XI.PROS – 98

FRESH WAVE - **F**lood **RE**silience and **S**ustainable **H**uman **W**ater **A**ccessibility for **V**ulnerable **E**nvironments - A Pilot Study in Indonesia

Section 1: General Information	
Summary	Climate change has been directly linked with increased frequency and intensity of heavy rainfall events, which has contributed directly to urban flooding[1]. In addition to disrupting daily livelihoods of communities and causing extensive property damage, urban floods strain cities' emergency management systems[2]. Social equity plays an important role in urban resilience, as it is central to effective disaster risk management[3]. Urban floods represent multifaceted socioeconomic challenges, as they show the relationship between social equity, natural hazards, and systemic vulnerabilities, especially in informal settlements. According to a study by Akbar and Edelenbos[4], informal settlements, often known as kampungs in Indonesia, are particularly vulnerable since they frequently have an informal land tenure and lack essential infrastructure. In Indonesian urban kampungs, the term "informality" refers to a combination of physical attributes as well as sociocultural, economic, and geographic characteristics[5]. Our proposed project aims to improve flood resilience within Indonesia's informal settlements (our pilot study) through identifying infrastructure vulnerabilities, community engagement, and a specialized early warning system. We have aligned our initiative with several Sustainable Development Goals (SDGs), particularly SDG 6, 11, 13, 15, and 17. We plan on utilizing a multidisciplinary analytical toolset drawing from remote sensing, hydrologic modeling, network science, complex systems, and infrastructure resilience, the Infrastructure Disruption, Operation, and Recovery Analysis of Inundation (INDORAIN) tool, to assess and prioritize water infrastructure upgrades. We intend on engaging communities in flood risk mapping, and we seek to co-develop local-level early warning systems with local leaders and residents of informal communities. By doing so, we hope to measurably

[1]Schreider, S. Yu., D. I. Smith, and A. J. Jakeman. "Climate Change Impacts on Urban Flooding." Climatic Change 47, no. 1 (October 1, 2000): 91–115. https://doi.org/10.1023/A:1005621523177.

[2] Lamond, Jessica E., Zuzana Stanton-Geddes, Robin Bloch and David G. Proverbs. "Cities and flooding: Lessons in resilience from case studies of integrated urban flood risk management." (2013).

[3] Matin, Nilufar, John Forrester, and Jonathan Ensor. "What Is Equitable Resilience?" *World Development* 109 (September 2018): 197–205. https://doi.org/10.1016/j.worlddev.2018.04.020.

[4] Akbar, Poeti, and Jurian Edelenbos. "Social Impacts of Place-Making in Urban Informal Settlements: A Case Study of Indonesian Kampungs." *Social Sciences* 9, no. 6 (June 17, 2020): 104. https://doi.org/10.3390/socsci9060104.

[5] Ibid

	reduce flood risk in informal communities by 2030, increasing community preparedness as a result. Furthermore, we propose to establish workshops and training sessions for informal settlements' residents to raise awareness around flood risk management. Finally, we hope to replicate the pilot study's methods in other parts of the Southern Corridor.
Proponent Name(s)	Northeastern University, Indonesia, UN
Proponent Type	University and National Government
Primary Contact Name	Prof. Auroop R. Ganguly
Primary Contact Details	a.ganguly@northeastern.edu
Additional Contact Details	-
Region	Southern Corridor (Developing Countries) Nations

Section 2: Commitment	
Linkages to SDG 6	Our proposed project can be linked to several sub-goals of SDG 6: *Insights for developing flood-resilient infrastructure*: This aspect directly supports **SDG 6.5** since it aims to improve water stewardship and reduce the community impacts of water-related disasters. *Community-based flood management initiatives and participatory flood risk mapping:* This directly supports **SDG 6.6** because it calls for the protection and restoration of water ecosystems (which can include natural barriers such as mangroves) through greater community involvement and participatory risk mapping. *Projects for water accessibility:* This directly supports **SDG 6.1** and also **SDG 6.2;** it does so because it ensures more sustainable access to safe and sanitary water, especially in informal settlements that are often underserved.
Target	Our proposed project has six targets, each of which can be tied to our actions and outcomes referenced later in this document: • *Target 1:* Reduce flood risk vulnerability of informal settlements in the pilot area (Indonesia) by 2030 through use of the INDORAIN tool for simulating flood impacts and what-if scenarios for community-driven retrofitting programs. We will analyze the flood vulnerability of infrastructure to provide information needed for resource allocation and/or to identify infrastructure upgrade prioritizations. • *Target 2:* Engage informal communities in the participatory flood risk mapping process by 2027, which can lead to new community-led water ecosystem projects such as mangrove restoration in high flood-risk areas. • *Target 3:* Utilize the INDORAIN tool to perform a comprehensive assessment of existing water infrastructures within Indonesia’s informal settlements. This, in conjunction

