



TOWARD RESILIENT KOLKATA

Introducing India's first
comprehensive city-level flood
forecasting and early warning system



Cover photo: One of the children living in Notupara slum community (photo by Amit Verma).



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BACKGROUND

2018 marks 20 years of partnership between the Asian Development Bank (ADB) and the Kolkata Municipal Corporation (KMC). Since 1998, ADB has been supporting KMC to make Kolkata a more livable city through integrated planning and phased investments for resilience building and urban services improvement.

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After successful implementation of the Kolkata Environment Improvement Project (KEIP), KMC is implementing another ADB-supported project, the Kolkata Environment Improvement Investment Program (KEIIP). Besides upgrading urban services in Kolkata, ADB has also been assisting KMC to make it a smart and resilient city by modernizing financial, administrative, and asset management systems; reducing urban flood risks; improving land use planning; and developing their capacity to reach citizens through introduction of a flood forecasting and early warning system (FFEWS).

The FFEWS for Kolkata has been designed and implemented through a technical assistance (TA) attached to KEIIP, TA-9157 IND: Strengthening Climate Resilience of Kolkata through Improved Planning and Disaster Risk Management, funded by ADB's Urban Climate Change Resilience Trust Fund (UCCRTF) under the Urban Financing Partnership Facility. A consortium comprising consultants from TARU Leading Edge Pvt. Ltd., PricewaterhouseCoopers, and Antea Group is assisting KMC to design and implement the system.



Faces of Kolkata. The new FFEWS is centered on people, particularly the poor and vulnerable. (all photos in this brochure by ADB, unless specified).

HIGHLIGHTS

The FFEWS for Kolkata will be the first comprehensive city-level early warning system in India. It has been designed to provide forecasts as well as real-time updates from sensor nodes installed in key points throughout the city. Information generated and disseminated by the FFEWS will enable informed decision-making before and during disasters. The system includes: weather forecasts; flood models for various intensities of rainfall; real-time information on key pump status, sump and canal water levels, actual rainfall, inundation levels, among others; and a messaging system to provide warnings and real-time information to city officials and citizens.

Expected Outcomes



reduced impacts from flood-induced traffic congestions



flood-informed urban planning



reduced economic loss and impacts on livelihoods



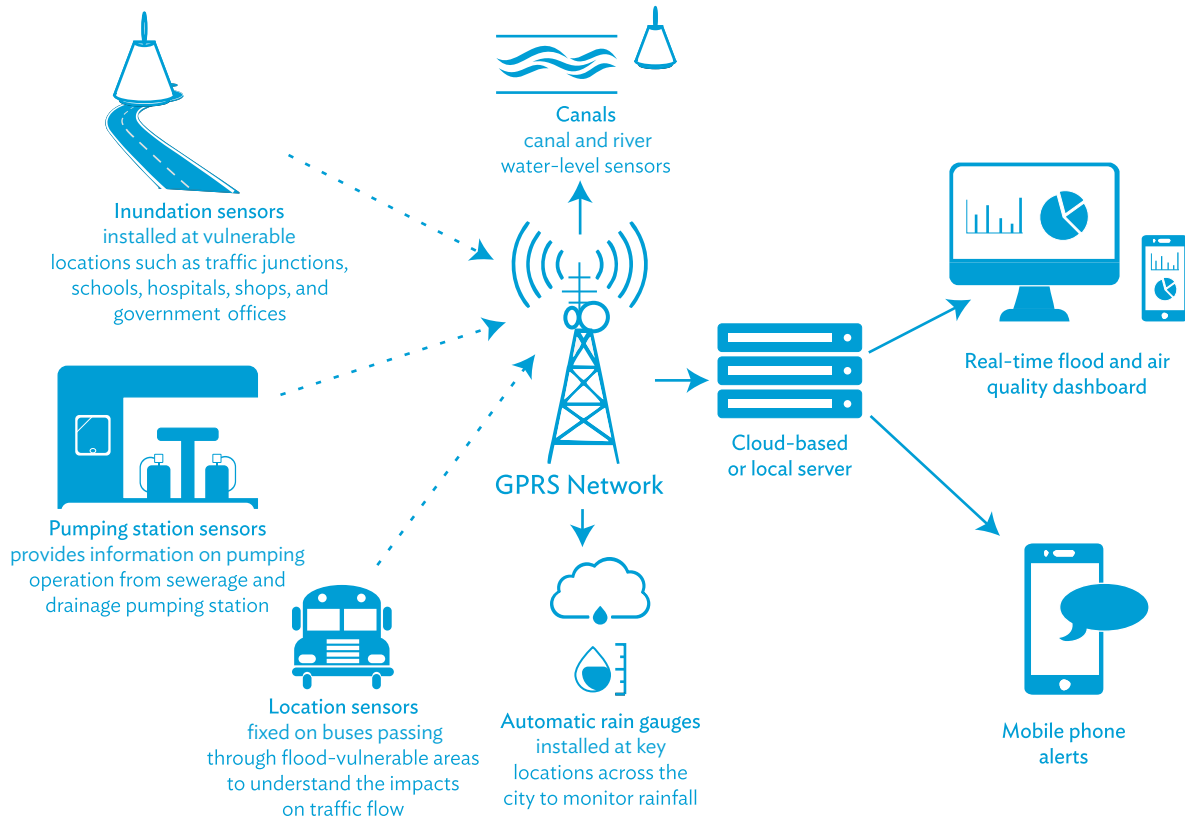
improved flood awareness and safety at community level



