

Appropriate Waste Management in Climate Change Adaptation: Prevention of urban flush flooding in Asia

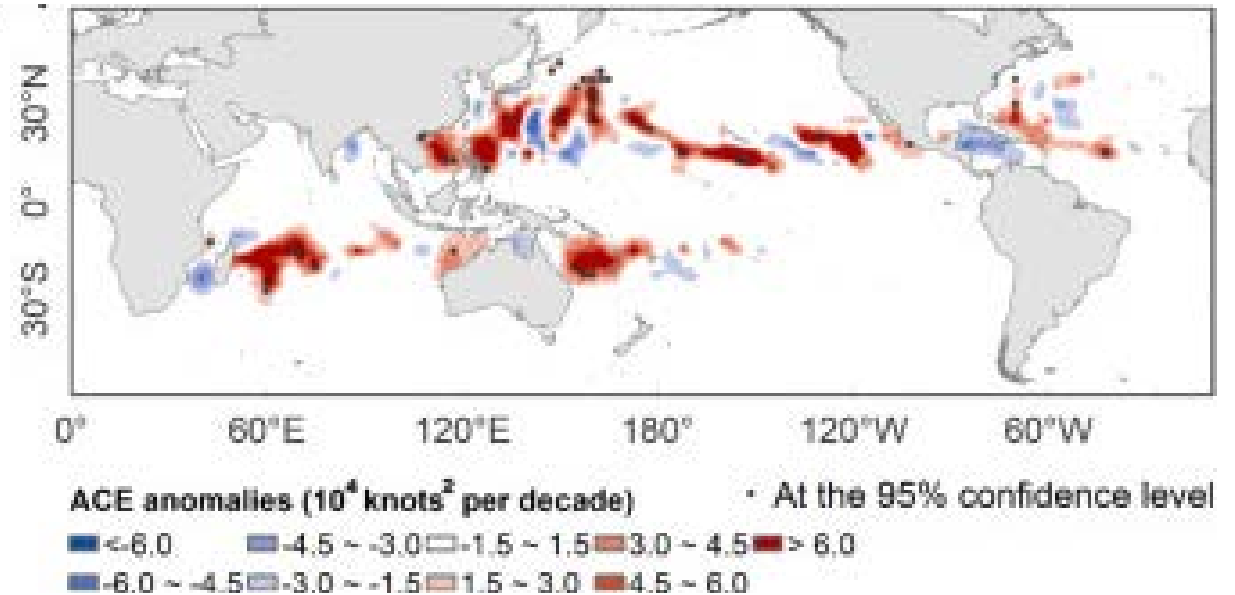
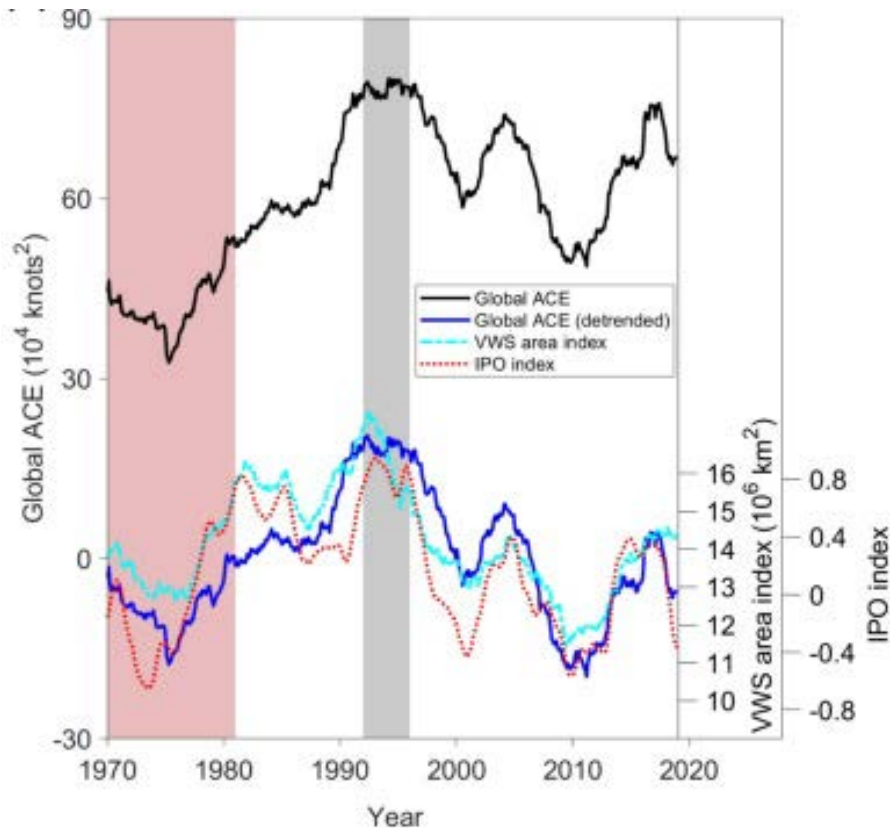
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Climate-related Extreme Events and Disasters

