INVESTIGATING MAJOR CAUSES OF FREQUENT FLOODING IN HIGHLY URBANIZED METROPOLITANS USING A QUALI-QUANTITATIVE APPROACH

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AGU FALL MEETING

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OUTLINE

- Background
- Objective and Rationale
- Study Area
- Methodology
- Results and Discussion
- Conclusions

BACKGROUND

- Urban pluvial flooding occurs when the city's drainage capacity exceeds the volume of runoff.

- Climate change and rapid urbanization are stressing metropolitans in public service delivery.

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OBJECTIVE

- To investigate the major causes of urban pluvial flooding in a highly urbanized metropolitan using a mixed approach.

RATIONALE

- Provides common ground for an evidence-based understanding of the issues and possible solutions, taking a joint call to action.

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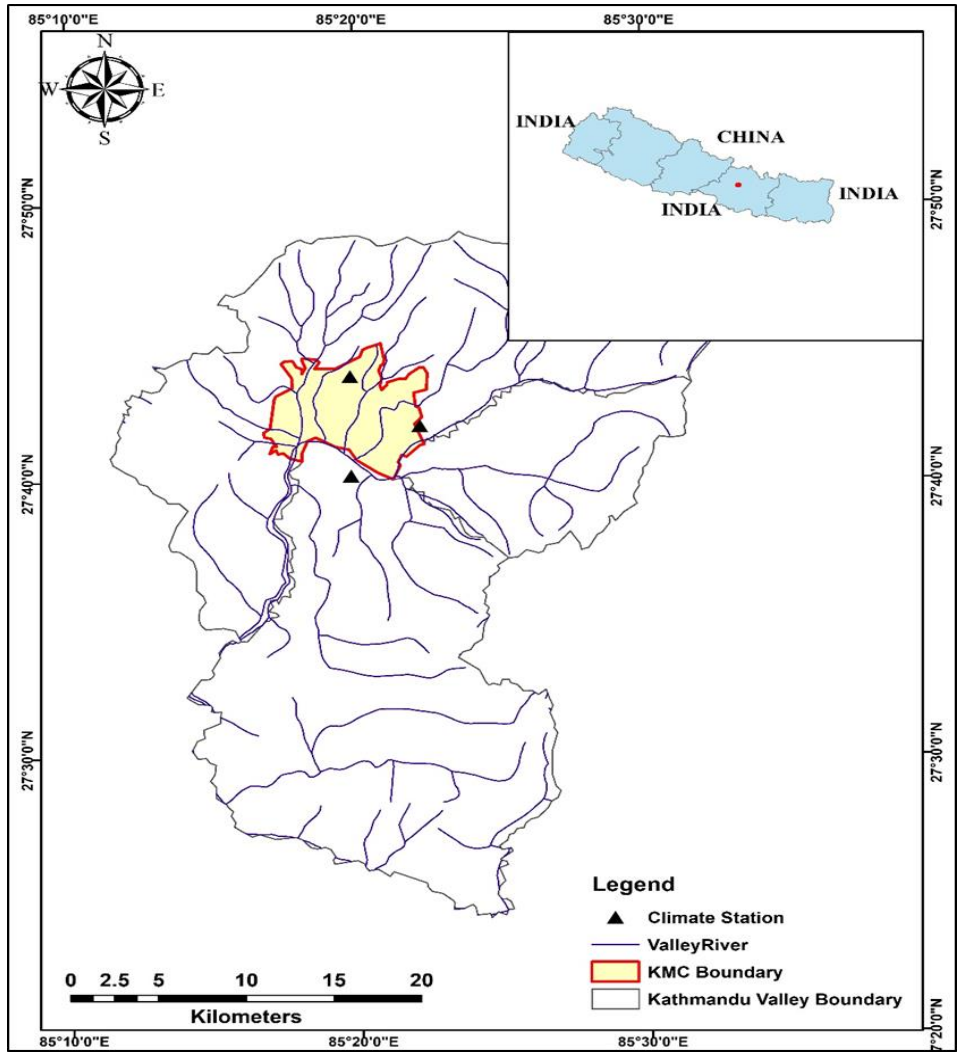
STUDY AREA

Country	Nepal
Location	Kathmandu Metropolitan City
Area	51.94 sq km
Population (2019)	1,000,000
Population Density	≈19250 Person/sq.km
Average Rainfall	≈1407 mm
Drainage System	Combined Sewerage



