EVALUATING INVESTMENT IN FLOOD PROTECTION AT RIVER BASIN SCALE

TRANSDISCIPLINARY APPROACH, DISASTER RISK REDUCTION, RECOVERY/ RECONSTRUCTION

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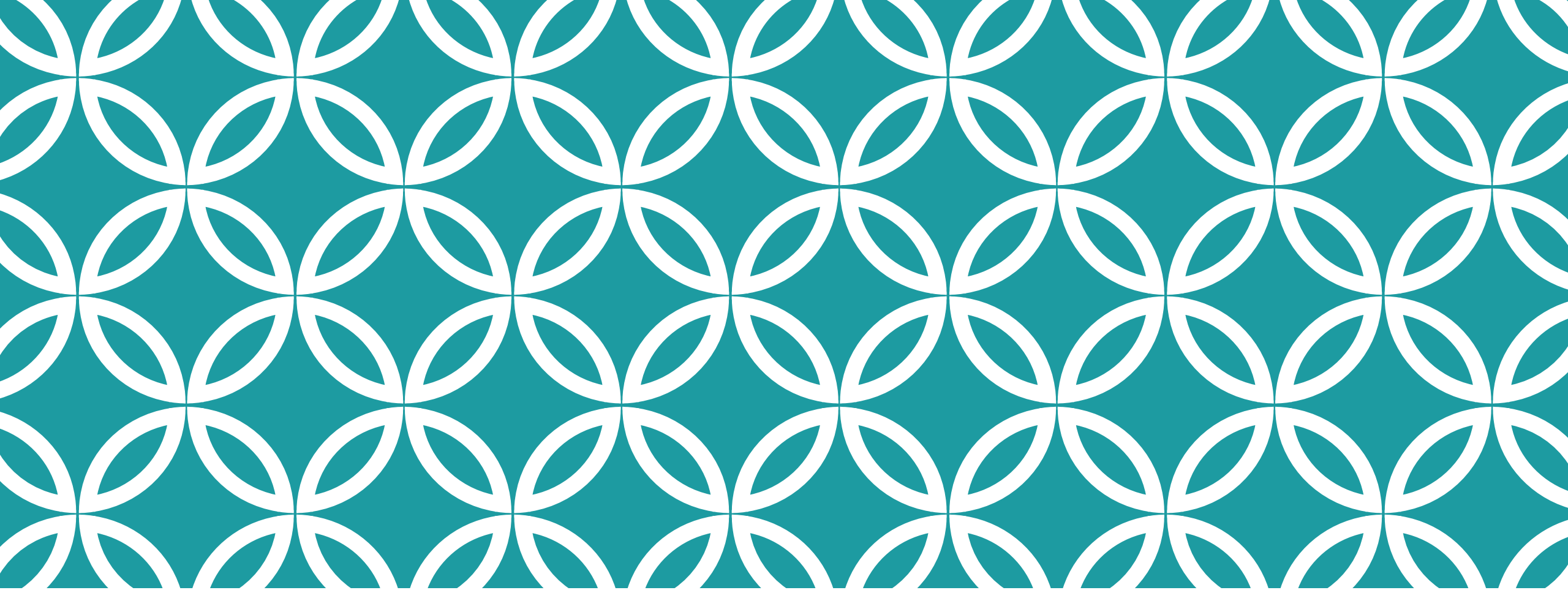
CONTENTS



I. INTRODUCTION

1. INTRODUCTION

- Disaster risk reduction (DRR) Investment
  - ✓ crucial for decreasing damage
  - ✓ Information is essential for formulating investment policies and financial arrangement

However,

- Scale and effect of DRR investment are not clear
  1. how much are countries investing?
  2. how much do countries need in future?
  3. how much return can be expected from investment

INTERNATIONAL ARENAS

- Sendai Framework for DRR, adopted at 3rd UN World Conference on DRR in Sendai in 2015: investment as a priority action
- Copenhagen Accord, COP in 2009: set a target of $100 billion per year by 2020 to support mitigation and adaptation measures in developing countries
- Kumamoto Declaration, adopted at 4th Asia-Pacific Water Summit in 2022 by the participating leaders, double investment to solve water issues.