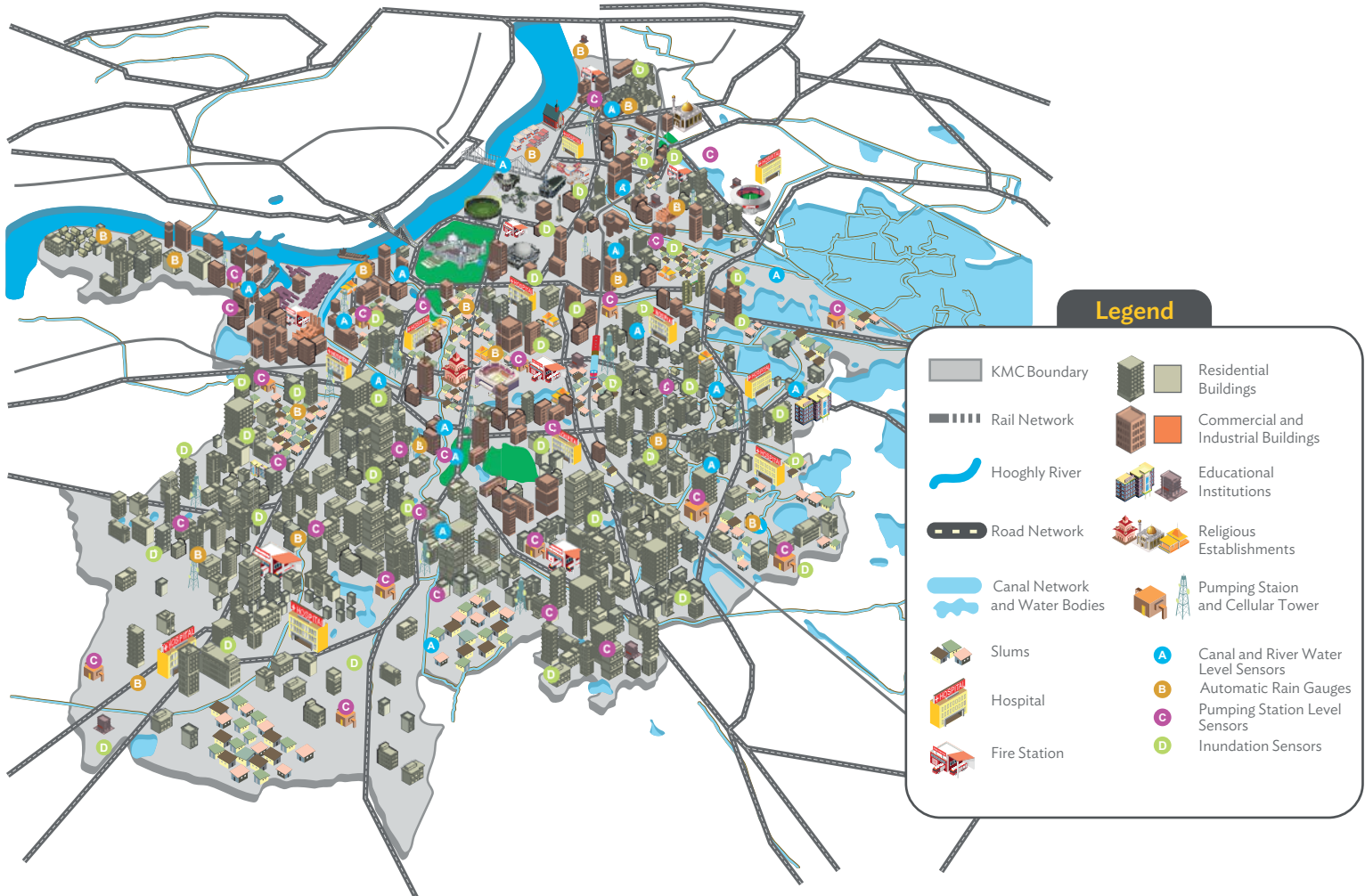
Becoming a resilient city. All low-lying and slum communities will benefit from the FFEWS.