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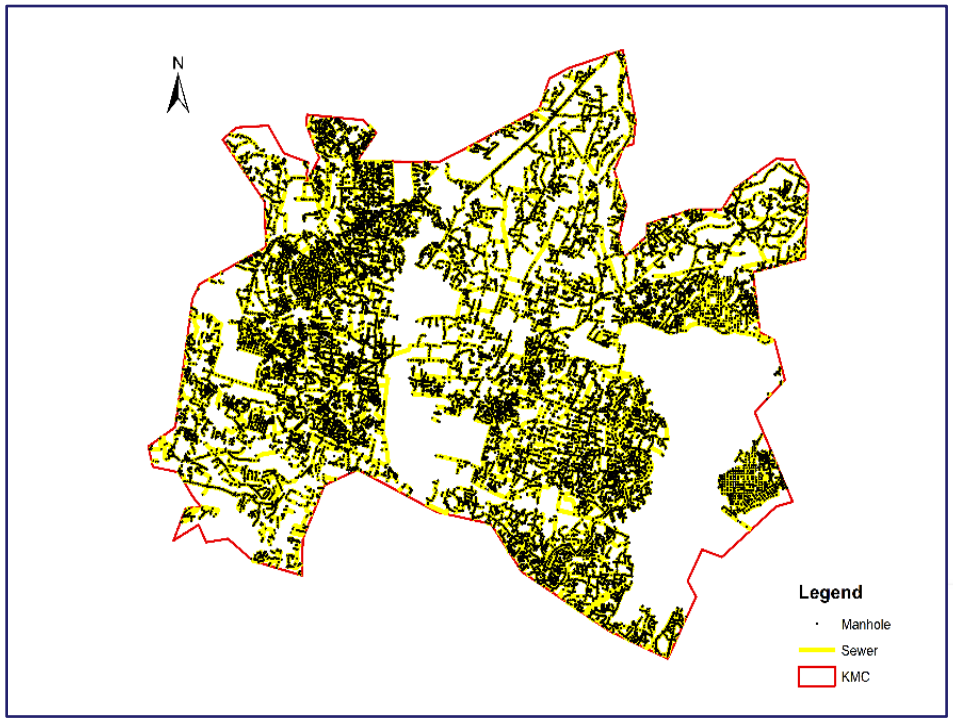
STUDY AREA



30,450 Manholes

30,144 Conduits

650 Km Length

National News

the kathmandupost

NATIONAL SILVER LININGS SPORTS EDITORIAL OPED INTERVIEW TECHNOLOGY WORLD ESCALATE OTHERS

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PRINT EDITION - 2011-03-11 | METRO

'Drainage system a major problem'

'Drainage system a major problem' Mar 10, 2011-

What are the ongoing development works in the ward?

There is no development work as such at present. Recently, the ward office paved roads with stones in a few places while the development budget of the ward is over now. We were given only Rs 200,000 for development and construction this year.

República

Nepal Republic Media | April 24, 2019

HOME POLITICS ECONOMY SOCIETY SPORTS WORLD TECHNOLOGY

Lack of proper drainage management bothering locals of Kathmandu

30 May 2016 | 19:40pm | | SHRADDHA AMATYA | 0 Comments

Share 0 Tweet 0 Google + 0 Pin 0 Email 0

KATHMANDU, May 31: Sampada Koirala, a local of Maitidevi, recently got late for her medical preparation class as she had to walk carefully along the muddy road in her locality.

the kathmandupost

NATIONAL SILVER LININGS SPORTS EDITORIAL OPED INTERVIEW TECHNOLOGY WORLD ESCALATE OTHERS

PRINT EDITION - 2014-05-05 | MAIN NEWS

waterlogging: First rains expose city's poor drainage

- POST REPORT, Kathmandu

waterlogging: First rains expose city's poor drainage May 4, 2014-

The sudden downpour on Sunday revealed the cracks on the newly-expanded roads in the Capital. Pedestrians and drivers had to navigate through waterlogged streets—an unpleasant introduction to times ahead. Authorities have once again failed to install a drainage system capable of flushing away the monsoon rain.