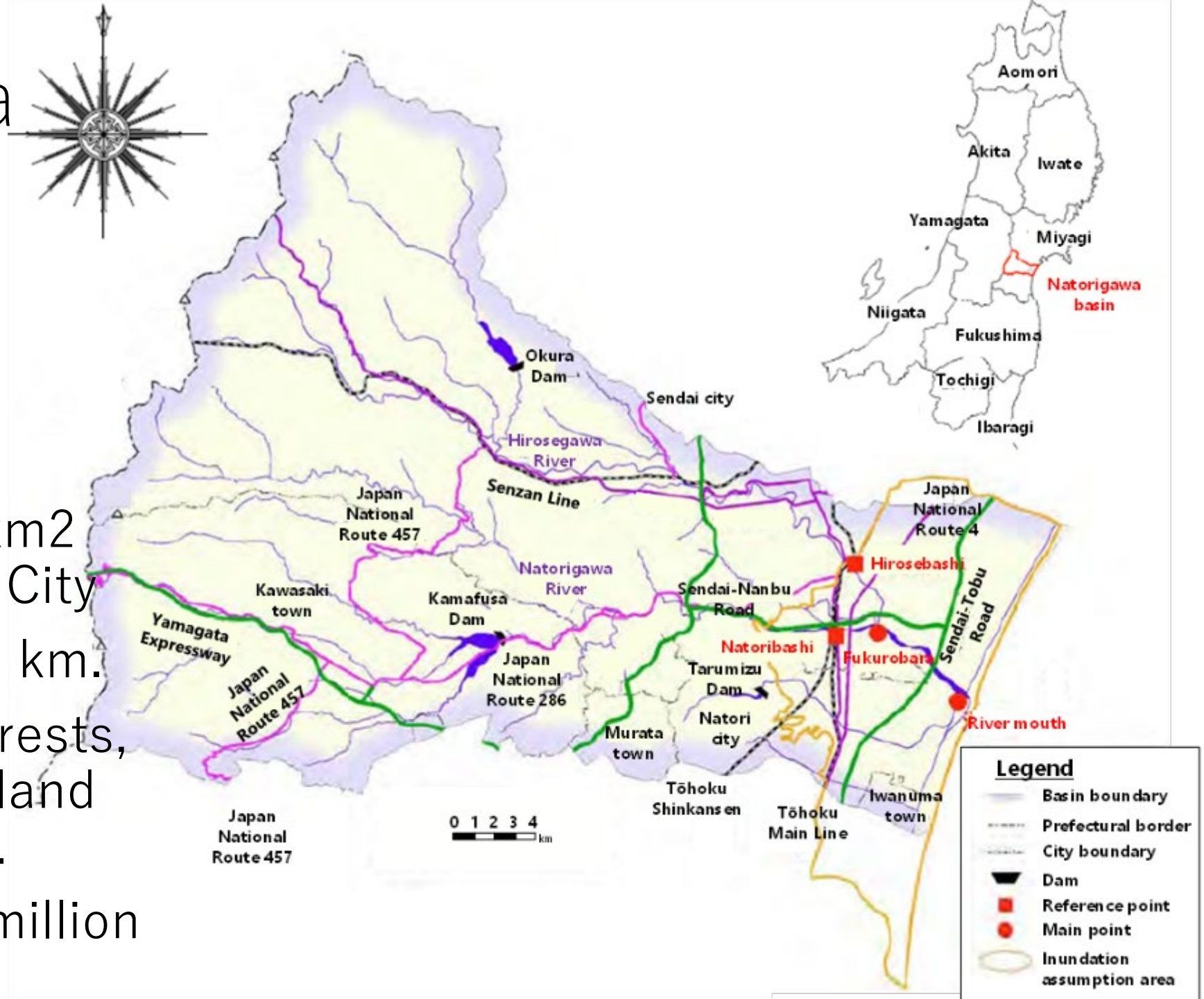
PURPOSE

- This study aims at proposing methodologies for estimating the benefits for flood protection infrastructure in river basin scale
- Case study in Sendai City, Natorigawa River Basin

