

# Solid Waste, Flood and Waste Water Nexus in South Asian Countries

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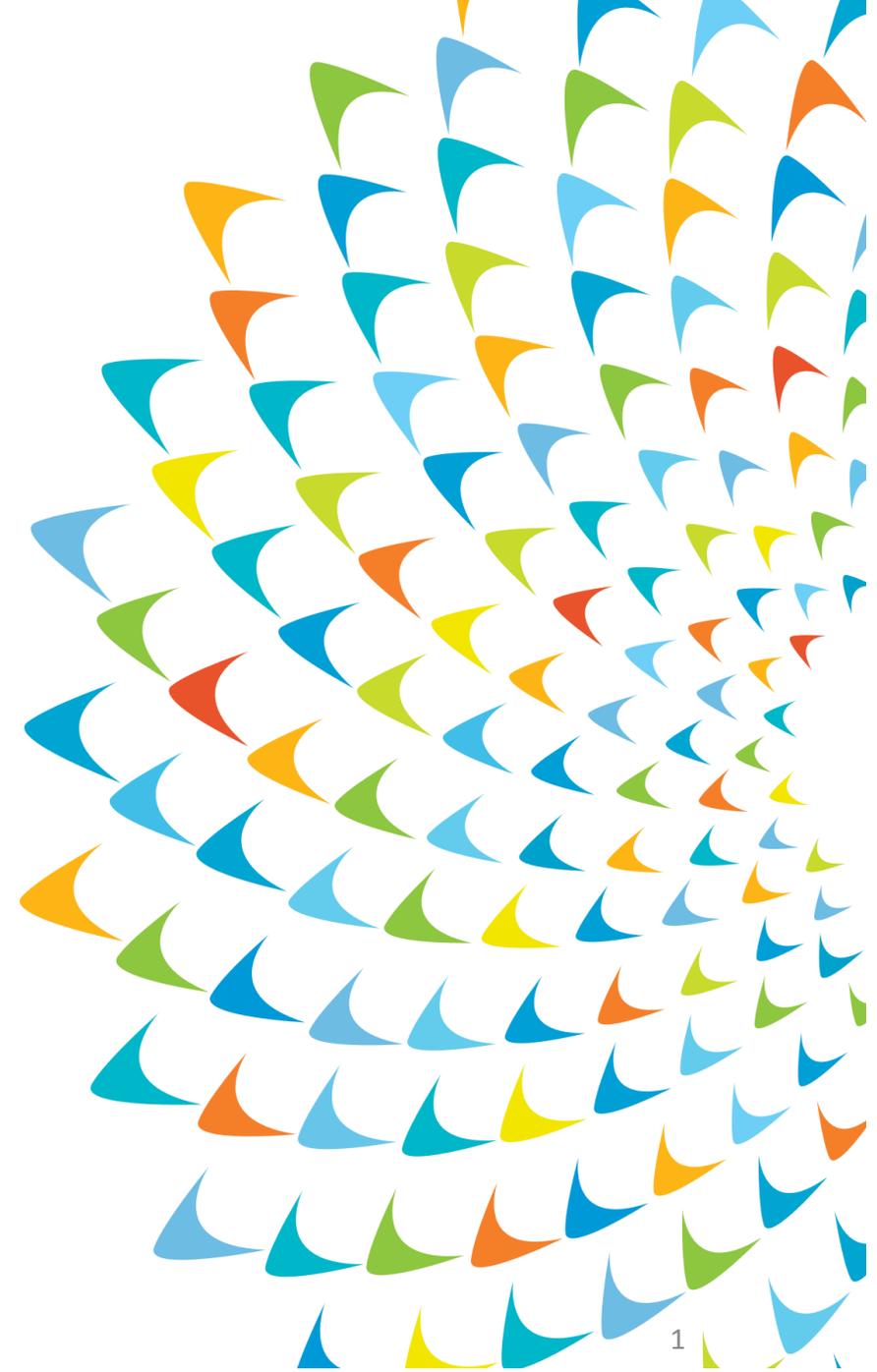
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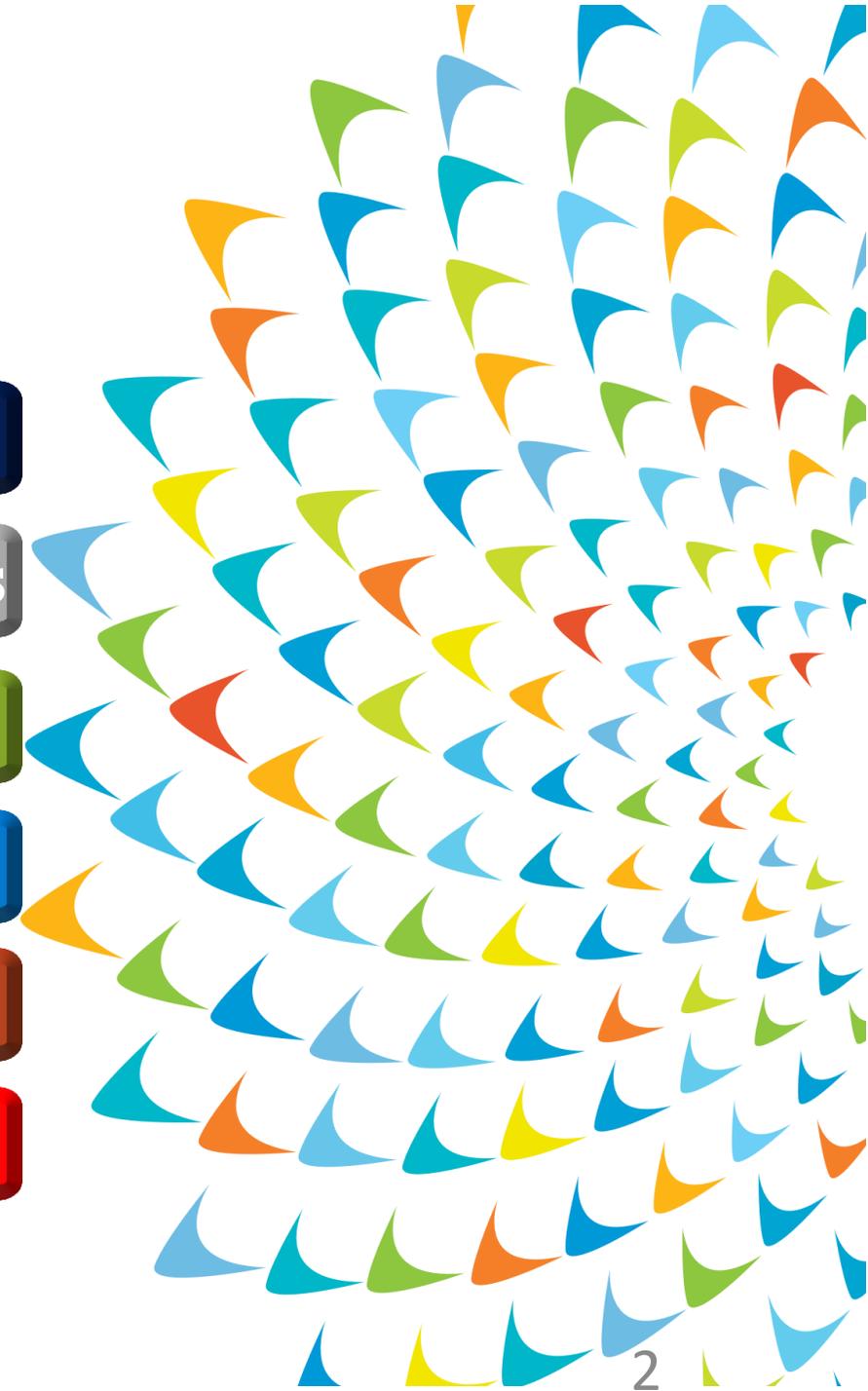
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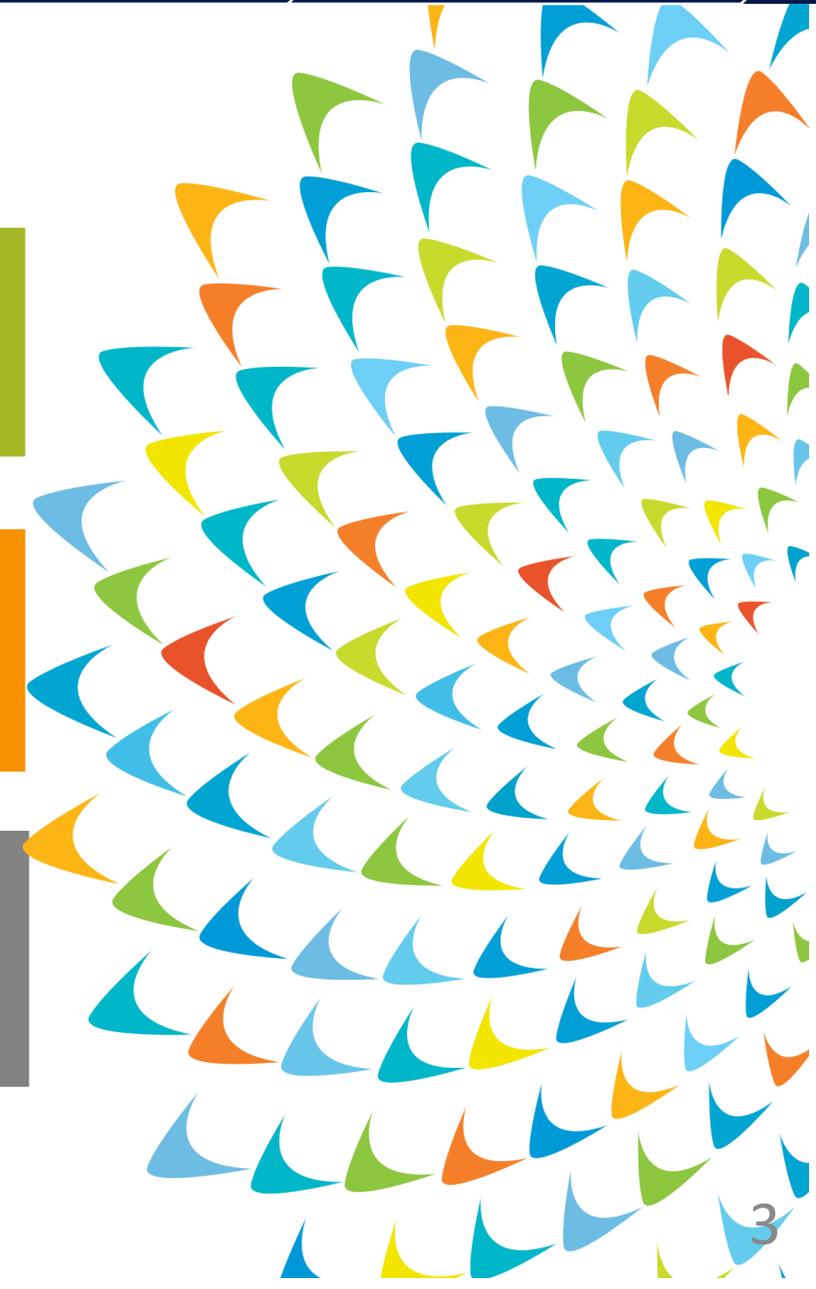