Frequency and **Intensity** of extreme events has been increased as a result of human influences on climate. Climate change may be perceived most through the impacts of extremes, although these are to a large degree dependent on the system under consideration, including its vulnerability, resiliency and capacity for adaptation and mitigation. (ref IPCC AR4. 2007)

Cyclone Energy (ACE) index



Climate-related Extreme Events and Disasters

- **Cyclone (Hurricane, Typhoon)**
- **Tornado**
- **Flood**
- **Earthquake and Tsunami**
- **Drought**
- **Mass movement (landsliding)**
- **Cold wave**
- **Abnormal Weather (continues rain, rain in dry season, etc)**

Damages by Natural Hazards

Deaths by Disasters

Figure 3

Proportion of Deaths by Continent in 2023

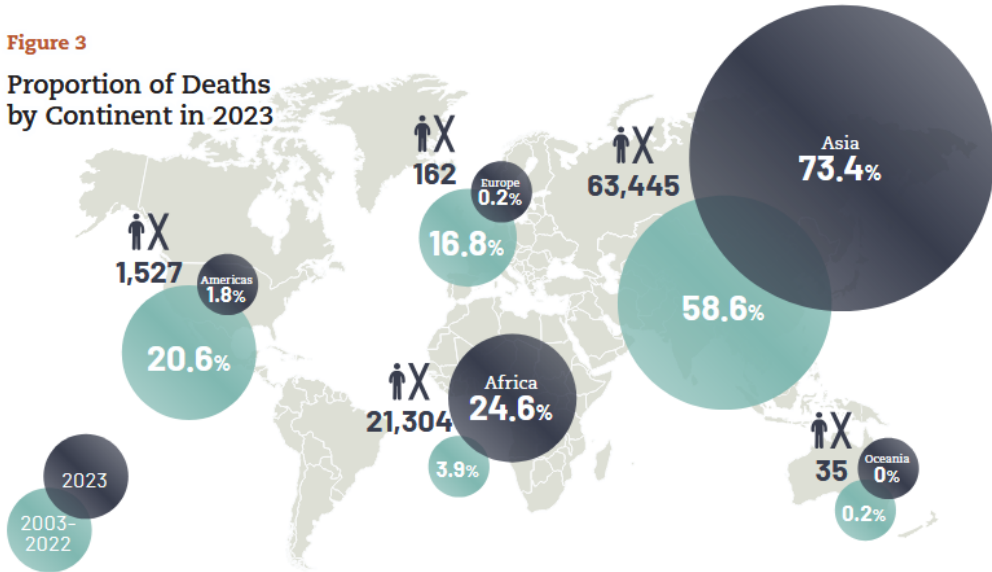


Figure 4

