



# 4. VULNERABILITY, RISK, AND RESILIENCE OF ASIAN DELTA SYSTEMS

The Living Deltas Hub is developing a novel integrated delta risk assessment framework. The framework considers the dynamic interactions between human and natural systems and processes that drive biophysical and socio-economic risks. Through the framework, we seek ways to build resilience of delta social-ecological systems to rising incidence and severity of climate extremes.



Foreign, Commonwealth & Development Office



Climate change & biodiversity



Science, research, technology



Trade & economic development

## SUSTAINABLE DEVELOPMENT GOALS

1 NO POVERTY



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



8 DECENT WORK AND ECONOMIC GROWTH



10 REDUCED INEQUALITIES



11 SUSTAINABLE CITIES AND COMMUNITIES



## Achievements

Multiple hazards, like cyclones during the current COVID-19 pandemic created an additional burden on delta health care systems, particularly in the Sundarbans impacted coastal areas of the GBM delta. This situation has inevitably generated additional research questions for the delta social-ecological systems work stream. An example is the research carried out on public health interventions contributing to ongoing scientific and policy discourses on the complex interplay of climatic factors determining the risks of COVID-19 transmission. The Hub team has also published research on a systematic analysis of Vietnam's province-level household energy security status: Energy Budgeting for the Sustainable Development Goals, which will eventually contribute to the Hub's systems approach to resilience assessment.

The project initiated a novel pathway suggesting changes in the framework for sustainable development actions through COVID-19 recovery, economic growth, and climate-resilient pathways for the attainment of equitable human wellbeing for the people of Bangladesh. In addition:

1. Hub members have been involved in TV debates to convey core concepts of resilience building.
2. The Living Deltas Hub team participated as an Institutional partner for the 2nd International Symposium on Disaster Resilience and Sustainable Development in June 2021 and organised a plenary session with key stakeholders to address policy challenges on lives and livelihoods entitled 'Dwellers and Stakeholders in Asian Mega-Deltas: their contributions to locally led adaptation and resilience'.
3. The Hub received a grant award under the Capacity Development Programme (CAPaBLE) for 2021-22 as part of the Asia-Pacific Network for Global Change Research (APN), Japan with the project title 'CBA2020-FP13-Pal: Capacity building for measuring multi-hazard livelihood security and resilience in the Lower Mekong Basin'.

## Interdisciplinary approaches

Based on stakeholders' expertise, the Hub's interdisciplinary modelling team, composed of social and environmental scientists and engineers has collaboratively-developed a new version of the Global Delta Risk Index. The systems approach considering the Pressure-and-Release model and Driver-Pressure-State-Impact-Response framework will be central. The Hub interdisciplinary research team is integrating several models to understand different aspects of the interactions between anthropogenic drivers, exposure, occurrence of multiple hazards, vulnerability, and coping and adaptation capacities. These are aimed at different scales and incorporate Coupled Human and Natural Systems (CHANS) approaches, risk informed policy planning and decision making.

## Innovation

The initial plan for the proposed integrated delta risk assessment frameworks (CHANS and the Global Delta Risk Index) that incorporate a coupled social and economic systems approach for delta resilience is based on large scale primary data with qualitative and quantitative data analysis. The multidisciplinary team made excellent progress on the baseline research in three project deltas despite the unprecedented impacts of the COVID-19 pandemic. Several research activities have provided building blocks for our integrated delta risk assessment framework. When primary data collection was not possible due to lockdown, earth-observation data coupled with secondary datasets and field-based inputs from the project partners allowed continued co-production of the proposed integrated model. We have assessed the interdependence of ecosystem services and livelihood security in the mangrove SES using Agent Based Modelling, a useful tool for integrated assessment of human behaviour and natural processes in a social-ecological system.

We have examined multiple hazards, such as Cyclone Amphan in 2020 and Cyclone Yash in 2021, together with COVID-19 as an additional hazard (with an additional burden on the health care systems), particularly in the Sundarbans impacted coastal areas of the GBM delta, which inspired new research questions to expand the Living Deltas research profile. The systematic analysis of Vietnam's province-level household energy security status and energy budgeting for sustainable development goals is contributing to the components of the systems approach for resilience assessment. Our work has suggested some changes in the framework for the sustainable development actions through the COVID 19 recovery path, economic growth path, and climate-resilient path for the attainment of equitable human wellbeing for the people of Bangladesh.

The outcomes of this research will address a gap in scientific understanding of delta regions through integrated community-driven and natural-cultural-sensitive risk characterization. It provides recommendations and proposes step-change in modelling design to allow for better informed delta policies by comprehensively assessing the impact of climate change and human activities with state-of-art models and multi-source datasets.

## Summary of outputs

1. Pramanik et al. (2020) Climatic influence on the magnitude of COVID-19 outbreak: a stochastic model-based global analysis. *International Journal of Environmental Health Research*, 1-16.
2. Pramanik et al., (2020) A Systematic Analysis of Vietnam's Province Level Household Energy Security Status and its Implication for Sustainable Development Goals. In 2020 International Conference and Utility Exhibition on Energy, Environment and Climate Change (ICUE) (pp. 1-8). IEEE.
3. Pramanik et al., (2021) Population health risks in multi-hazard environments: action needed in the Cyclone Amphan and COVID-19-hit Sundarbans region, India. *Climate and Development*, pp.1-6.
4. Udmale et al. (2020). Global food security in the context of COVID-19: A scenario-based exploratory analysis. *Progress in Disaster Science* 7.
5. Pramanik et al. (2020). A Systematic Analysis of Vietnam's Province Level Household Energy Security Status and its Implication for Sustainable Development Goals. 2020 International Conference and Utility Exhibition on Energy, Environment and Climate Change, Thailand.
6. Udmale et al. (2021). Virtual Land and Water Flows through International Cereal Trade and its Implication for Bangladesh's Carbon Emissions from Agriculture: Energy, Disaster, Climate Change: Sustainability and

7. Pramanik et al. (2021). Twin Disasters: Tracking COVID-19 and Cyclone Amphan's Impacts on SDGs in the Indian Sundarbans. Environment: Science and Policy for Sustainable Development.
8. Sweety et al. (2021). An Agent Based Model of Mangrove Social-Ecological System for Livelihood Security Assessment. In Review. Post Conference peer-reviewed publication by Springer Nature, Switzerland. 8th International Conference on Water and Flood Management (ICWFM-2021).

## People involved in this work

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