## Objective of research

**1** How and what level of solid waste, flood and waste water (SFW) nexus has been considered and implemented in literature

**2** Review of SFW nexus in urban areas, focusing on the potential link for more integrated project design

**3** What are the best practices and recommendations for applications in SAUW projects



## Methodology of research

Draft recommendations for ADB to improve the SFW nexus for a more integrated project design.

4th

3rd

Review of ADB Solid waste and Flood Projects and meeting with project management

2nd

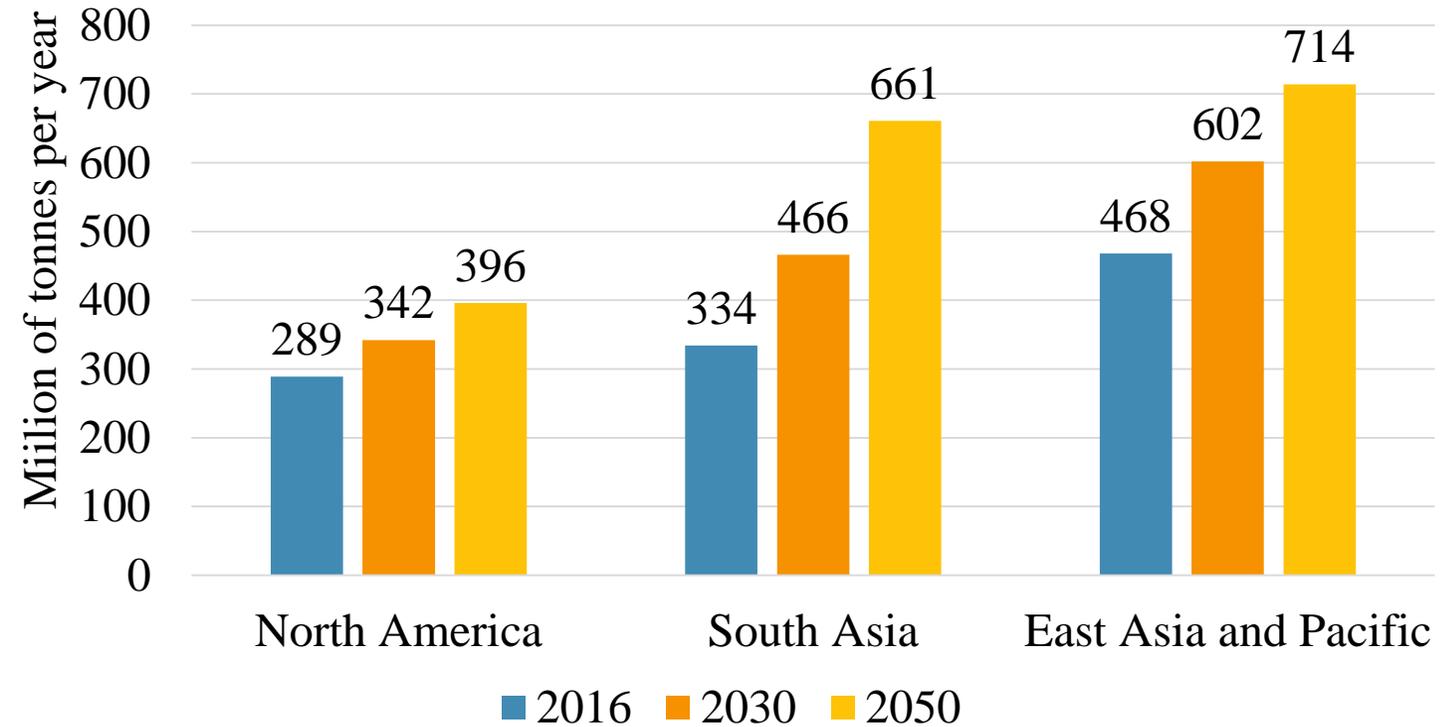
Review of international best practice of SFW nexus

1st

Literature review of SFW nexus in Asia context and recent progress

## Enormous Solid Waste Generation

- World yearly waste generation 2 billion tonnes
- 70% increase over the next 30 years.
- Asia generates about one quarter of the world's waste



Projected waste generation by region, (Kaza, Yao et al. 2018)

## 90% of Solid waste is mismanaged



a) Waste Dumping in Canals in Bangladesh; b) Waste dumping in Canals in Madagascar, (Arai 2017)