Number of Deaths by Disaster Type: 2023 Compared to 2003-2022 Annual Average

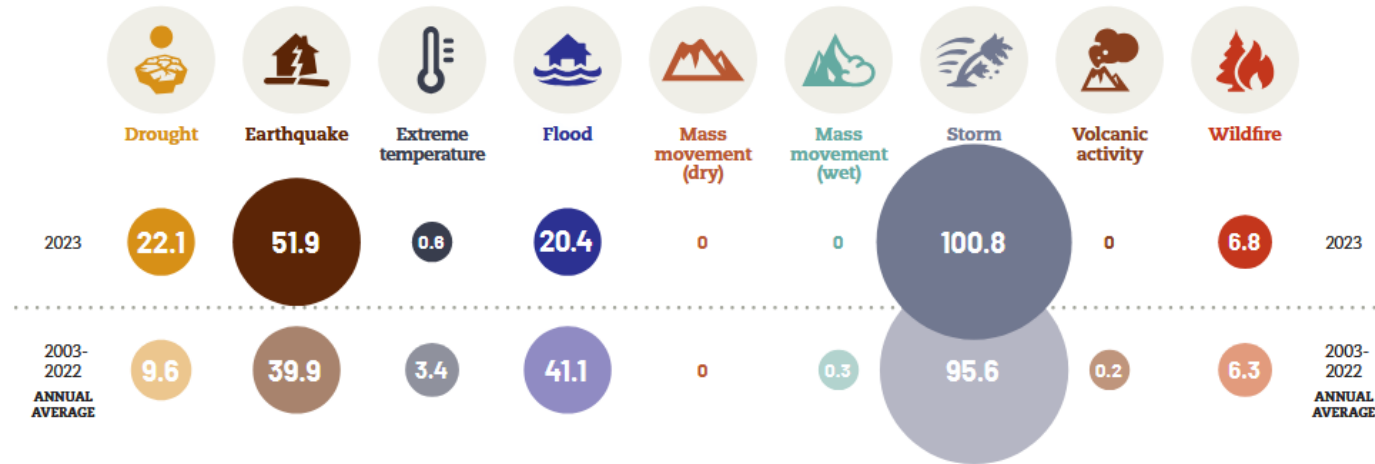
64,148 < **86,473**
2003 to 2022 in 2023

Economic Losses by Disasters

Figure 8

Economic Losses (US\$ billion) by Disaster Type: 2023 Compared to the 2003-2022 Annual Average

196.3 < **202.7**
2003 to 2022 in 2023



Consider Measures mitigating the damages of natural disasters

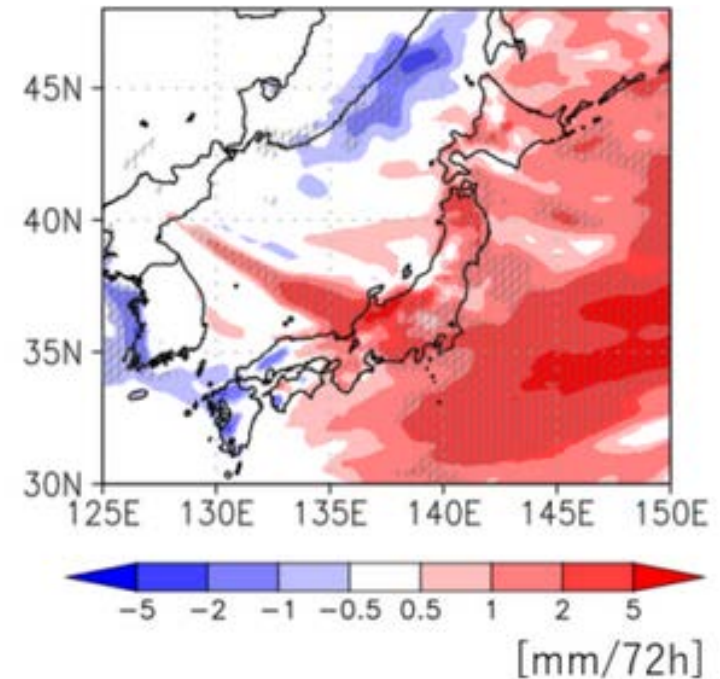
Flooding in Hue (Nov. 2025)



Record-breaking Snow in Japan (2026)



Affected precipitation in winter by climate change



Flood Waste Hindering Quick Recovery/Reconstruction



Waste Generated by Flood Damage



Waste Generated from Daily Life in Prolonged Inundation



Flood Waste Management (FWM) in Small-Middle scale cities



Hue, Vietnam

Annually threatened by monsoon flood
(3-5 times in a year)