HOW THE SYSTEM WORKS

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KMC FLOOD FORECASTING AND EARLY WARNING SYSTEM SENSORS



KEY FEATURES

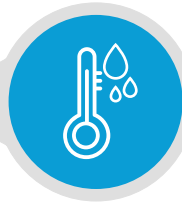
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Cost-effective sensors



Various cost-effective sensors enable high-density coverage, increasing granularity of real-time data across the city. The data can be validated using available high-quality, low-density monitoring system.

Multi-parameter monitoring of other climate-related data



Compared to usual flood forecasting systems, the FFEWS collects a wide range of data such as temperature, humidity (heat stress), and air quality, so the system is useful for the whole year, not only for specific seasons.

Provision for crowdsourcing



The system helps increase participatory planning and community engagement by allowing small enterprises to install shop-front sensors, thus getting environmental and inundation data at the shop or building-level. Site-specific warning messages can in turn be provided to the business owners to save valuables and assets in times of floods or disasters.

Modular capacity

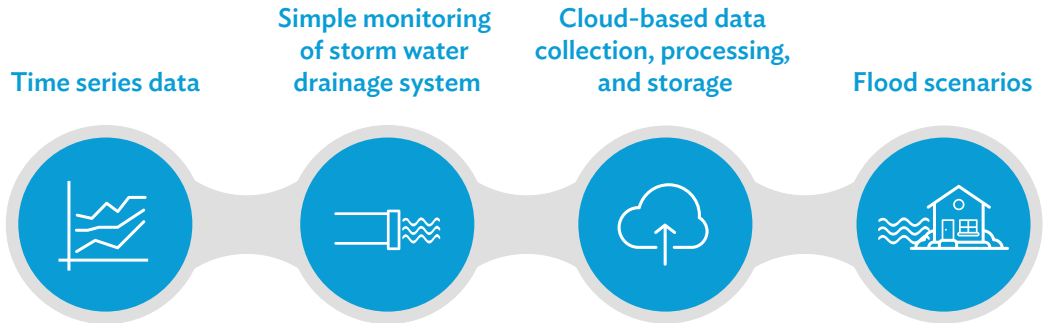


The system is designed for flexibility, such that more sensors can be added to expand the coverage of the system.

Access anywhere



Through web browsers and mobile phone apps, the system is accessible anywhere. No additional software is necessary and there is no need for a control room to view data and manage warnings.



This can be used to validate flood models, heat stress, air quality, and urban heat island effect. These data sets help inform storm water drainage design and support the city in learning from past events and emergencies.

With this feature, the city can also assess pumps, sumps, and outflow of canals.

A cloud-based platform reduces capital as well as operations and maintenance costs of physical servers.