## Randomly Dumped Solid waste

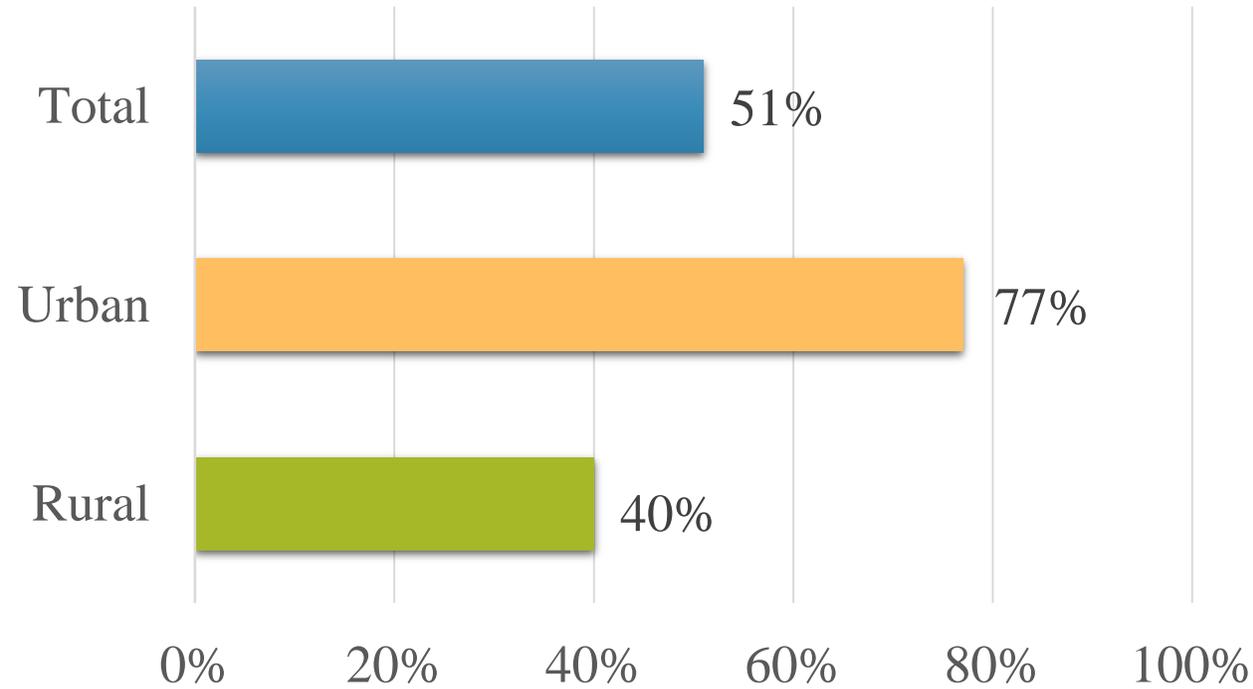


(Arai 2017)

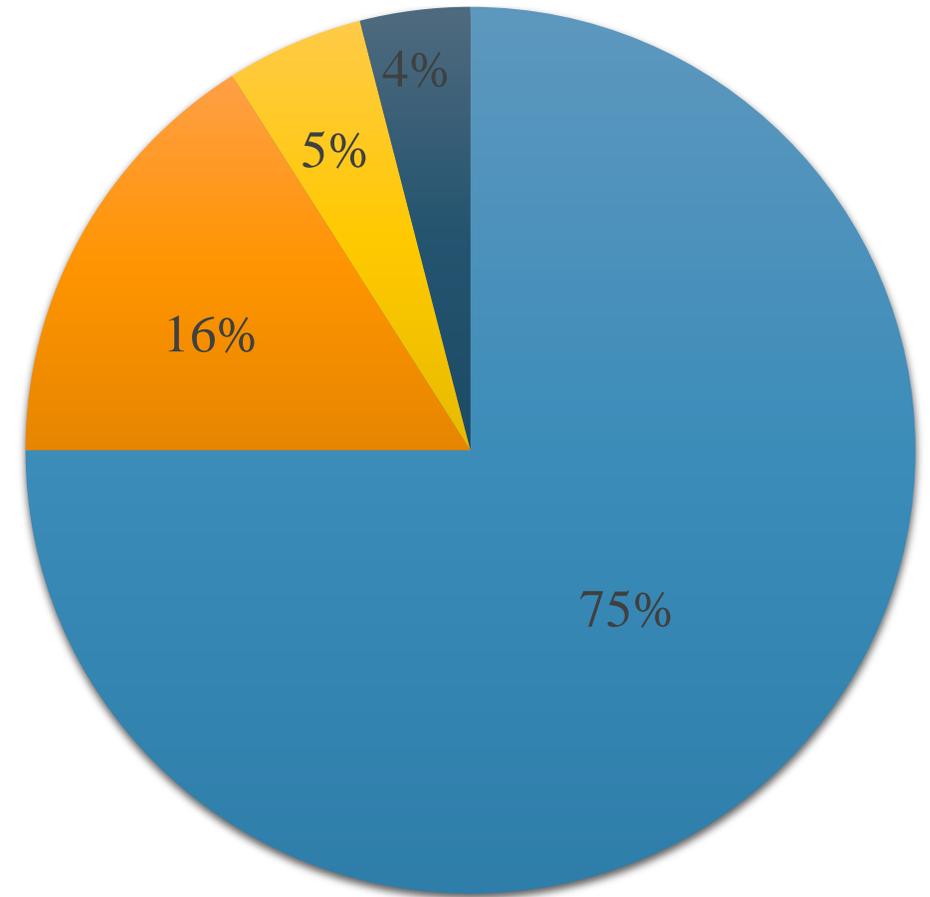


[https://en.wikipedia.org/wiki/Water\\_pollution\\_in\\_India](https://en.wikipedia.org/wiki/Water_pollution_in_India)

# Solid waste Collection and Disposal



Waste Collection Coverage in South Asia, (Kaza, Yao et al. 2018)



Waste disposal and treatment south Asia (Kaza, Yao et al. 2018)

## Plastic Waste disposal challenge



<http://www.nationmultimedia.com/detail/national/30331888>



Plastic waste at the Thilafushi waste disposal site, Maldives, World Bank



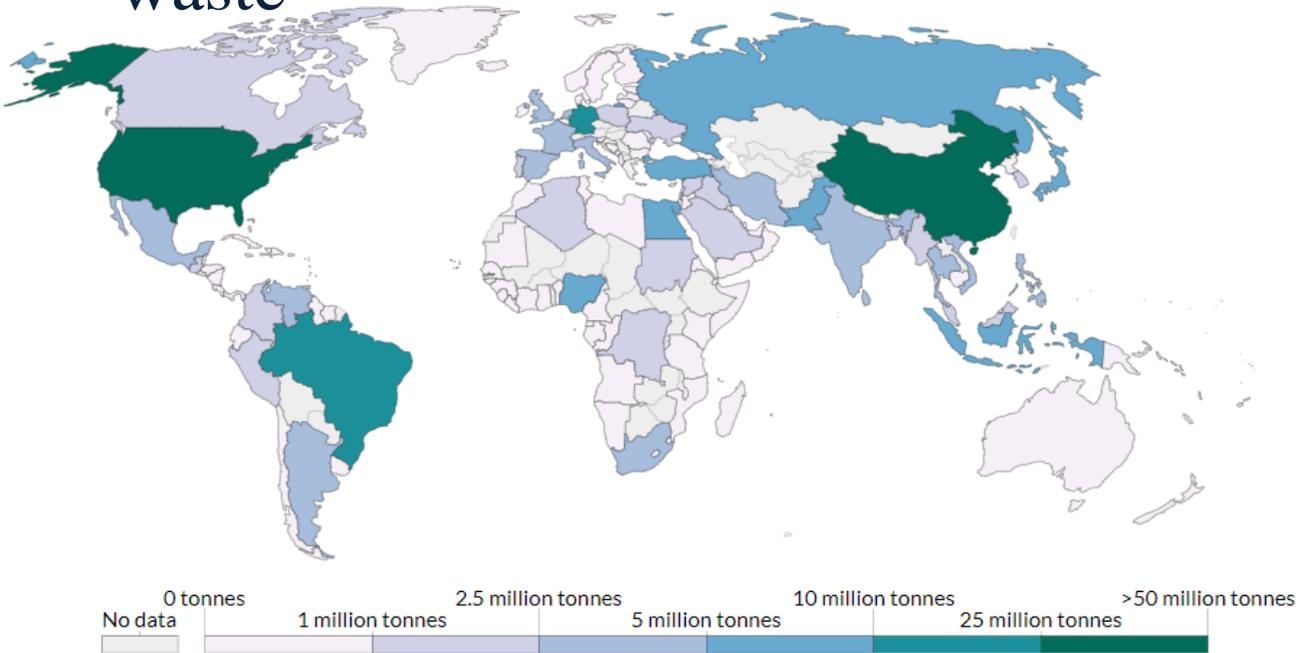
Floating garbage off the shore of Manila Bay in the Philippines



<https://www.independent.co.uk/environment/plastic-pollution-sea-increase-government-scientists-uk-oceans-a8266356.html>