	with informal community engagement, can help with prioritizing water infrastructure upgrades, as there can be a greater focus on systems that would increase water availability to the largest numbers of informal residents. • *Target 4:* Develop a scalable early warning system in Indonesia's informal settlements area by 2027, with the system being co-created by local communities, ensuring local-level needs are heard and implemented. In the event a flood occurs after the system's implementation, gain feedback from stakeholders such as informal citizens and local leaders. • *Target 5:* Help establish workshops and training sessions for residents of informal settlements, to raise awareness around flood risk management and strengthen local capabilities in the early warning system usage/emergency response. • *Target 6:* Replicate the pilot study's methods and tools in another region of the Southern Corridor by 2029, depending on the level of need at that time (for example, a country may be experiencing a higher flood risk compared to others, which would be our priority as the next focus region). Develop an early warning system to cater to the region's needs and focus on informal/marginalized/vulnerable communities.
Linkages to other SDG	• SDG 11.5 (Sustainable cities and communities): This SDG sub-goal focuses on mitigating disasters in urban environments. Our proposed project is linked to this goal because we are aiming to upgrade flood-resistant infrastructure specifically to reduce vulnerability of urban populations in flood events. • SDG 13.1 (Climate action): This SDG is linked to our proposed project, as it focuses on efforts to improve resilience to flood events (more and more induced by climate change), by enhancing water infrastructure and implementing community-based planning. • SDG 15.3 (Life on land): This SDG is linked to our proposed initiative since it involves ecosystem management to reduce damage from floods; in addition, this SDG also halts biodiversity loss and promotes sustainable practices, which are key to our overall goals. • SDG 17.17 (Partnerships for the goals): This SDG is linked to our proposed plan, as it encourages partnerships between public/public-private/local communities.

Section 3: Actions and Outcomes to Achieve Targets	
Relevant Sub-Theme	Disaster risk reduction and disaster management
Actions and Outcomes	Our proposed project has six actions and outcomes: 1. Develop **analytical tools** for vulnerability assessments using frugal innovation *(Target 1).* a. Begin by implementing a pilot project in Indonesia, where we focus on informal settlements (kampung). We will develop and employ an analytical toolset, the Infrastructure Disruption, Operation, and Recovery Analysis of Inundation **(INDORAIN)** tool,

	pipelining storm and rainfall data from earth observation satellites, climate models, and stream gauges into hydrologic models, integrating simulations of urban flooding with methods drawn from network science and complex systems to simulate the impacts of fluvial, pluvial, and coastal flooding on lifeline infrastructure systems including transportation, communication, water, and power. Combined with demographic and land use information and with scenario-specific tailoring, this approach will enable the identification of component-level vulnerabilities based on assessed flood exposure and system-level impacts to informal settlements. *b. Outcome:* We will have a better understanding of flood risks in informal settlements which will lead to effective targeted interventions for vulnerable communities of Indonesia. 2. Include community-driven flood control measures (*Target 2)* a. Once the analytical tools from Step 1 have identified the most vulnerable informal settlement areas, continue developing the early warning systems to include community-driven flood measures. This will include citizens in all stages of planning through participatory flood risk mapping, a concept that has been proven to be successful in the past in Indonesia and other similar geographies. We plan to include relevant stakeholders, some of which may include the Indonesia's National Development Planning Agency (Bappenas), the Ministry of Public Works and Housing, the National Disaster Management Agency or the Badan Nasional Penanggulangan Bencana (BNPB) , local level governmental agencies, academic institutions that may specialize in hydrology and environmental science, and certain NGOs. b. *Outcome*: This will result in increased community readiness and responses to flood events. By having stronger community engagement, this will also establish a greater trust in the early warning systems. 3. Use the INDORAIN tool for infrastructure assessment *(Target 3)* a. Implement a detailed assessment by using INDORAIN to evaluate the current state of water infrastructure, especially in Indonesia’s informal settlements. This will include technical evaluations and community inputs to identify which areas lack adequate potable water supply. *b. Outcome:* Our assessment will result in a clear and comprehensive map showing the important vulnerabilities and possible areas that need urgent attention. Our plan would prioritize regions that are most vulnerable (both regarding housing status but also water accessibility). As we will integrate community inputs in the plans through participatory flood risk mapping, our map would have both technical assessments and usage patterns/needs identified by the vulnerable communities. 4. Co-create an early warning system for floods *(Target 4)* a. We will work with local communities in informal settlements to implement a scalable early warning system for floods. This will involve workshops and participatory sessions to ensure the specific needs of the vulnerable residents are being met. *b. Output:* By 2027, the early warning system should be operational. We will also gain continuous feedback from all stakeholders.

	5. Community engagement and relevant stakeholders *(Target 5)* a. We aim to develop educational awareness through workshops and training for citizens of informal settlements to understand early warning systems, flood risks, and how to refine flood management strategies to fit their needs. Engaging local stakeholders and leaders in this refinement will further build trust for the warning systems. b. *Outcome*: Strong community engagement will help strengthen the flood response initiatives, especially the development of the early warning systems, and increase the local-level capacity to manage flood risks. 6. Replicating the pilot study to the Southern Corridor *(Target 6)* a. After we assess the pilot study's effectiveness in alerting vulnerable populations in informal settlements in Indonesia, we plan to adapt and scale this study to fit different geographies and cultures in the Southern Corridor region. We are cognizant of the fact that each region will bring forth its own unique challenges, ranging from topographical and physical characteristics to varying cultural and region-specific contexts. If the regions don't have the equivalent informal settlements, we aim to focus on any vulnerable or marginalized populations. b. *Outcome:* By replicating this study, we will improve knowledge sharing among countries that may be close in proximity, share certain characteristics, or generally improve their flood resilience for their respective vulnerable populations.
Implementation Period	2024-2030
Financial Commitment	Our team brings forth frugal innovation, wherein we have both cost-effectiveness and a high impact. We will provide the necessary **analytical tools** that we have already developed in our laboratory as the INDORAIN software tool, and will refine as needed in-house. In addition, by training local residents and stakeholders to maintain and monitor these early warning systems, we will be reducing the need for a high-cost external entity, and instead support local ownership.