Ayutthaya, Thailand

Seasonal inundation in every year
Flush flood occurred every 3-5 years

Prioritized Actions (Workshop in Hue)

invest

Resources

- Finance
- Vehicle
- Treatment
- Traffic infrastructure
- Urban discharge
- Migration

Emergency,
Reserved, Gov.,
international

mobilize

Alliance with
industry,
association,
local forces

Planning

- Flood risk zoning
- Respond plan
- Training
- FW database
- Warning system

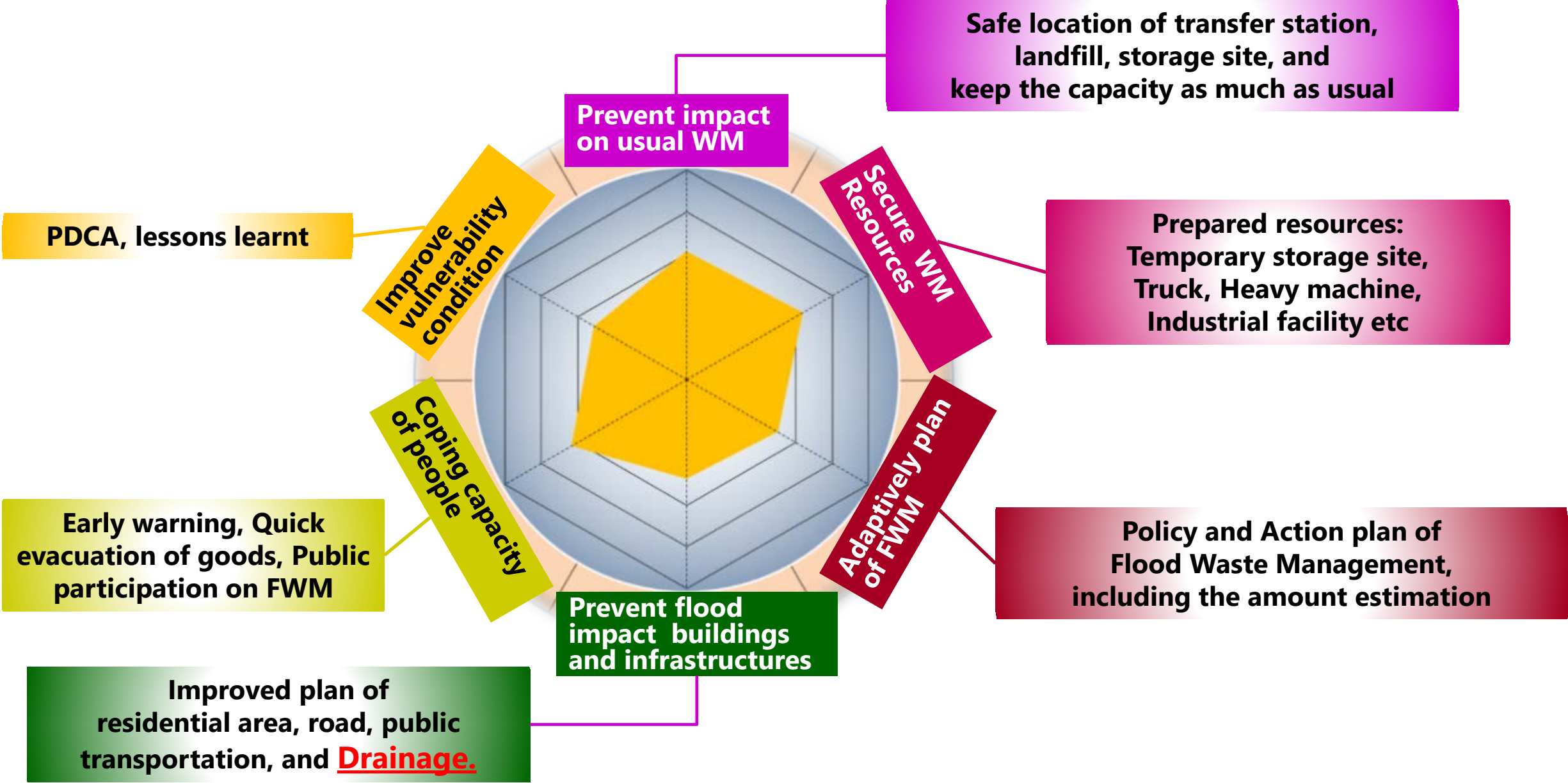
Command,
Association,
Information
Sharing