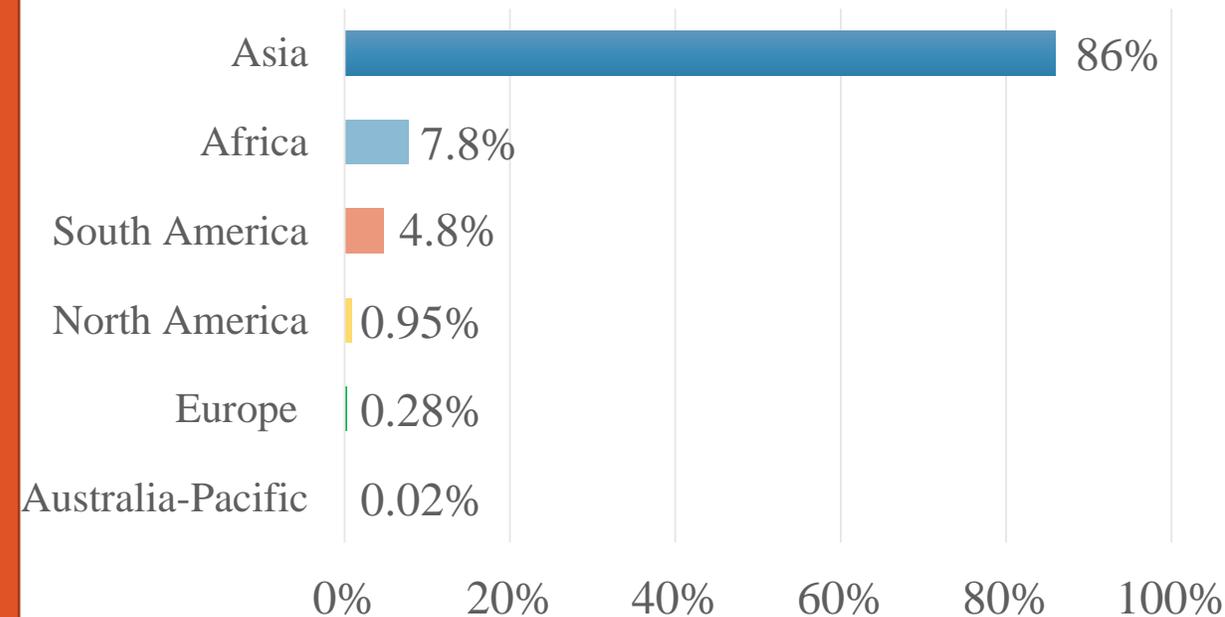
## Plastic Waste complex problem

- The East Asia and Pacific region generate 60 % of the world plastic waste



Plastic waste generation by Country (Jambeck, Geyer et al. 2015)

86% of plastic to oceans came from Asian rivers



Global river plastic input to the ocean by region, 2015 (Lebreton et al. 2017)

## Increase in Floods

- Climate change
- Informal urban settlement
- Open dumping and clog drains
- Huge loss

Total no of Floods in Asian Countries 2000-2016 (Ashraf, Luqman et al. 2017)

Country	Number of Floods	Total Deaths	Total Affected People (Millions)
Pakistan	57	6,584	46.0
India	148	23,592	293.6
Bangladesh	32	2,764	72.7
Sri Lanka	31	211	0.3
Indonesia	109	3,553	4.7
China	173	11,078	829.5
Nepal	23	2,067	2.3
Vietnam	57	2,612	17.4

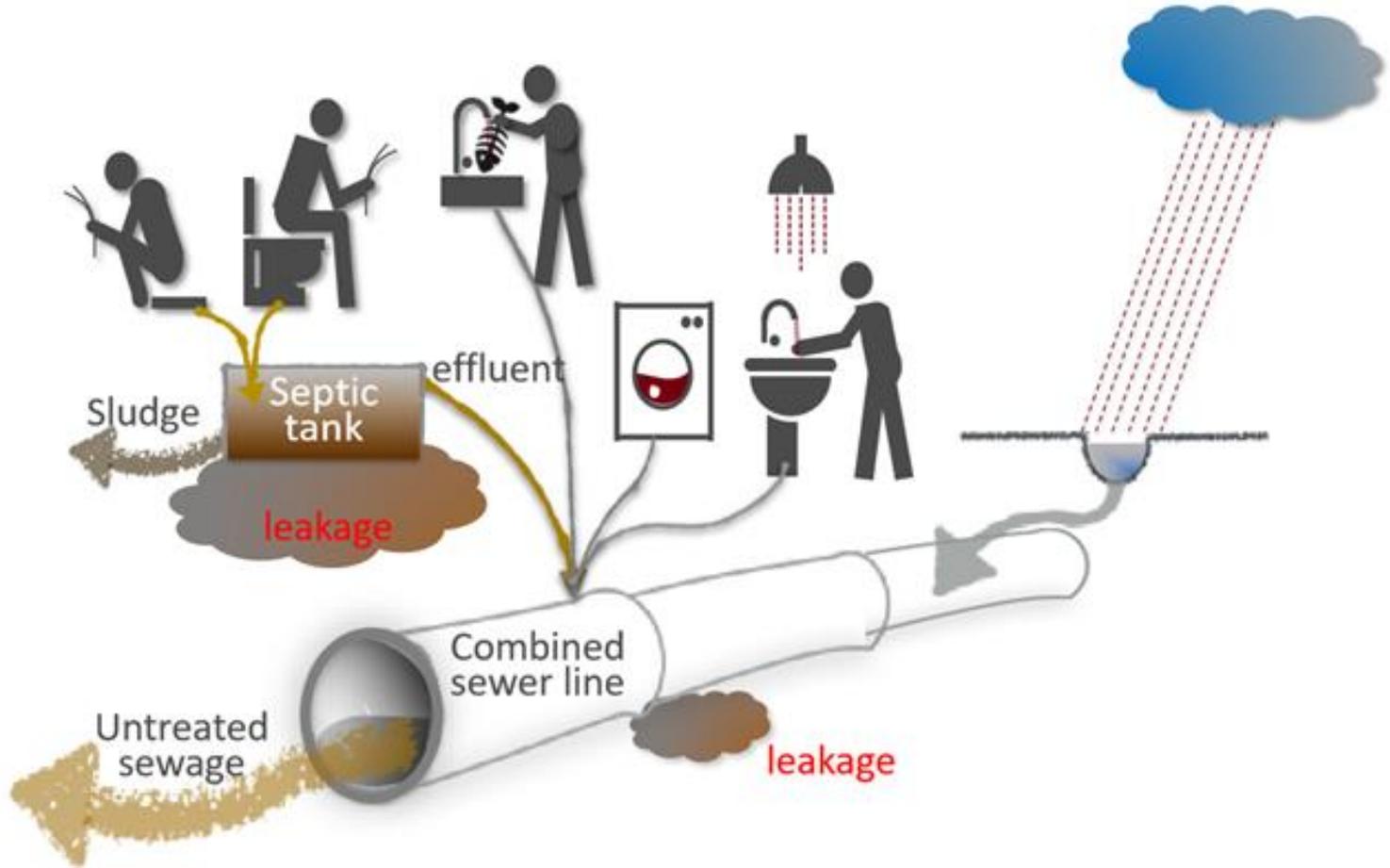
## Urban Flood in Karachi, Pakistan



<http://floodlist.com/asia/pakistan-karachi-rising-flood-risk>

## Untreated Wastewater

- Wastewater discharge
- Less than 1% treated in South Asian Countries
- Water Pollution and Diseases

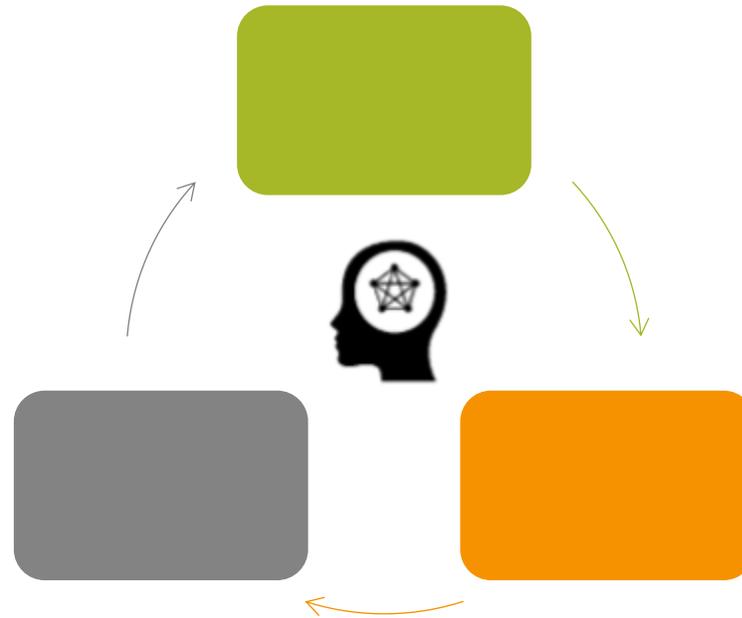


Risks Related to the Common Sanitation System in most Asian Cities <http://old.iclei.org/index.php?id=2545>