These can be used to train KMC staff on how to respond to floods from different rainfall intensities.



Numerous studies rank Kolkata among the top 10 most vulnerable cities in the world due to high exposure to flooding under climate change projections. Heavy rains occur during the monsoon season when cyclones pass through the region. Flat deltaic terrain, insufficient natural drainage, and tidal blockage of channels amplify flooding and water logging in the city.

KEY FEATURES

Kolkata's FFEWS is people-centered. It empowers individuals, communities, and other stakeholders to act quickly and appropriately to reduce flood risks. Key stakeholders were consulted during the design phase to identify the best places for monitoring. Predictive modeling, historical flood assessment from remote sensing, and consultation with citizens and borough engineers helped identify locations for real-time data collection on rainfall and flood risk. These are being verified during monsoon season.

Information Access

Real-time information and forecasts will be available on an access-anywhere basis for KMC decision-makers, on-the-ground staff, and other stakeholders. The data will be accessible online through web browsers and mobile apps. Notifications based on trigger values will be provided through the mobile apps, and whenever necessary, text messages will be sent to key functionaries. The information will be provided through a hierarchical access control system or need-to-know basis to reduce possibility of misinformation and rumors. The control room of KMC will also prepare and communicate warnings through radio, TV, and social media.

Dissemination of Warnings

A user registration system will be used to ensure that risk information is provided to citizens and community groups. Warning messages will be sent in simple language and will focus on actions people need to take to ensure their safety and plan their daily activities, such as commuting. The messages will be specific to different groups of vulnerable people. The warning information will also be provided to the media (radio and TV channels) to ensure knowledge and awareness is widespread. TV channels will be provided with map-based information for more location-specific action.



KEY BENEFITS

For the first time in the country, a city will have a comprehensive forecasting system that provides real-time information on inundation, temperature, air quality, and other climate-related data which will help improve the work and lives of various stakeholders.

CITY MANAGERS



- can manage traffic and monitor municipal storm water drainage systems
- can take preventive measures to improve air quality and reduce outdoor temperature in vulnerable areas
- can develop flood risk informed urban plans
- can have invaluable data set to be used in synergy with other initiatives for a more resilient city, such as satellite-based city-wide assessment of historical extent of floods, vulnerability, and future risk modelled scenarios inclusive of coastal storm surge and sea level rise

CITIZENS



- can modify their commuting during floods to avoid getting stuck in flood-induced traffic jams
- can retrofit their homes to improve resistance to floods and avoid buying homes in vulnerable areas
- can take preventive measures to reduce impacts of excessive heat and poor air quality
- can protect their businesses from flood damage through site-specific inundation information generated from shop-front sensors

COMMUNITIES



- can plan responses based on early warning and real-time inundation status
- can disseminate flood warning and evacuation information to vulnerable people

CIVIL SOCIETY AND ACADEMIA



- can use sensor data to conduct research and provide inputs to the municipality to develop flood-, temperature-, and air quality-informed urban planning and management measures
- can develop awareness programs to catalyze ground-level preventive action
- can form partnerships between different groups and organizations to make the city ready for extreme weather events, reducing damage and loss

PRIVATE SECTOR



- can develop context-specific innovative products to reduce impacts (e.g., flood protection for vehicles, water-resistant protective apparel, cost-effective masks to improve air quality)
- can improve health services to deal with flood, temperature, and air quality risks
- can invest in corporate social responsibility initiatives catering to vulnerable people
- can extend and improve communications to address location- or people-specific needs before and during extreme events

SMALL SHOPS AND VENDORS



- can monitor flooding near establishments and reduce flood vulnerability of assets by installing shop-front sensors

