhancing resilient to climate change / floods. The private sector might also benefit when SLAMDAM reduces damages incurred by floods.

The key metrics are defined through the (i) objectives, (ii) outcomes and (iii) outputs. With each output there are identified indicators with metrics described on how to measure and monitor indicators. Indicators can be expressed in monetary or non-monetary values. For each indicator, there will be a baseline (i.e. flood event without SLAMDAM) and the target (i.e. flood event with SLAMDAM).

Implementation of SLAMDAM has an impact of the following Sustainable Development Goals (SDGs):

- SDG 5. Gender equality
- SDG 6. Clean water and sanitation
- SDG 8. Decent work and Economic Growth
- SDG 11. Sustainable cities and communities
- SDG 13. Climate Action

**Long-term impacts i.e. objectives:**

- Objective 1: Reduce vulnerability and increase resilience to climate-induced flooding through innovation and technology transfer for climate change adaptation.
- Objective 2: Strengthen community resilience and local capacity building to increase prosperity.

**Mid-term impacts i.e. outcomes:**

- Outcome 1: Weather information service solutions in combination with a mobile flood barrier piloted or deployed to reduce climate-related flood and drought risks and/or enhance resilience.
- Outcome 2: Institutional and human capacities strengthened to identify and implement adaptation measures.

**Short-term impacts i.e. outputs:**

- Output 1.1.1: Physical and natural assets made more resilient to climate induced flooding
- Output 1.1.2: Livelihoods and sources of income of vulnerable populations diversified and strengthened
- Output 1.1.3: The number of people who are warned of climatic induced floods and drought grows and the warning consistency and reliability is increased
- Output 1.1.4: Vulnerable natural ecosystems strengthened in response to climate change impacts
- Output 2.1.1: Active, skilled, and materialised local flood and drought response team
- Output 2.1.2: Number of people trained and informed regarding climate change impacts and appropriate adaptation responses

There is a Theory of Change reflecting the short-, mid- and longterm impacts. In addition, there is a Logical Framework that includes indicators that are measured and monitored to evaluate the realization of these impacts with the implementation of SLAMDAM.

Zephyr Consulting is experience in developing flood and drought resilient solutions such as the mobile flood barrier and software-related solutions. The company has implemented various projects in developing countries across Asia and Africa financed by international donors such as the U.N., the World Bank, and the African Development Bank Group. Zephyr Consulting furthermore collaborates with many local partner organisation and reputable expert organisations in the water industry including the University of Delft and Deltares. The ambition is to scale-up the innovative climate resilient measures worldwide to help enhance resilience to climate change.

**3. Process, Progress and Results**

The project team consisted of people/organisations based in the Netherlands and Pakistan. Key to the success of the project was an active and positive collaboration between the different parties. The project took the following steps to implement the project:

- Collect and synthesize hydraulic and area data.

- Develop hydrological model and flood scenarios.
- Develop flood risk assessment.
- Manufacture and ship the mobile flood barrier and accessories.
- Appoint and train the local flood response team.
- Demonstrate the deployment of SLAMDAM.
- Monitoring and evaluation activities.
- Project closure including lessons learned.

The project was implemented successfully and to the satisfaction of the different involved stakeholder groups.

#### **Outcomes:**

- Outcome 1: Weather information service solutions in combination with a mobile flood barrier piloted or deployed at Passu to reduce climate-related flood risks and enhance resilience.
- Outcome 2: Institutional and human capabilities of people and institutions in Gilgit-Baltistan in Pakistan strengthened to identify and identify SLAMDAM as an effective climate resilient measure and how to operate this technology.

#### **Outputs:**

- Output 1.1.1: Physical and natural assets in Passu made more resilient to climate induced flooding using SLAMDAM.
- Output 1.1.2: Livelihoods and sources of income of vulnerable populations in Passu diversified and strengthened.
- Output 1.1.3: The number of people in Passu who are warned of climatic induced floods grows and the warning consistency and reliability is increased.
- Output 1.1.4: Vulnerable natural ecosystems in Passu strengthened in response to climate change impacts.
- Output 2.1.1: Active, skilled, and materialised local flood response team in Passu.
- Output 2.1.2: Number of people in Passu trained and informed regarding climate change impacts and appropriate adaptation responses.