## What is SFW Nexus?

The SFW nexus means the actions in any one particular area often can have effects in one or both of the other areas

SFW consider both structural and nonstructural solutions without undermining one another

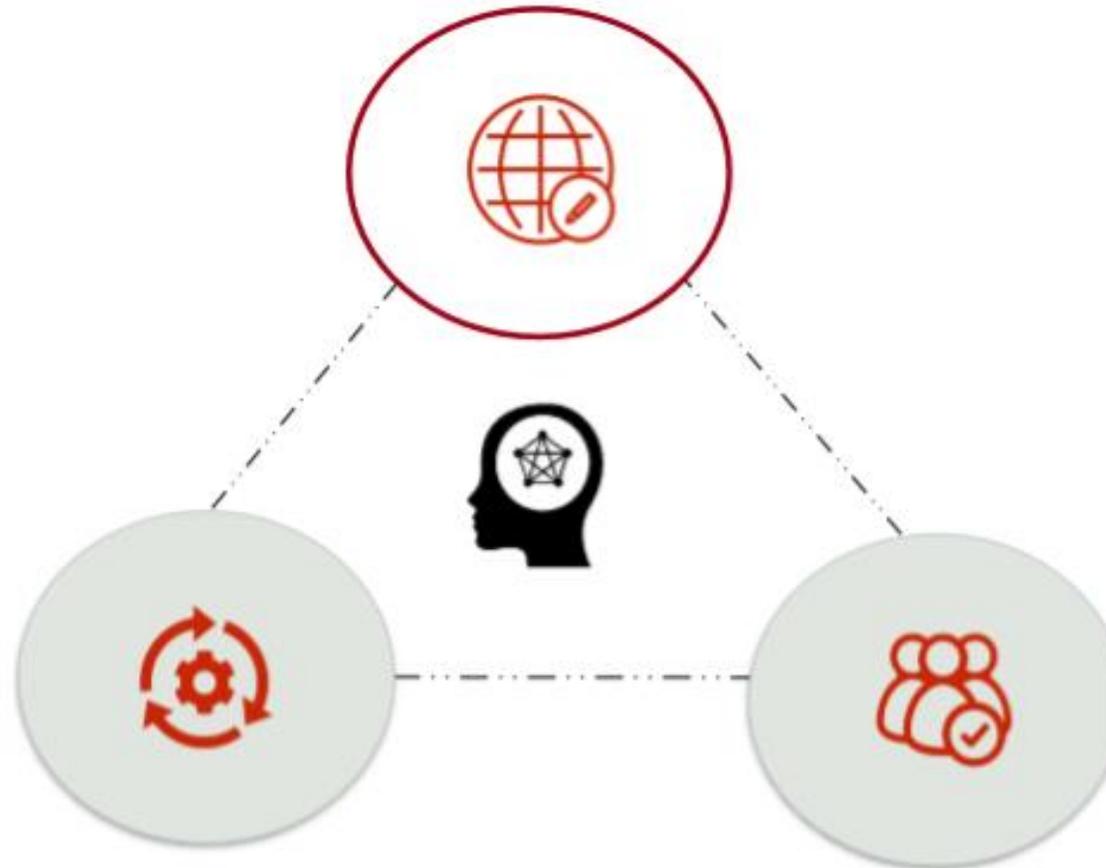


SFW nexus grow; rapid urbanization, climate change and increased in urban infrastructure investment

## Why SFW nexus is Important?

SFW will promote synergies across  
Municipalities to get the benefits

SFW integrated  
management leads to  
sustainable development



The interdependence  
of the SFW required  
integrated action.

## SFW Nexus in reality?

- Solid waste block the drain and cause the flooding
- Flood would bring the solid waste to the rivers and to the oceans
- Flood would also spread wastewater
- Solid waste in flood would produce more water pollution



**Solid waste management is critical in nexus**

## Cause of some urban floods

Sr. No	Case Study	Issues	Community awareness
1	Mumbai, India	Plastic bags	Poor awareness
2	Marikina, Philippines	Waste clogging the river	Poor awareness
3	Maputo, Mozambique	Inadequate drainage	Poor awareness
4	Lagos, Nigeria	Blocked drainage	High awareness
5	Jakarta, Indonesia	Blocked channels	High awareness

## Model Analysis of flooding in Bangladesh and Nepal

Sylhet City					
Scenarios	Current Situation	In 2050 due to Climatic change	After Structural interventions	Proper Urban Infrastructure with climate change in 2050	Without Solid waste management
Flooded Area (%)	22.3	27.1	3.6	2.6	18.5
Bharatpur City					
Flooded area (%)	12.7	13.5	5.5	7.2	7.6

(Pervin, Rahman et al. 2019)

## Bangkok, Thailand and Hue, Vietnam



Findings in a blocked manhole (APN 2018)

# Bangkok, Thailand and Hue, Vietnam



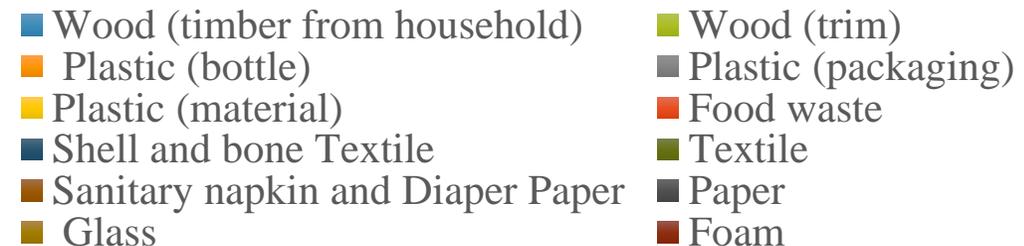
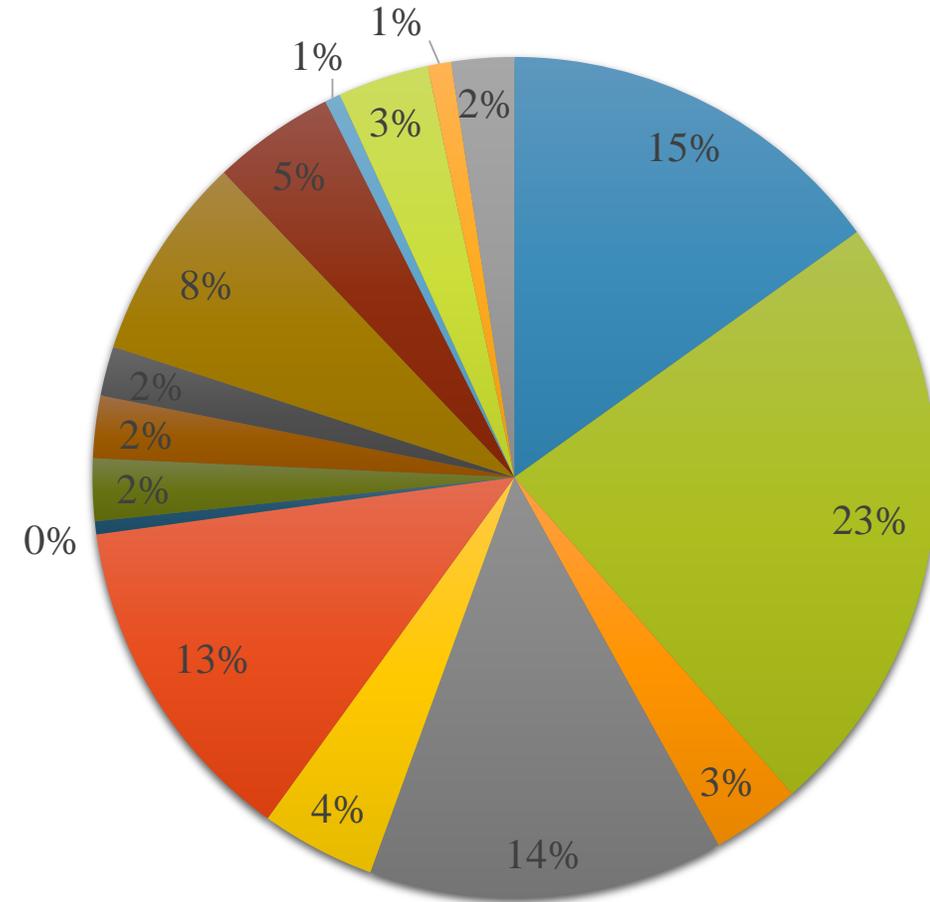
Waste on screens, Hue (APN 2018)