The authorities lament that most of the major roads are grappling with this problem due to lack of connectivity to the drainage system. According to them, in roads like Maitighar-Tinkune and Lainchaur

METHODOLOGY

Literature Review
(Possible Causes, Adaptation and Management Options)

Questionnaire Development
(Experts Survey)

Field Survey
(4 Experts Category)

Results Extraction and Analysis

Secondary Data Collection

Validation
(Statistical Test, RClimDex, Land-use Change Analysis)

Causes of Pluvial Flooding

Rainfall Trends

Possible Adaptation and Management Options

70
Respondents

- **20** Managers & Administrative Officers
- **10** Researchers & Academicians
- **20** Engineers and Planners
- **20** On-Site Workers

19
Organizations

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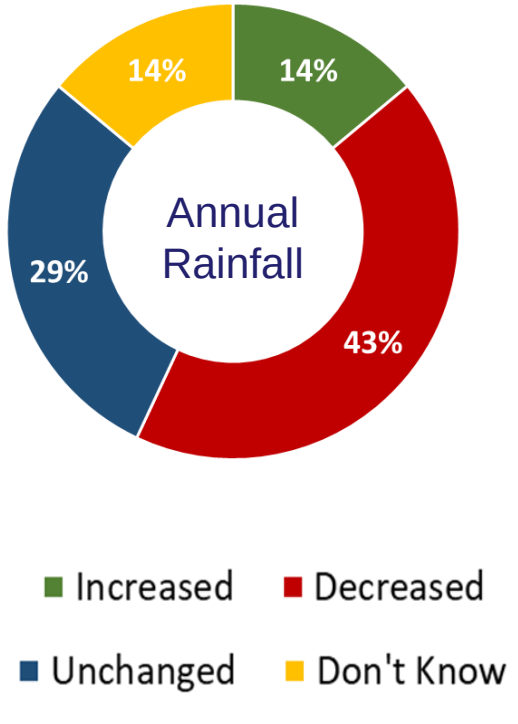
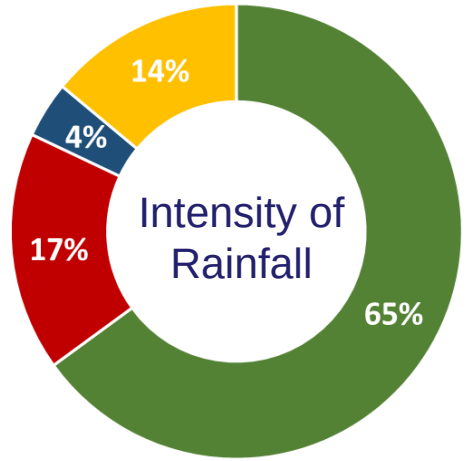
RESULTS AND DISCUSSION

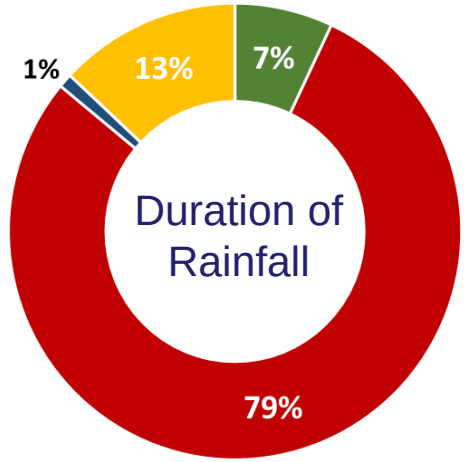
Time series	Trend Test (1989-2018) Test Z	Sig.	Q
Annual	-0.036	-	-0.144
Monsoon (Jun-Sep)	0.285	-	1.341
Post-Monsoon (Oct-Nov)	0.250	-	0.127
Winter (Dec-Feb)	-1.070	-	-0.642
Pre-Monsoon (Mar-May)	0.214	-	0.438

Category	Indices	Slope
Intensities Indices (I)	Rx1day	0.261
	Rx5day	0.042
	SDII	0.043
	R95p	1.516
	R99p	-0.297
	PRCPTOT	0.676
Duration Indices (D)	CDD	0.226
	CWD	-0.076
Frequency Indices (F)	R10mm	0.063
	R20mm	0.127
	R25mm	0.074