#### **Achievements per outcome and output**

- Outcome 1: The project utilized hydrodynamic modelling software to analyse flood risks in the selected region. In addition, recommendations have been made to improve the current flood early warning system. The mobile flood barrier has been manufactured and shipped and deployed at Passu to prevent damages caused by rising water levels due to melt water from the neighbouring glaciers.
- Outcome 2: We've trained local stakeholder groups including local community members on how to enhance resilience using the technologies

we've supplied. Training was provided online as well as onsite during a local visit from project team members. Training was completed successfully and people are very capable on how to use SLAMDAM to prevent damages caused by flooding.

- Output 1.1.1: People, buildings and crop land in Passu are made more resilient to flooding by using SLAMDAM to prevent flooding. The flood barrier has been deployed and is preventing damage from rising water levels.
- Output 1.1.2: The damage reduction enables farmers to grow crops without these being damages during flood season. Crops production will increase contributing to livelihoods and sources of income of vulnerable populations in Passu.
- Output 1.1.3: The project has developed recommendations to improve the flood early warning system. In addition, the project has established clear communications lines and roles and responsibilities with regards to flood monitoring and flood response.
- Output 1.1.4: The deployment of the SLAMDAM technology will reduce damages to the biodiversity in the region. In addition, deployment of SLAMDAM will lead to depositing of sediments and therewith preventing land erosion.
- Output 2.1.1: The local flood response team in Passu has been trained well and this is demonstrated when the team deployed the mobile flood barrier independently.
- Output 2.1.2: Local community members have attended presentations on climate change and the need for flood resilience measures. Some of them have also witnessed and contributed to the deployment of SLAMDAM.

**Value added by SLAMDAM / Early stage impacts expressed in indicators:**

Despite that it's early stage, the project has already realised impacts as targeted in the initial setup of the project. The impacts will increase with time, seeing as floods take place periodically. Some of the early-stage impacts are listed below:

- Protected land from flooding: SLAMDAM is preventing land from being flooded due to current rising water levels.
- Protected crops: Potato fields are protected from flooding due to rising water levels caused by seasonal melt water from the neighbouring glaciers.
- Protected animal shelter: Nearby animal shelter is protected from rising water levels.
- Improved level of flood resilience: The overall resilience to flooding has increased in the Passu area.
- Trained people: Local stakeholder groups like the PDO, local community and AKRSP have been trained on how to use SLAMDAM to prevent damages caused by flooding.

- Improved level of climate risk awareness: There is an increase awareness on the risks of climate change and the need to implement climate resilient measures. The Passu community already came up with ideas how to deploy SLAMDAM elsewhere in the region.
- Improved flood response process: There is an improved flood response process to ensure people are warned in a timely fashion in case a flood has been detected.

Another added value is that SLAMDAM is used to control water availability for irrigation purposes of nearly crop land.

#### **Real difference by SLAMDAM**

The SLAMDAM-technology will improve the resilience of the community at Passu against flooding. The community is better prepared to prevent damages caused by rising water levels of the Hunza river due to seasonal melt water of the nearby glaciers.

The SLAMDAM-technology can also be used to control water availability for irrigation purposes. This in turn will support increase in crops production.

In addition, the community has improved capabilities on how to use the SLAMDAM-technology as well as an improved awareness with regards to flooding.

#### **4. Challenges and Mitigation Measures**

- One of the challenges is to make sure the area is suitable to deploy SLAMDAM and reasonably accessible. In that sense, the pilot location was challenging, considering that it was not easy to take the flood barrier to the location, although we were successful at the end.
- To mitigate this challenge in the future, it is important to conduct multi-disciplinary field visits to inspect the areas.
- Another challenge was that the underground was sometimes “sandy” and “sloped”. A suitable underground is needed to implement an effective flood barrier.
- To mitigate this challenge in the future, it is important to conduct multi-disciplinary field visits to inspect the areas.
- Another challenge was that the community is very interested in higher models of the mobile flood barrier. Higher models require heavy equipment to deploy them.
- To mitigate this challenge in the future, it is important to develop higher models and carefully work out how to operate these barriers.
- Another challenge was it’s challenging to monitor the effectiveness of the flood barrier from a distance, not in the least part because the internet connection is not always available in the region.
- To mitigate this challenge in the future, it is important to appoint and instruct

an M&E officer. It would help if the officer is well-versed with SLAMDAM so that he/she can advise should anything go wrong.