## Bangkok, Thailand

- Solid wastes composition clog in canals system
- Largest; 38% Wood and leaves
- 2<sup>nd</sup> largest 21 % Plastic waste

At half of blockages, the water level at the upstream increased almost 50%



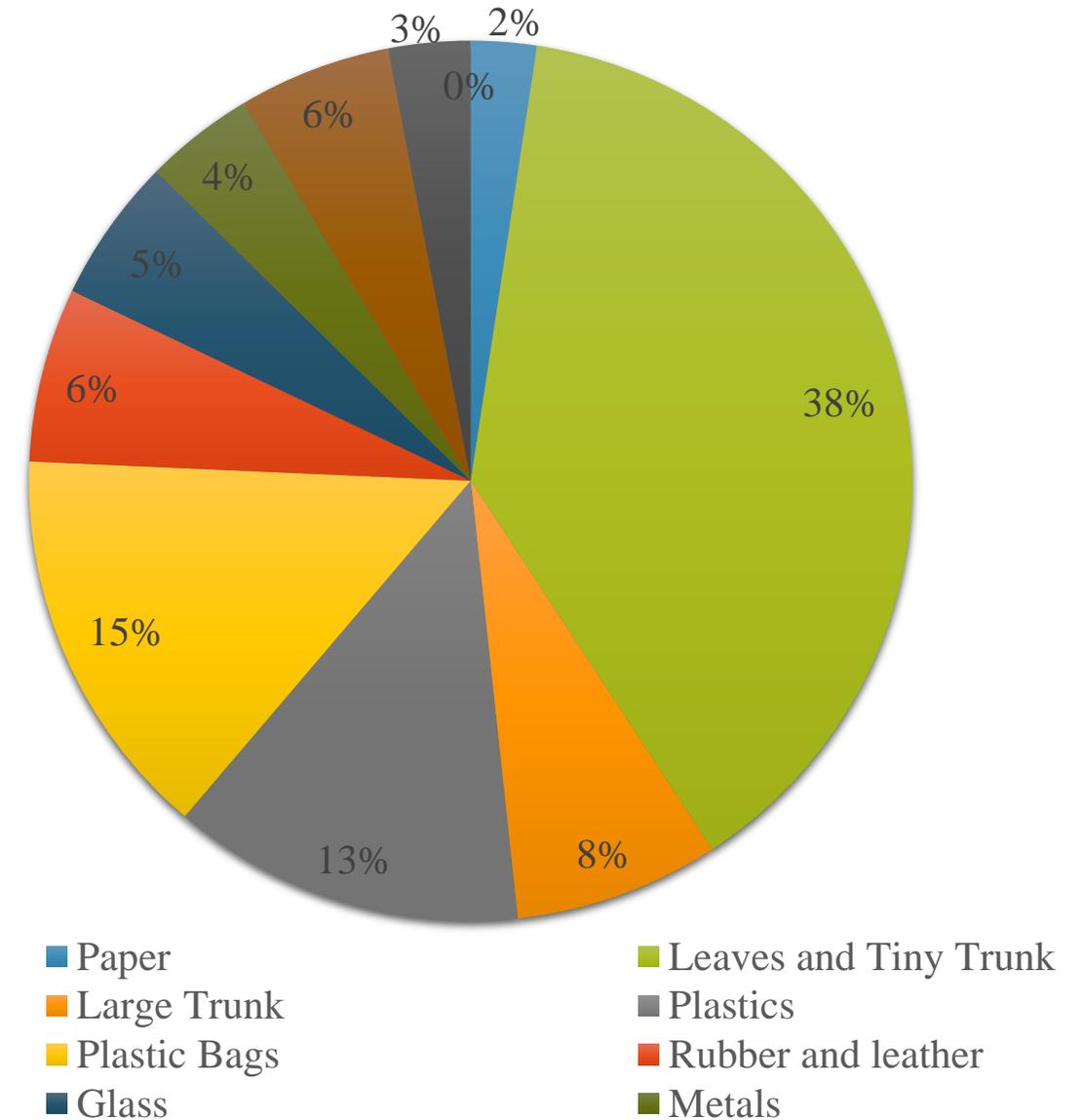
Composition of solid waste in canal in Bangkok, (APN 2018)