Dissemination

- Cooperation to FWM
- Damage prevention

Collection
schedule
Separation/ Reuse

FWM Improvement: Vulnerability Assessment Tools



Reason of Prolonged Flooding: Deterioration of Drainage Capacity

Frequent Flash Floods in Urban Aea



Waste Clogging Drainage

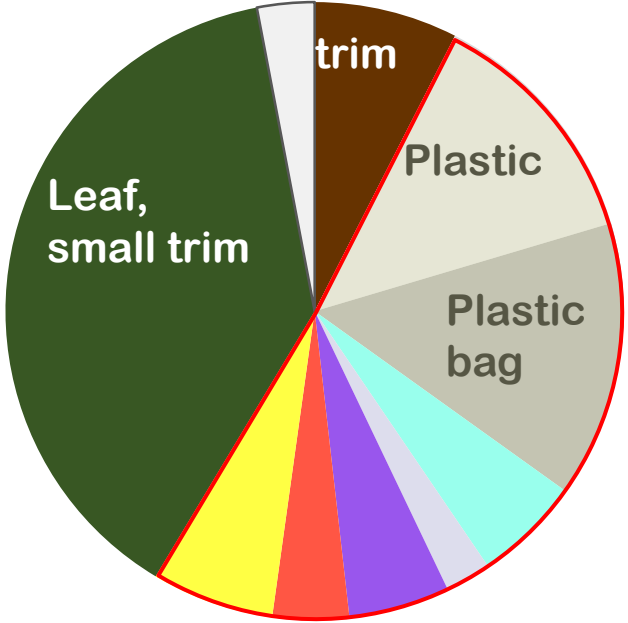


Waste in Urban Drainage

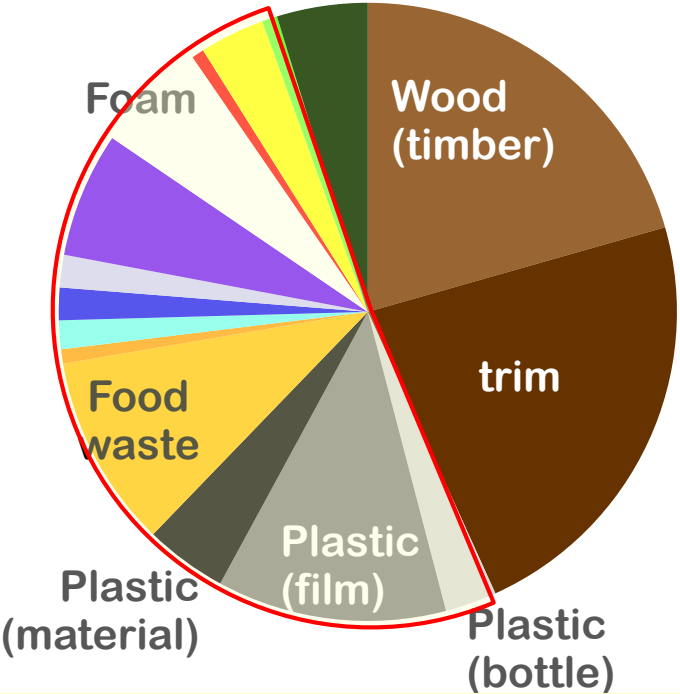


Composition of waste in canals in Hue and Bangkok

Hue



Bangkok



Common trend: Domestic waste occupies 50% (plastic 30%)



Why do people throw away waste into canals?