Experts Experience

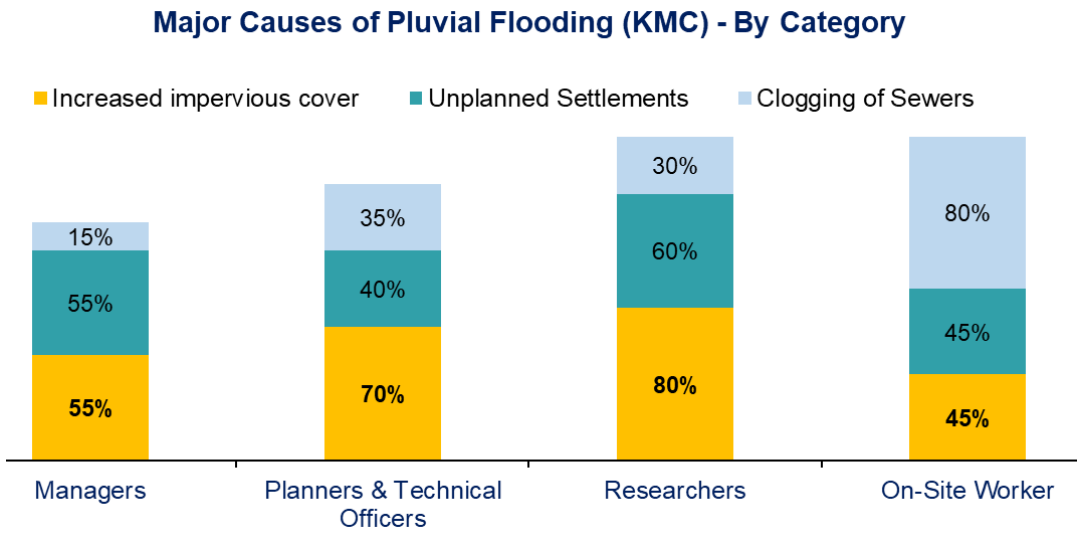


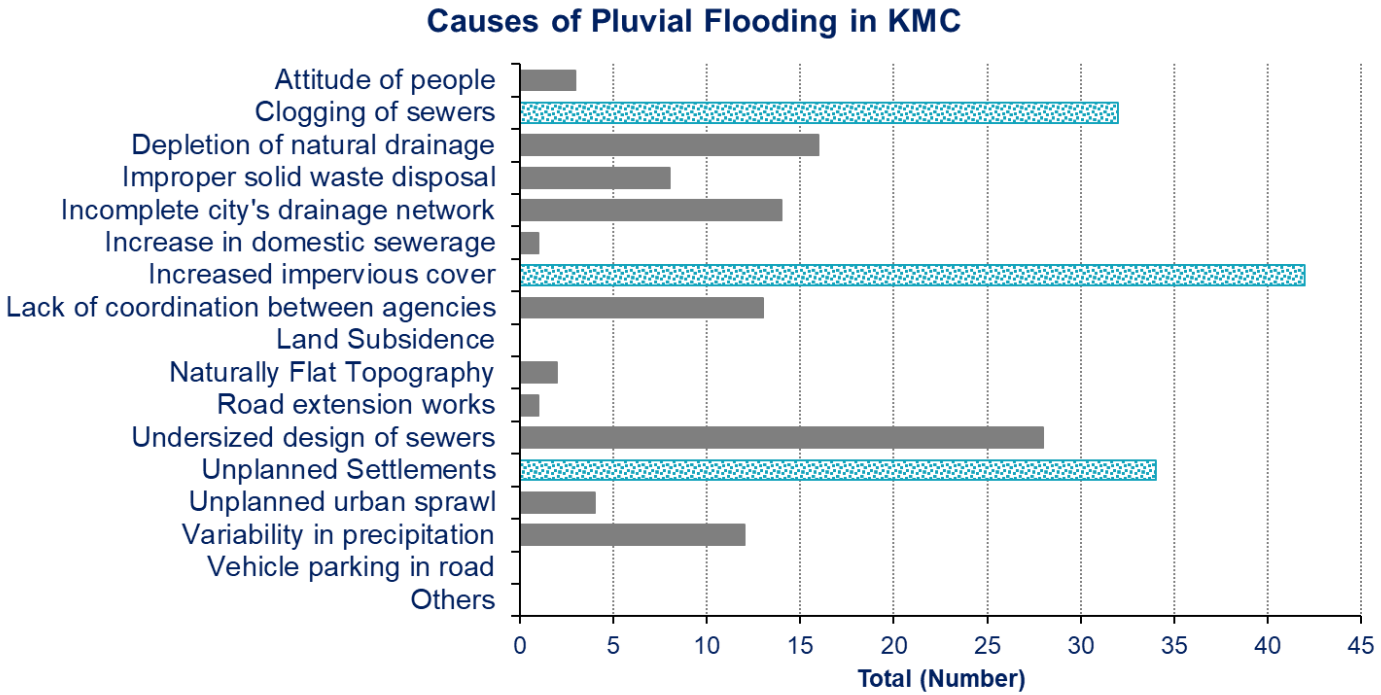




RESULTS AND DISCUSSION

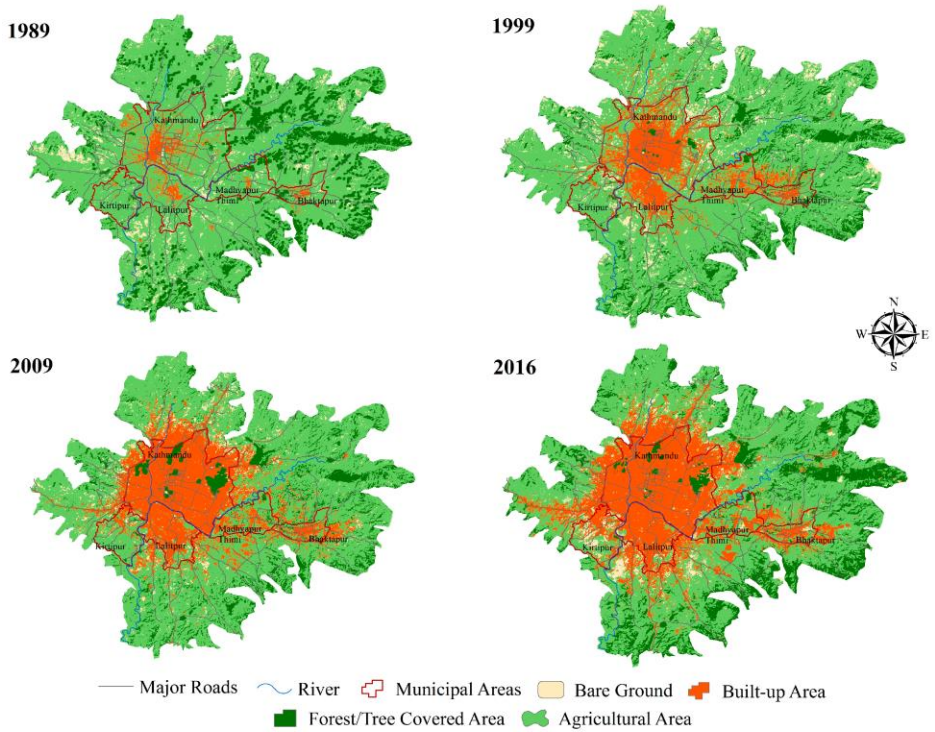
- Major Causes of Pluvial Flooding: Increased Impervious Cover (60%), Unplanned Settlement (49%), Clogging of Sewers (46%)





RESULTS AND DISCUSSION

- Imperviousness increased to 75% from 25% in 1990 (KVDA, 2016).
- More than 7% of sewers are clogged (Uprety, 2017 – UNESCAP).



Source (LULC Map): Ishtiaque et al., 2017

Population Change		
Year	Population (Census)	Population Density (persons/ km^2)
1991	421,258	8,314
2001	671,846	13,259
2011	975,453	19,251
Source: Central Bureau of Statistics		