## Hue, Vietnam

Solid wastes composition clog in  
drainage system

Largest; 38% Wood and leaves

2<sup>nd</sup> largest 28 % Plastic waste



## Best Practice of Bamako, Mali- Africa

### Background and Objective

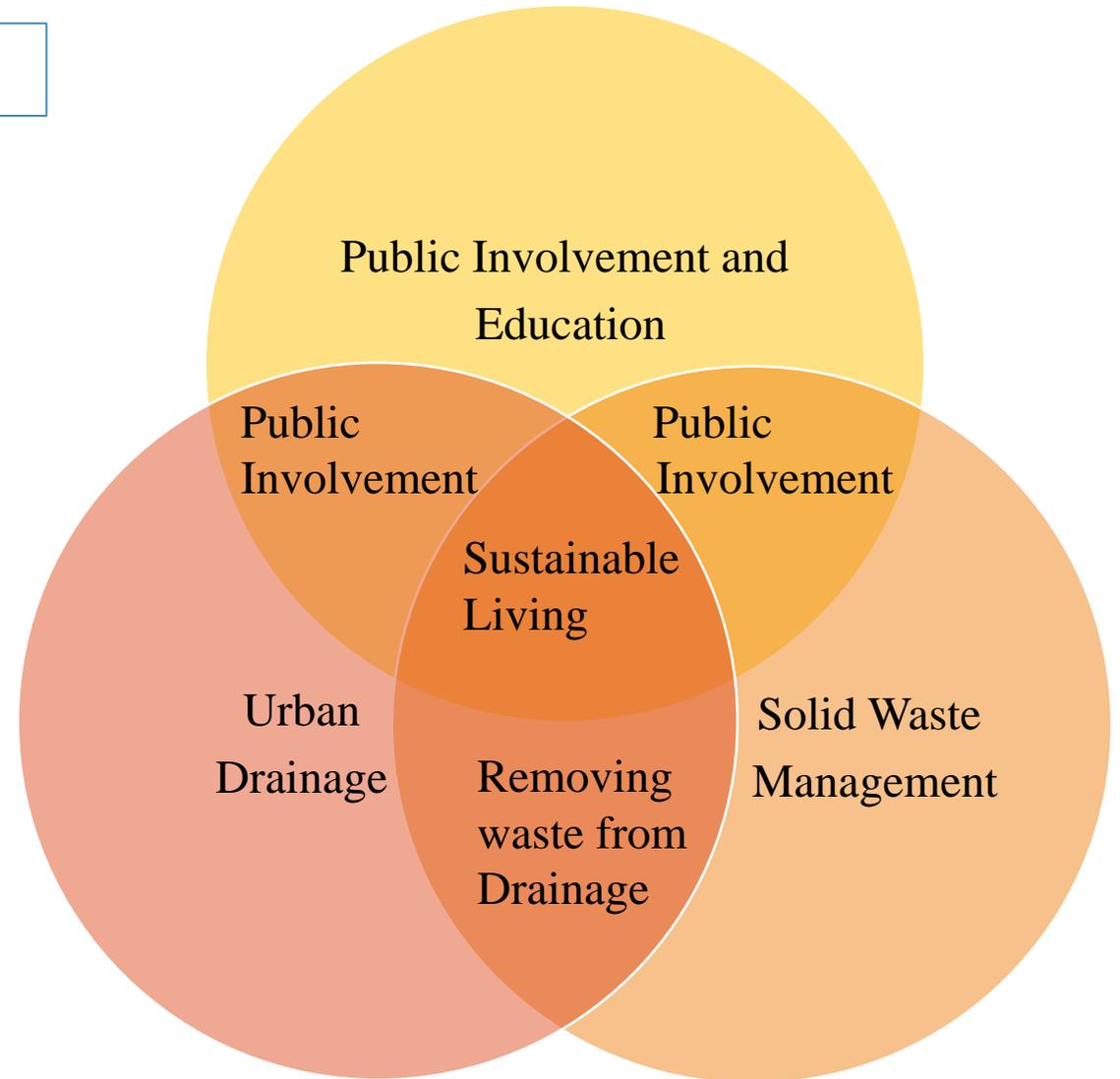
- 1999 Flooding
- Population Growth
  
- Flood Management
- Waste management

### Actions and Outcomes

- Community involvement
- Waste Collection
- Drainage improvements
  
- Reduced flood risk
- Water-borne illness reduce 33%-40%
- US\$426 /Year/House

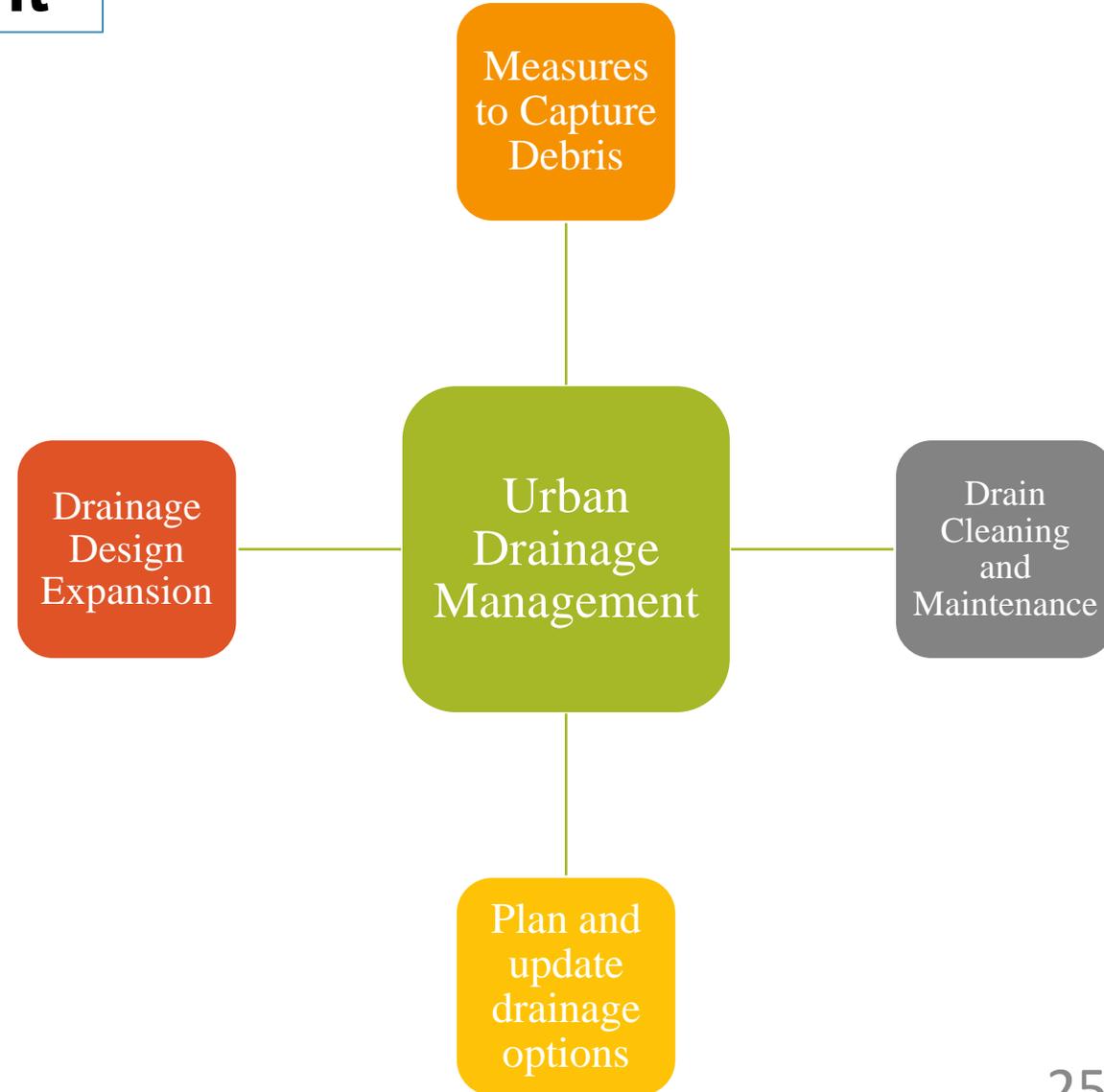
## Best Practice in Kitakyushu, Japan

- Independent City Government Sectors and Activities.
- All Unite as City Residents



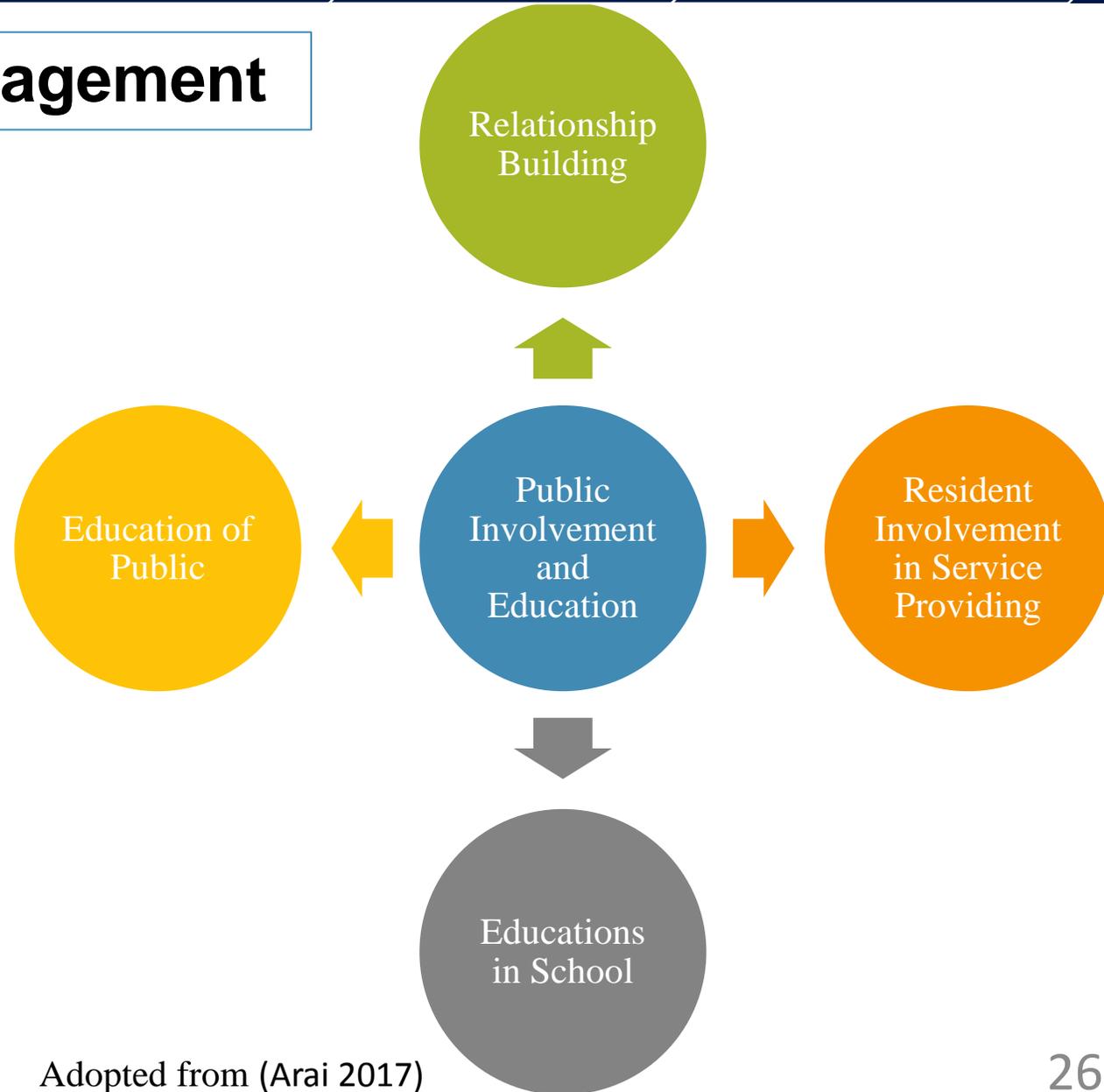
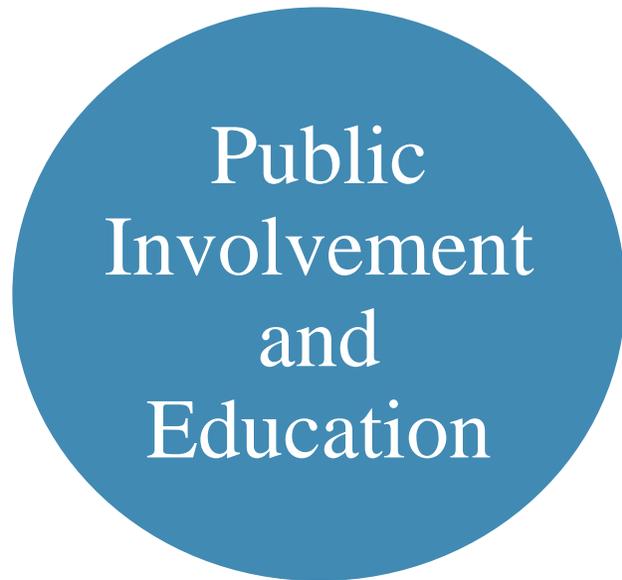
Model Overview, Adopted from (Arai 2017)