Social survey on behavior in the community



I donot dispose it to canal! But collectors always delay



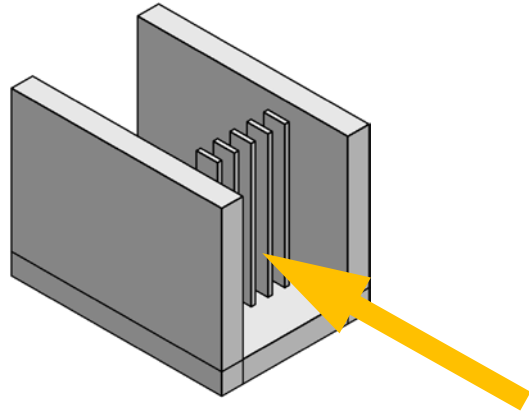
I never know the disposed waste causing our inundation



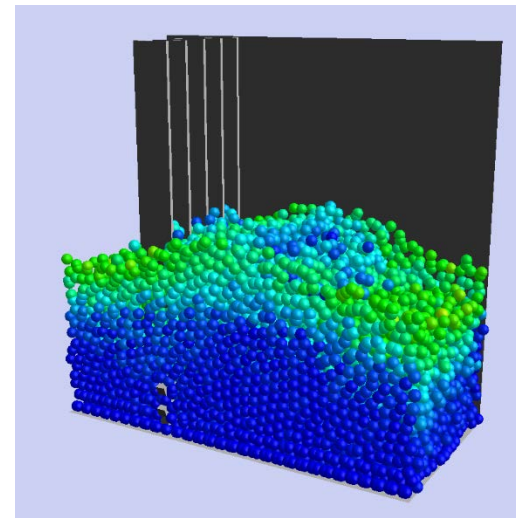
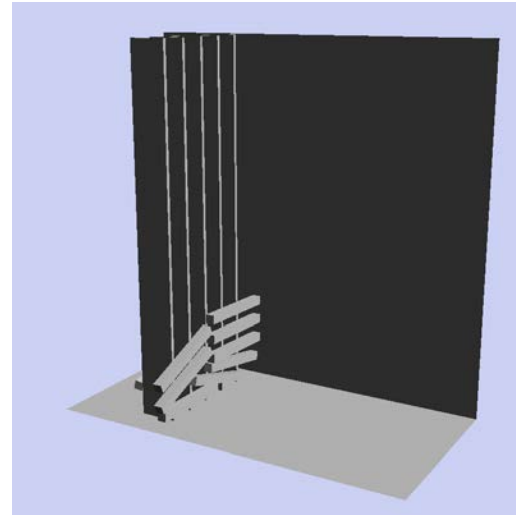
Irregal dumping into canal is more serious!