## **5. Lessons Learned and Recommendation**

- Next projects it's important to hold more frequent field visits with different stakeholder to inspect the areas. Field visits should also take place in the early stage of the project. This will shorten the time needed to select suitable project locations.
- Explore opportunities to reduce costs related to taxes and duties, considering that these can get very high.
- When we have selected multiple locations where SLAMDAM could be deployed, it might be worth installing a centralised storage facility strategically located to cover the different possible locations.
- Part of the analysis phase should also be to use flood intelligence software to determine the anticipated benefits from deploying SLAMDAM. This helps in understanding how best to implement the flood barrier.

## **6. Conclusion and Way Forward**

The project is at an end and it is now necessary to explore opportunities to scale-up / replicate SLAMDAM in Pakistan and the rest of South Asia. The project has identified incentives / factors that determine whether the pilots will be taken up by governments. The conclusion and way forward are described below.

### **Conclusion**

The original project objectives have been realised seeing as the innovative flood barrier called SLAMDAM has been manufactured and deployed at the pilot location. The flood barrier is currently preventing floods seeing as water levels have already risen.

The local community has been trained well and knows how to operate the mobile flood barrier independently. The community is satisfied with this solution and they are already exploring locations in the region where SLAMDAM can be deployed.

Other stakeholder groups, including potential clients, were also invited to attend the demonstration at Passu. All of the attendees were impressed with the SLAMDAM-technology and they have ideas on where to scale-up the SLAMDAM-technology across Pakistan.

### **Incentives / factors that enable scaling up**

The project has identified incentives / factors that determine whether the pilots will be taken up by governments:

- Representatives have expressed an interest to see the SLAMDAM-technology in real-life, either at the pilot location or in The Netherlands.
- It is imperative that the anticipated benefits from the deployment of the SLAMDAM-technology are quantified. We have flood intelligence software that supports a quantification of the anticipated benefits.

- Financial means have to be available to finance projects.

### **Way Forward**

The project was completed successfully and potential clients have already expressed an interest to scale-up SLAMDAM across Pakistan. It is important to ensure decision makers support the scaling up of the SLAMDAM-technology as well. The technology is fully endorsed and adopted by various governmental bodies in Pakistan. Some of the organisations that have already expressed a serious interest in SLAMDAM are: WWF, RUDA, Sindh Provicen and AKP. Partnerships with these organisations have already progressed seeing as various meetings have taken place to further scale up the technology.

When we gave the demonstration at Passu we invited different stakeholders and presented them the technology. Considering their positive feedback, we requested them to be our ambassadors within their respective organisations and they agreed.

We have planned to hold a comprehensive demonstration in the Netherlands for Dutch governmental bodies and water boards in October 2022. We will invite different stakeholders from Pakistan to the demonstration in The Netherlands so that they can see the workings of the mobile flood barrier.

We will discuss with potential clients and donor organisations how best to finance projects in Pakistan to enhance resilience to floods in Pakistan.

Once decision makers agree to implement SLAMDAM and financing has been secured, we will prepare a project plan to scale-up the mobile flood barrier.

### **Pictures of the demonstration:**







*Annexes:*

*Annex 1: Transfer Donation Plan for all equipment (durable items with a value of over USD 500) and any remaining consumables/goods (with a value of over USD 500 per category of items, namely identical or similar items used for the same purpose) purchased under the Agreement (refer to Clause 7f, page 4 of the Grant Agreement)*

*Annex 2: An Endorsement letter or certificate of completion from the endorser.*

*Annex 3: Dissemination products (case studies, brochures, links to videos etc)*

*Annex 4: Final Invoice*