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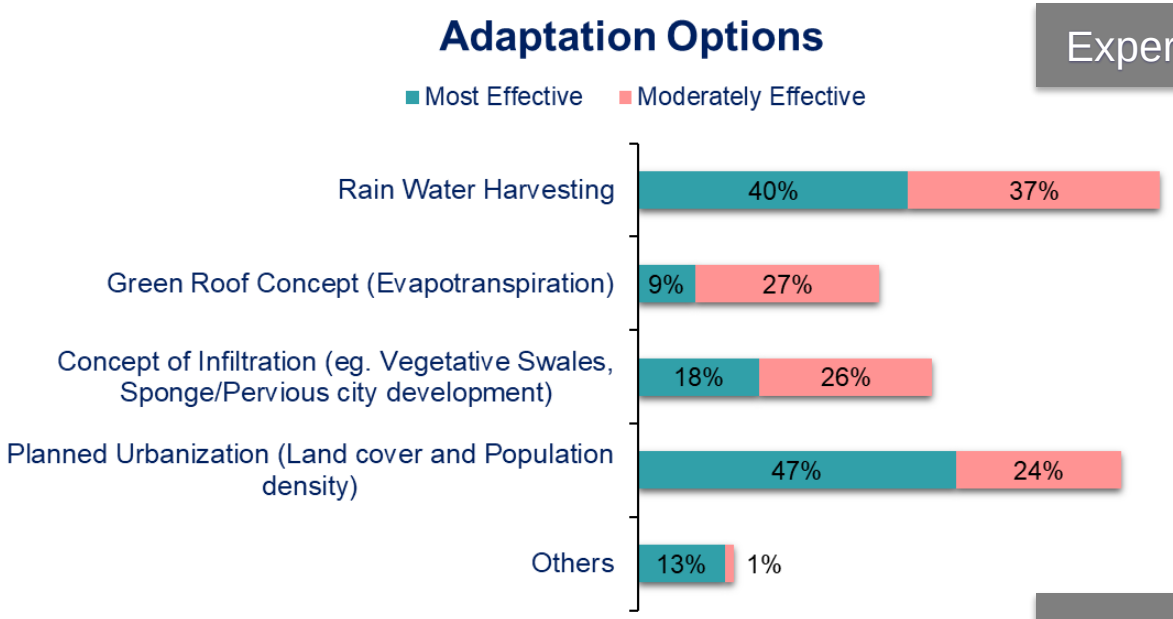
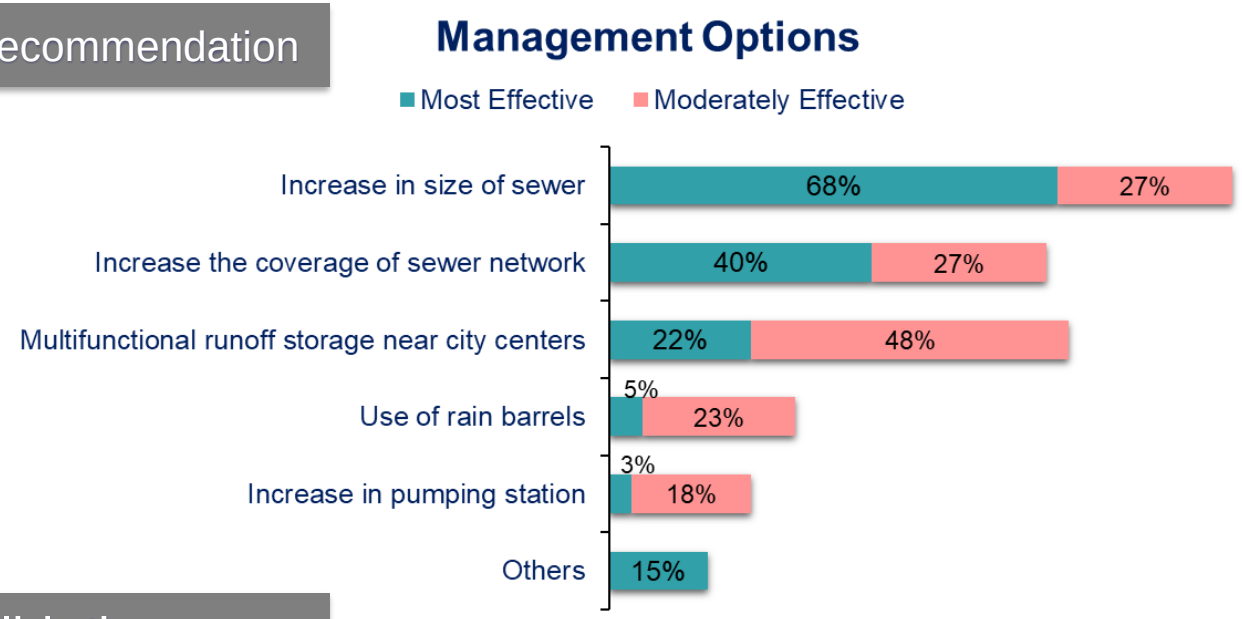
RESULTS AND DISCUSSION



Experts Recommendation



Validation

- Combination of small-scale rainwater harvesting, and overflow storage is likely to reduce flood volume by 20-35% (KC et al., 2021).

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CONCLUSIONS

- The three major causes of frequent pluvial flooding in KMC are increased impervious cover, unplanned settlement and clogging of sewers.
- KMC is experiencing frequent high rainfall intensities of shorter duration though the annual rainfall has declined.
- Combination of location-specific adaptation and management options is likely to reduce frequent flooding.

THANK YOU

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