Numerical Simulation of Drainage Clogging by Waste

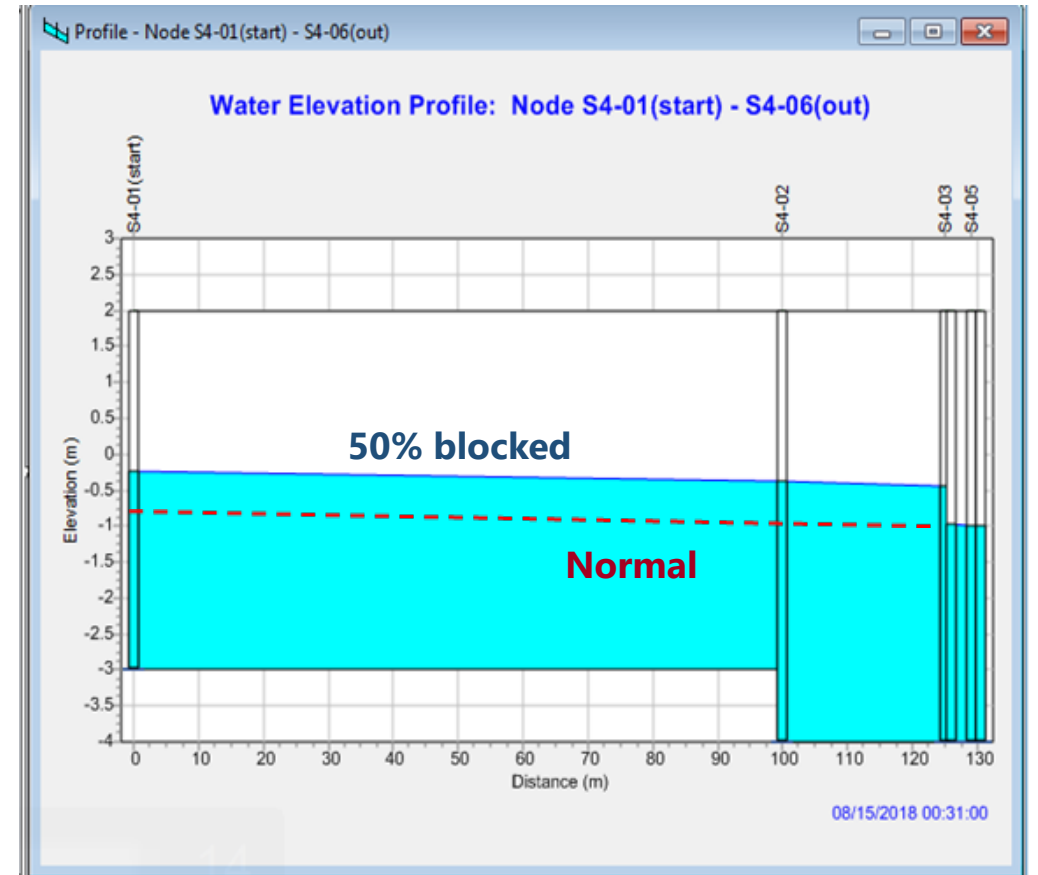


Waste clogging at Screen



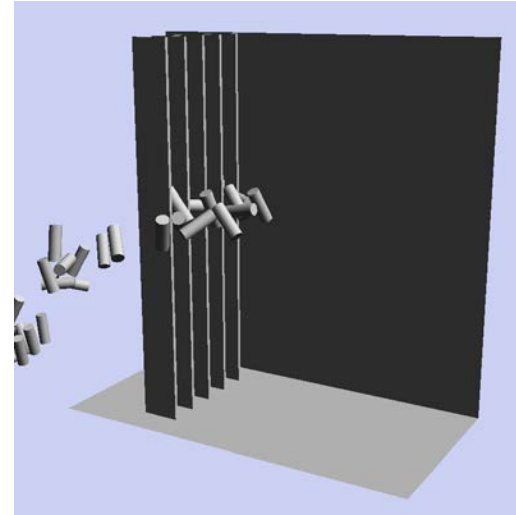
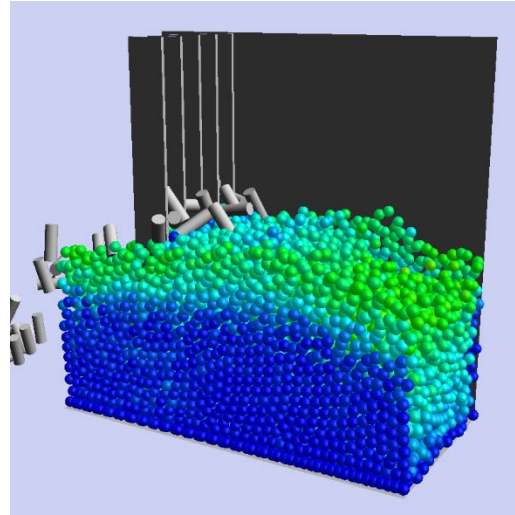
Case of Wood Timber