II. ECONOMIC BENEFITS OF FLOOD PROTECTION IN SENDAI CITY

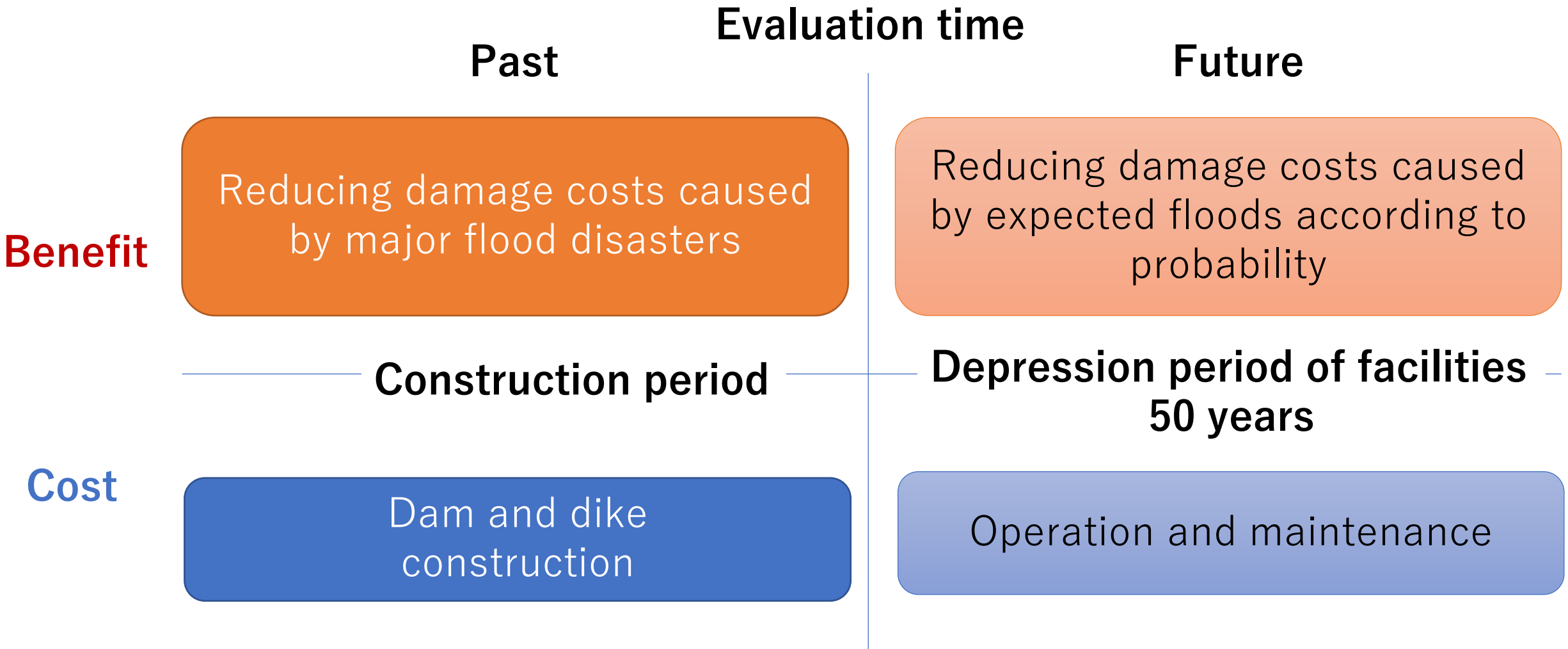
CASE OF NATORI RIVER, SENDAI CITY

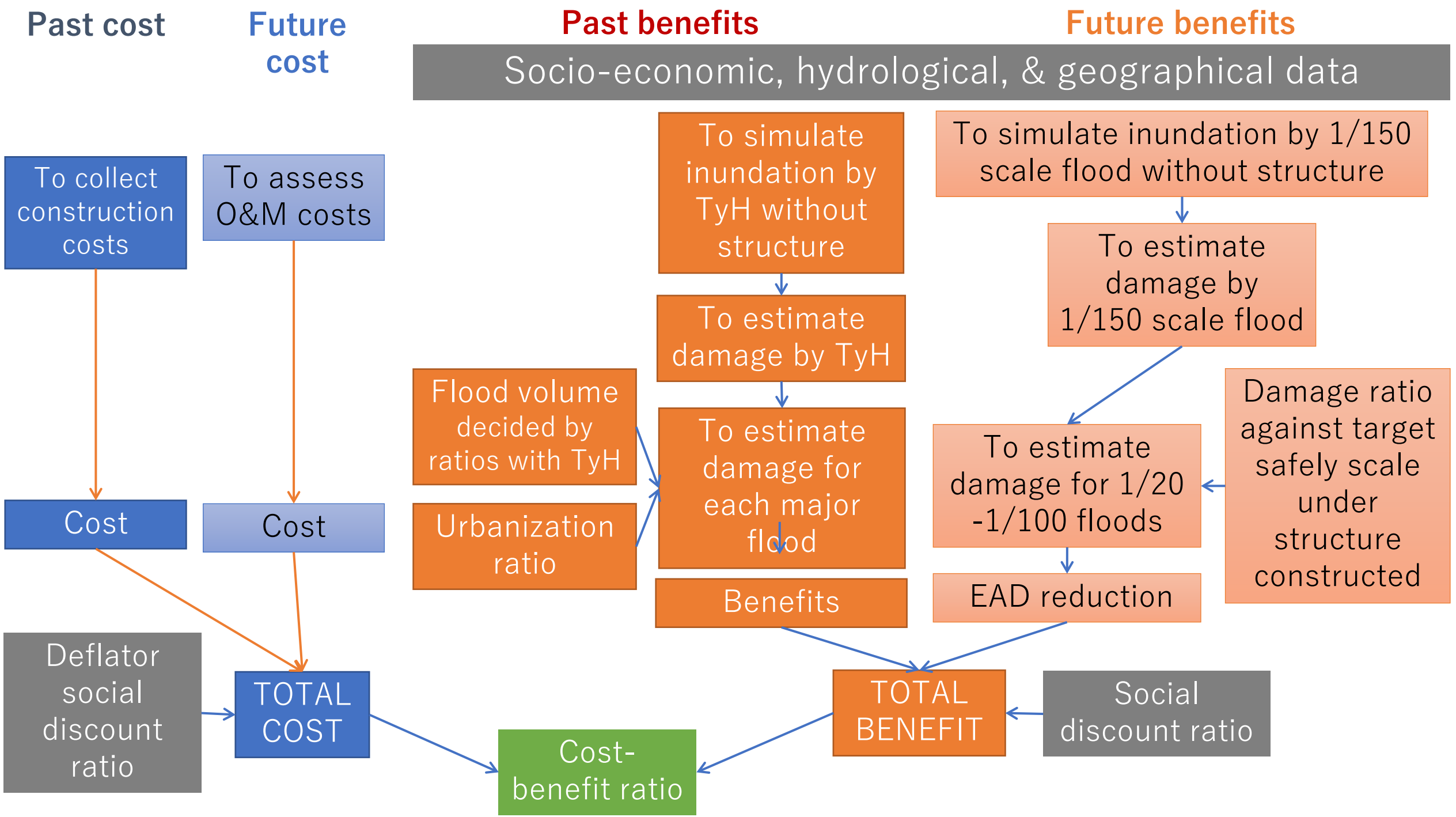
Natorigawa River basin



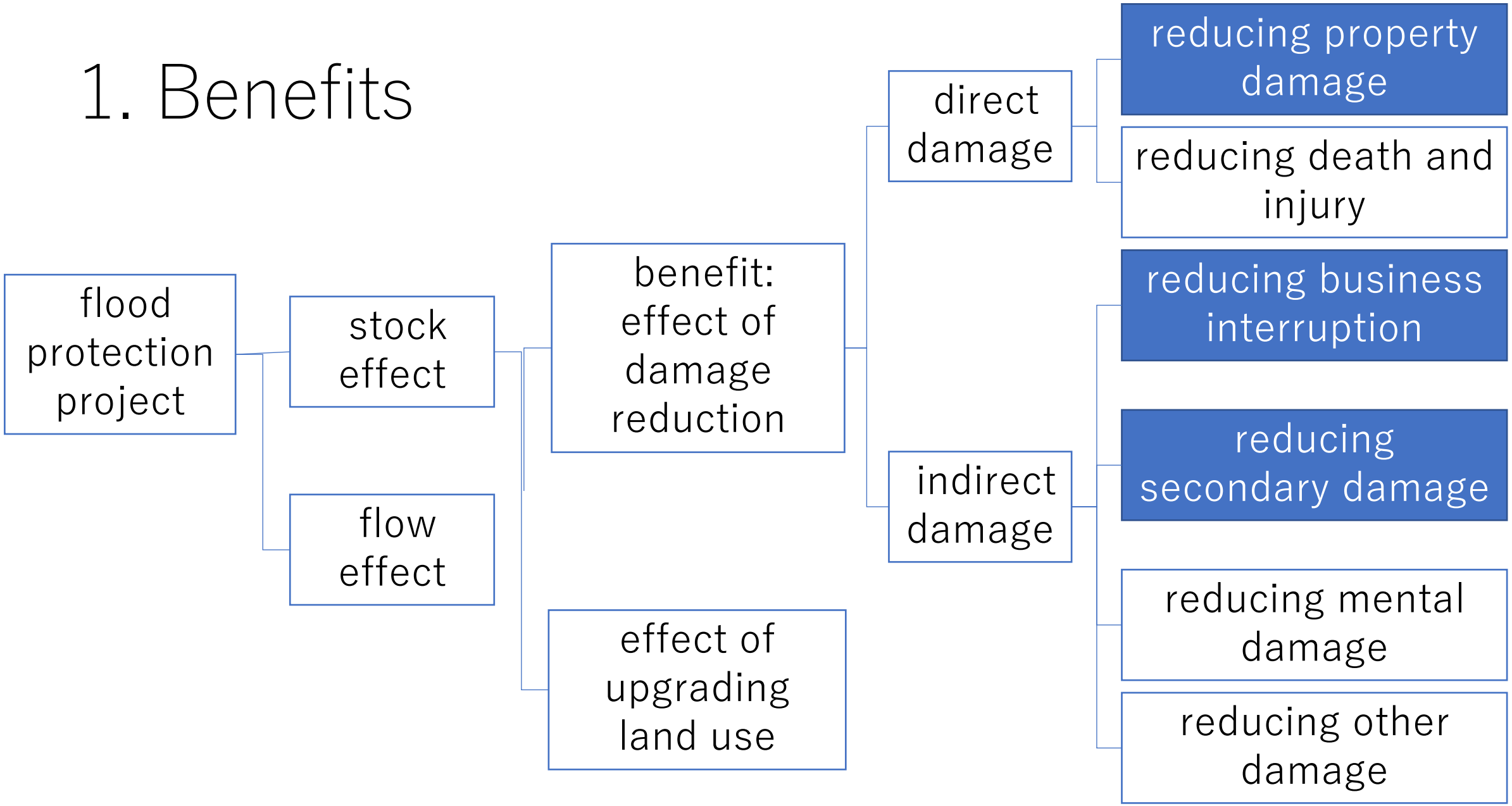
- river basin: 939 km2 including Sendai City
- main channel: 55 km.
- 76% mountain forests, 12% agricultural land 12% urban areas.
- Population; 1.1 million

Concept of economic analysis for long-term and large-scale investment




Past cost
Future cost
Past benefits
Future benefits
Socio-economic, hydrological, & geographical data
To collect construction costs
To assess O&M costs
To simulate inundation by TyH without structure
To simulate inundation by 1/150 scale flood without structure
To estimate damage by TyH
To estimate damage by 1/150 scale flood
Flood volume decided by ratios with TyH
Urbanization ratio
To estimate damage for each major flood
To estimate damage for 1/20 -1/100 floods
Damage ratio against target safely scale under structure constructed
Cost
Cost
Benefits
EAD reduction
Deflator social discount ratio
TOTAL COST
TOTAL BENEFIT
Social discount ratio
Cost-benefit ratio

1. Benefits


flood protection project
stock effect
flow effect
benefit: effect of damage reduction
effect of upgrading land use
direct damage
indirect damage
reducing property damage
reducing death and injury
reducing business interruption
reducing secondary damage
reducing mental damage
reducing other damage

