UK Government Centres of Expertise
Green Cities, Infrastructure and Energy

LEARNING NOTE

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GREEN CITIES, INFRASTRUCTURE AND ENERGY PROGRAMME (GCIEP)

Strengthening urban flood resilience through data-driven risk analytics

Urban flooding is an increasingly severe climate risk in many GCIEP partner countries, affecting housing, transport, health, basic services and economic development. Rapid urbanisation, undersized or poorly maintained drainage networks, encroachment on wetlands and coastal zones, and rising sea levels are combining to increase the frequency and severity of floods. Against this backdrop, GCIEP and its alliance partners have been working with governments to move from reactive emergency response towards proactive, risk-informed planning and investment.

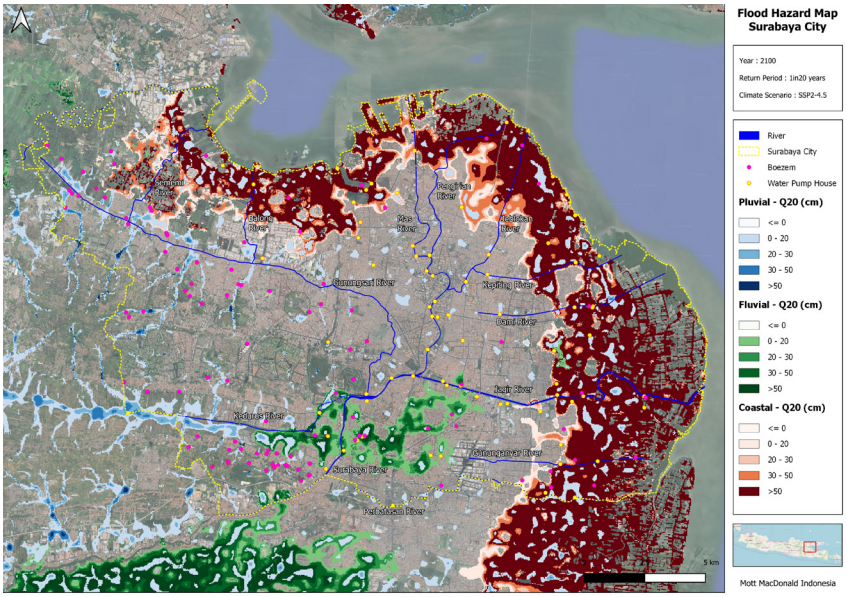
Recent work in Ghana and Indonesia demonstrates how GCIEP is building a coherent offer on flood risk that combines advanced analytics, geospatial tools, multi-hazard climate data and economic analysis. These experiences highlight a growing capability to design and deliver practical tools that city authorities can use to understand where flood risks are concentrated, how they will evolve under different climate futures, and which interventions offer the greatest return for resilience and socioeconomic development.

Learning from Ghana: a climate risk decision support system for cities

Ghana faces multiple climate hazards, with floods featuring prominently alongside drought and extreme heat. A significant share of the population and critical infrastructure lies in high-risk zones, yet until recently there was no integrated city-level climate hazard risk tool that could directly inform local planning or budgeting decisions.

GCIEP's support has focused on the design of the Ghana Climate Risk Decision Support System, an AI and machine learning-enabled platform that integrates high-resolution geospatial layers; downscaled climate projections for key hazards, including riverine, coastal and urban flooding; and socio-economic indicators such as population, services and vulnerable institutions. By combining these datasets, the platform generates granular, city-level multi-hazard risk profiles that show which neighbourhoods are most exposed to floods, which public and private assets sit in high-risk zones, and how vulnerabilities overlap with poverty and other social indicators.

A distinctive feature of the system is the alignment of climate projections with practical planning horizons. Rather than focusing only on long-term horizons such as 2050 or beyond, the platform provides scenario outputs over shorter timeframes that are relevant for city development



Fathom modelling of flood risks in Surabaya

plans and budget cycles, enabling local governments to sequence investments, update zoning regulations and prioritise drainage upgrades on a timescale that matches their mandates and funding envelopes.

Through an intuitive dashboard, the system supports the identification of flood-prone areas where new housing should be restricted, the targeting of investments in drainage or green infrastructure to locations where risk reduction benefits are greatest, the improvement of localised early warning and contingency plans, and engagement with communities through accessible visualisations of flood risk and adaptation options. This work showcases GCIEP's ability to structure large, disparate datasets into a single decision support tool that is technically robust while remaining usable by planners, engineers and local decision-makers rather than only specialists.

The platform is now being used by 25 municipal governments in Ghana, supporting robust decision-making that is enhancing urban resilience via urban planning and infrastructure project prioritisation.

Learning from Indonesia: rapid flood risk mapping in Surabaya using Fathom

Indonesia ranks among the countries with the highest flood risk globally, with coastal and riverine cities particularly vulnerable. Surabaya, located where several large rivers meet the sea, faces complex interactions between pluvial, fluvial and coastal flooding, compounded by land subsidence and the loss of natural buffers such as mangroves.