Elevation of Water Height of Canal

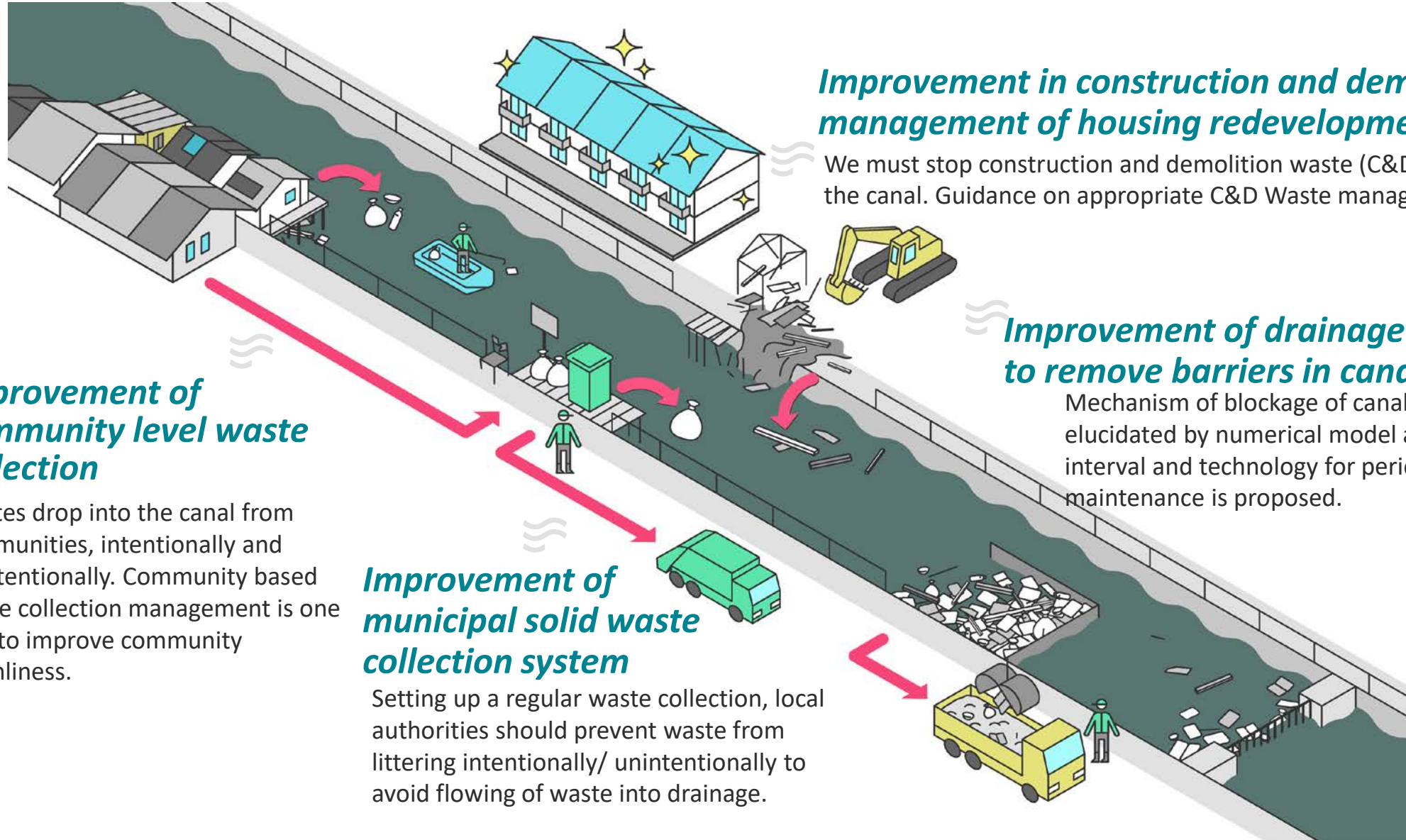


Higher Velocity (much rainfall) resulted in further Elevation

Numerical Simulation of Drainage Clogging by Waste



Policy Implications



Improvement of community level waste collection

Wastes drop into the canal from communities, intentionally and unintentionally. Community based waste collection management is one way to improve community cleanliness.

Improvement of municipal solid waste collection system

Setting up a regular waste collection, local authorities should prevent waste from littering intentionally/ unintentionally to avoid flowing of waste into drainage.

Improvement in construction and demolition waste management of housing redevelopment project

We must stop construction and demolition waste (C&D Waste) falling into the canal. Guidance on appropriate C&D Waste management is proposed.

Improvement of drainage maintenance to remove barriers in canals

Mechanism of blockage of canals by debris was elucidated by numerical model analysis. Proper interval and technology for periodic public drainage maintenance is proposed.