ALL STAKEHOLDERS



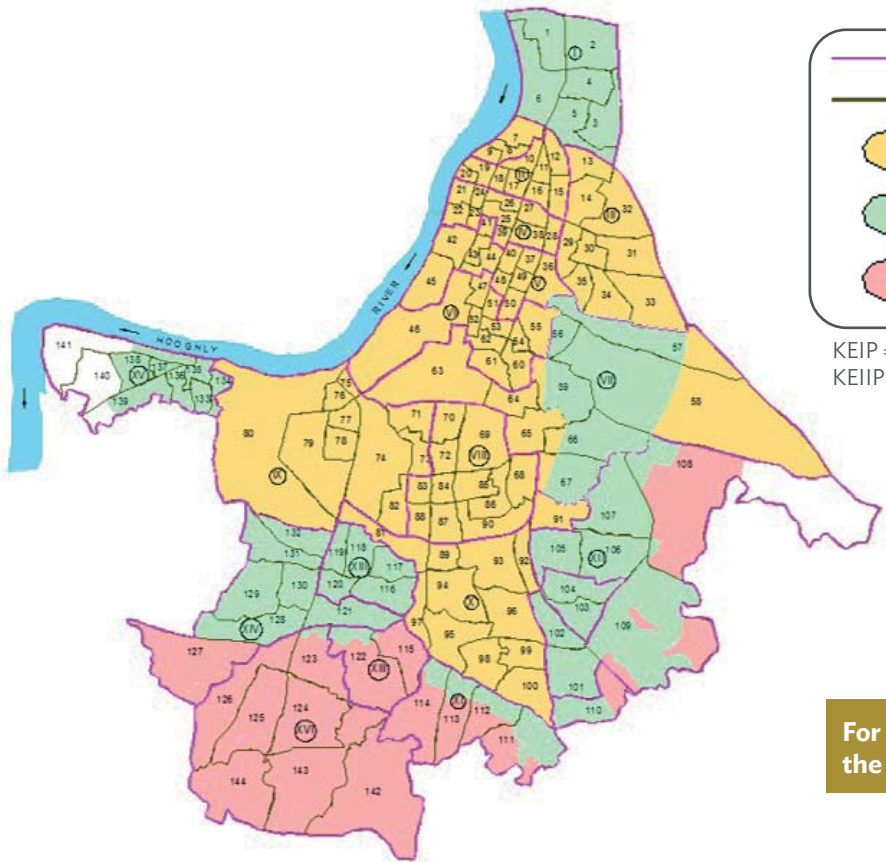
- can become engaged and empowered by providing support in installing and managing sensor nodes in their premises
- can take ownership of the system by ensuring regular data collection and sustainability of the system








The FFEWS complements the phased investments carried out since 2000 through ADB-supported projects, KEIP and KEIP, to improve Kolkata's urban services and climate resilience. Through these projects, KMC is systematically expanding sewerage and drainage network in Kolkata, including flood-prone areas; increasing sewage treatment capacity; improving water supply through reductions in nonrevenue water; managing solid waste; and increasing operational efficiencies and building capacity to better sustain the services it provides.

Flooding has already been reduced in about 4,800 hectares, and KMC expects further flood reduction in over 6,000 hectares covered under the projects. KMC will continue expanding the systems to fully serve all households within the city with improved and resilient sewerage and drainage, water supply, and solid waste management services for a truly resilient city.

INCREASE IN SEWERAGE AND DRAINAGE COVERAGE IN KOLKATA THROUGH THE SUPPORT OF ADB-FUNDED PROJECTS



Legend

-  BOROUGH BOUNDARY
-  WARD BOUNDARY
-  CORE AREA COVERED PRIOR TO KEIP
-  AREA COVERED UNDER KEIP
-  AREA COVERED UNDER KEIIP

KEIP = Kolkata Environment Improvement Project
 KEIIP = Kolkata Environment Investment Program

For more information and demonstration on how the FFEWS system works, please visit www.kflood.in.

Toward Resilient Kolkata

Introducing India's First Comprehensive City-Level Flood Forecasting and Early Warning System

This publication describes India's first comprehensive city-level flood forecasting and early warning system. Located in Kolkata, the system provides forecasts and real-time updates on rainfall and inundation levels, among other climate and environmental data, thereby strengthening the city's resilience. Since 1998, the Asian Development Bank has been supporting the Kolkata Municipal Corporation. This partnership has made Kolkata a more livable city through integrated planning and phased investments for building resilience and improving urban services.

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 67 members—48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.



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