GCIEP's Deep Offer team in Indonesia provided technical assistance to Surabaya City to assess the performance of its drainage infrastructure and to understand how climate change is likely to alter flood patterns. Working closely with the city government and the UK Embassy, GCIEP and its partners used Fathom, a flood risk modelling software, to provide a city-wide climate resilience assessment covering approximately 400 km².

Within a five week period, the team reviewed topographical information, ran Fathom analyses for pluvial, fluvial and coastal flooding across multiple return periods under climate scenarios such as Shared Socioeconomic Pathways 2–4.5 for 2030, 2060 and 2100, and generated flood depth maps that quantify both the spatial extent of inundation and the distribution of water depths across the city for different hazard types and time horizons. The outputs revealed how different parts of Surabaya would be affected under a range of future events, including the depths and frequency of flooding in both residential and commercial areas. Satellite data was used to validate and contextualise historical flood extent.

A further innovation arose from integrating with GCIEP's Future Cities and Infrastructure Programme in Indonesia. Flood depth outputs were combined with land value data to identify locations where investment in flood mitigation might unlock substantial increases in land value and development potential, providing options for land value capture mechanisms to help finance flood resilience investments. The collaboration with Surabaya City Government generated a shared evidence base on flood risk, informed discussions on updating the Surabaya Drainage Master Plan, highlighted opportunities for nature-based solutions and smart infrastructure, and increased demand for further technical assistance on structural measures and data-driven flood monitoring and warning systems.

What GCIEP and partners bring to flood risk management

GCIEP is helping national and sub-national government partners to use advanced analytics – applying AI, machine learning and global flood models alongside detailed local data to produce multi-hazard assessments that cover riverine, coastal and urban flooding in an integrated way. Rather than treating flood risk as a standalone issue, the programme links hazard data to exposure, vulnerability, socio-economic indicators and, where available, land and property values.

Equal emphasis is placed on practical, user-centred tools. Interfaces such as the Ghana Climate Risk Decision Support System are designed around the way planners, engineers and local officials actually work, enabling them to explore "what if" questions around different scenarios without needing to manipulate raw climate or hydraulic model outputs themselves.

GCIEP also brings a systems integration approach that connects flood analytics to broader infrastructure, energy and urban planning agendas, with flood-related tools framed as components of wider digital ecosystems rather than isolated pilots, improving the chances that they are maintained, reused and expanded. The programme's partnership model mobilises expertise from engineering firms, data and modelling specialists, economists and governance advisers, while anchoring all work in the mandates of national and city-level institutions.

Key lessons and insights

Drawing together GCIEP's experience in data-driven solutions for flood risk mitigation in Ghana and Indonesia, several cross-cutting learning points stand out:

- **Flood risk analytics must be tightly aligned with decision cycles.** Tools that provide flood risk scenarios over short, policy-relevant timeframes are more likely to influence municipal planning, budgeting and investment decisions than those focused solely on distant horizons.
- **Multi-hazard and multi-sector integration strengthens relevance.** Combining pluvial, fluvial and coastal flooding with socio-economic data, infrastructure networks and land values creates a more complete picture of risk and opens pathways to link resilience with economic development and financing strategies.
- **Usability and institutional fit are as important as technical sophistication.** Dashboards and decision support tools need to be intuitive for non-specialists, supported by clear governance arrangements and embedded in existing planning and budgeting processes, otherwise they risk remaining under-used.
- **Rapid yet rigorous assessments can unlock political momentum.** Producing city-wide flood risk maps and analysis within weeks helps demonstrate value early, builds confidence among government counterparts and creates demand for deeper technical assistance and reforms.
- **Data partnerships and local ownership are critical enablers.** Access to city datasets, combined with close collaboration with local officials, improves model accuracy, ensures context-appropriate interpretation of results and increases the likelihood that recommendations translate into action.
- **Linking flood resilience to economic value strengthens the investment case.** Analyses that show how reducing flood depths can protect or enhance land and property values provide a concrete basis for engaging finance ministries, investors and development finance institutions, and for exploring mechanisms such as land value capture.

GCIEP is a demand-driven initiative focused on sustainable green cities and climate-resilient infrastructure in lower-income countries. As the flagship programme of the UK's Centre of Expertise for Green Cities, Infrastructure and Energy, GCIEP supports the UK Government's mission to accelerate investment in, and delivery of, infrastructure and urban development that is responsible, reliable, inclusive, low-carbon and climate-resilient.

A significant proportion of GCIEP's work is carried out in seven priority countries: Ethiopia, Ghana, Indonesia, Philippines, Mozambique, Vietnam and Zambia, where a Deep Offer programme provides long-term, systemic interventions focused on transformative change and infrastructure financing.

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