# Solid waste and Drainage Management



Adopted from (Arai 2017)

# Public Involvement in Waste Management



Adopted from (Arai 2017)

## ADB, Solid Waste Management Projects

Sr No.	Name of the Project	Location of the Project	Year	Loan Amount (\$ million)	Interplay between Solid Waste, Flood and Waste Water		
					Solid waste Impact	Flooding Impact	Waste Water Impact
1	Hunan Xiangjiang River Watershed Existing Solid Waste Comprehensive Treatment Project	People's Republic of China	2018	150	✓	Partial	x
2	Greater Malé Environmental Improvement and Waste Management Project	Republic of Maldives	2018	33.07	✓	x	x
3	Sustainable Solid Waste Management Project	Uzbekistan	2019	60	✓	x	x
4	Solid Waste Management Sector Project	Republic of the Philippines	2015	70	✓	Partial	x

## ADB, Flood Management Projects

Sr No.	Name of the Project	Location of the Project	Year	Loan Amount (\$ million)	Interplay between Solid Waste, Flood and Waste Water		
					Solid waste Impact	Flooding Impact	Waste Water Impact
1	Strengthening Integrated Flood Risk Management	Developing Member Countries	2018	TA	Partial	✓	Partial
2	Ho Chi Minh City Climate Resilient Urban Services Project	Viet Nam	2019	360	x	✓	✓
3	Tamil Nadu Urban Flagship Investment Program - Tranche 1	India	2018	169	x	✓	✓
4	Chongqing Longxi River Basin Integrated Flood and Environmental Risk Management Project	People's Republic of China	2018	150	✓	✓	✓

## Conclusions

Strong interplay  
between SFW  
management

Best practices  
show integrated  
approach will lead  
to sustainable  
development

- i. Open dumping of solid waste contribute to urban flooding significantly by blocking drainage and increasing debris i.e Bangkok and Hue
- ii. Without proper management of solid waste, the flooding risks increase i.e Sylhet and Bharatpur
- iii. Public involvement need to be part of Urban drainage and solid waste management i.e Kitakyushu, Japan and Bamako, Mali

## Conclusions

ADB solid waste  
management  
projects

ADB flood  
management  
projects

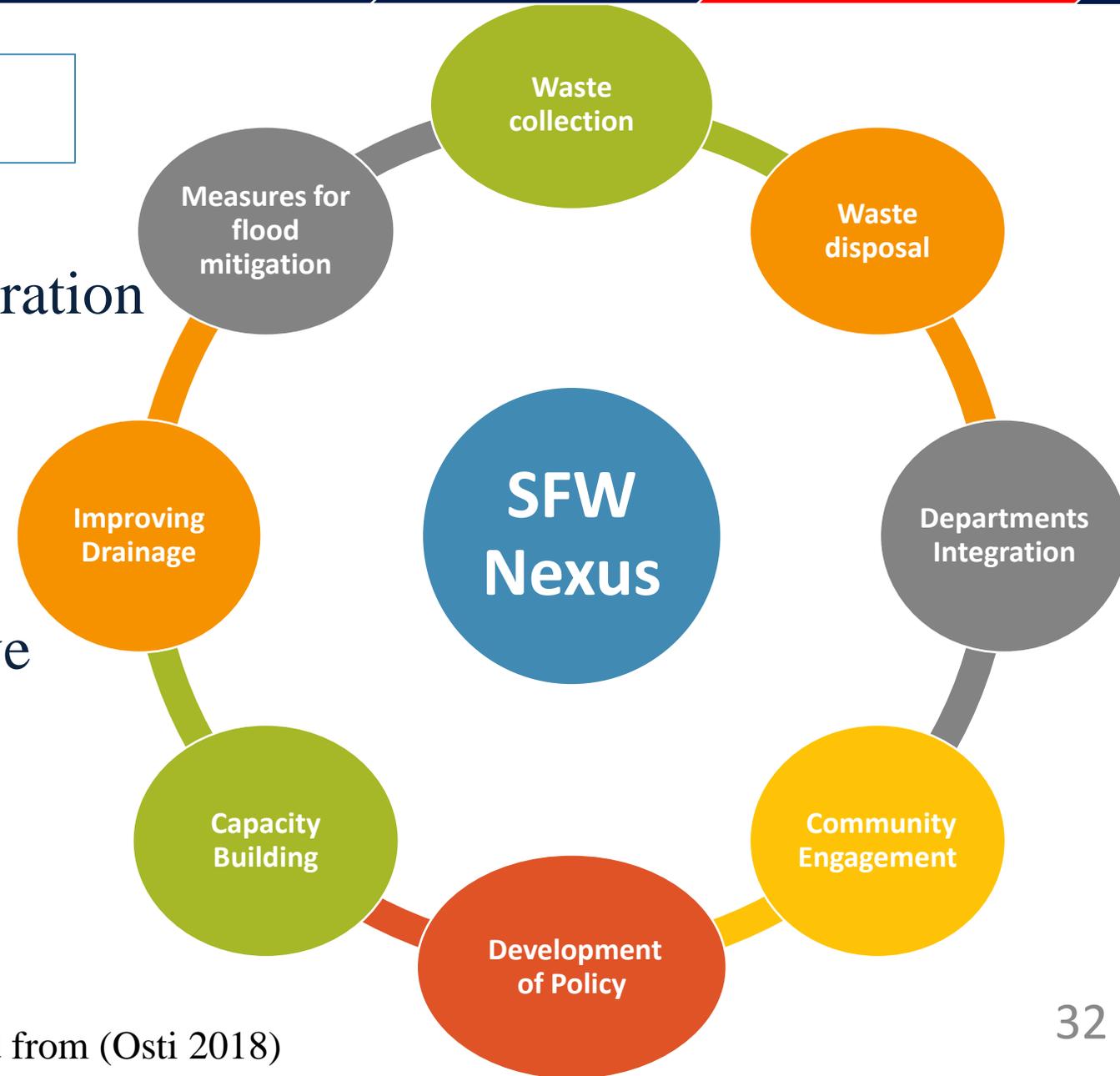
- i. Indicated the positive impact of solid waste management on flooding, however has not explained it explicitly.
- ii. Only PRC have considered integrated approach
- iii. TA has partial considered solid waste management

## Recommendations

1. In ADB solid waste management projects, benefits of Flood reduction can be explicitly explained in project reports.
2. ADB Flood management projects should incorporate challenges caused by solid waste disposal and collection, addressing of which would benefit flood management.
3. Strengthen public awareness regarding 3Rs (reduce-reuse-recycle)
4. Capacity enhancement of proper collection of solid waste

## Elements of SFW Management

- Solid waste-flood management integration
- Appropriate Framework Approach
- Monitoring, Evaluation, and Adaptive Management



THANK YOU