2019 TYPHOON HAGIBIS WITHOUT INVESTMENT

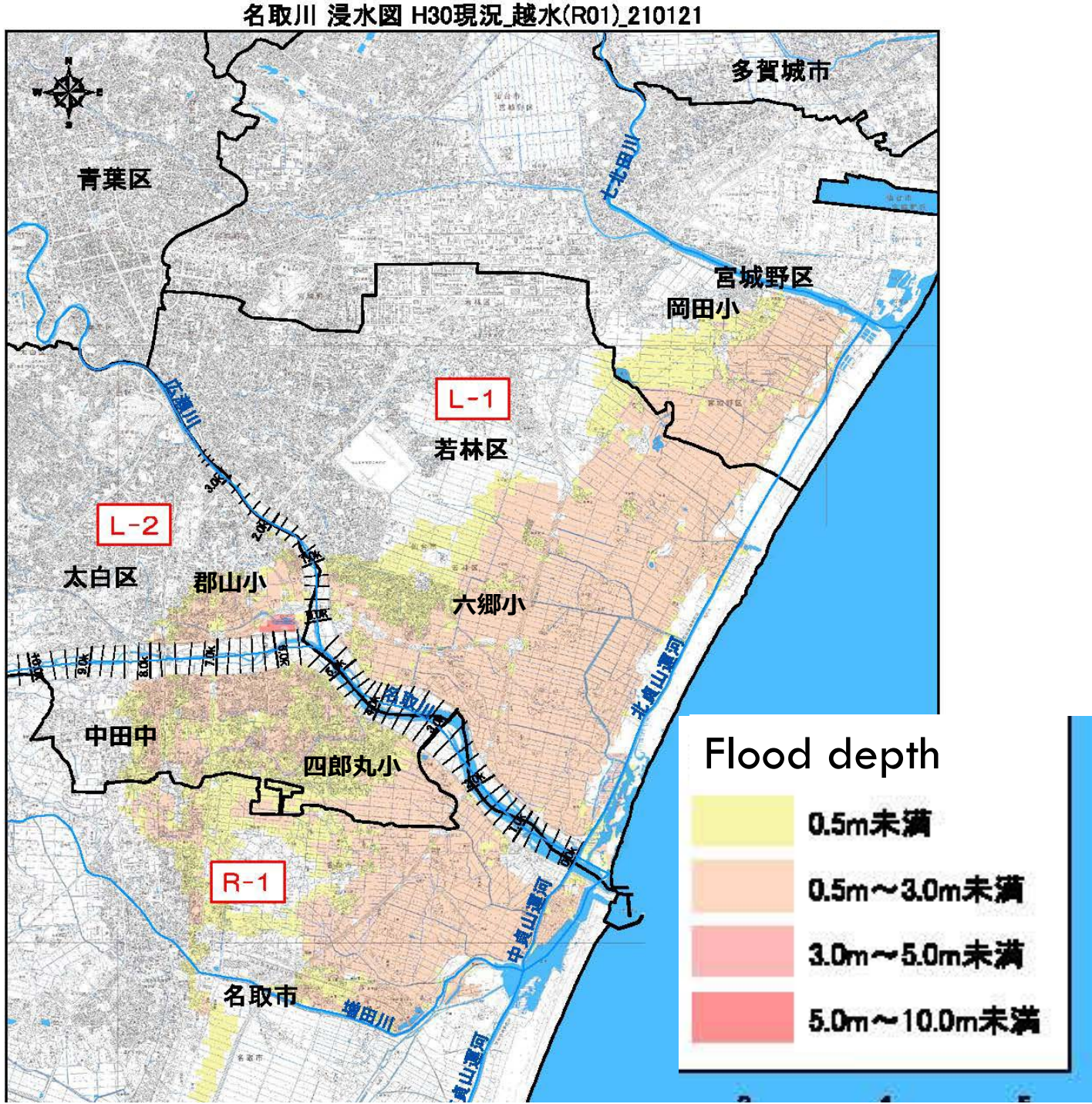
Estimated damage

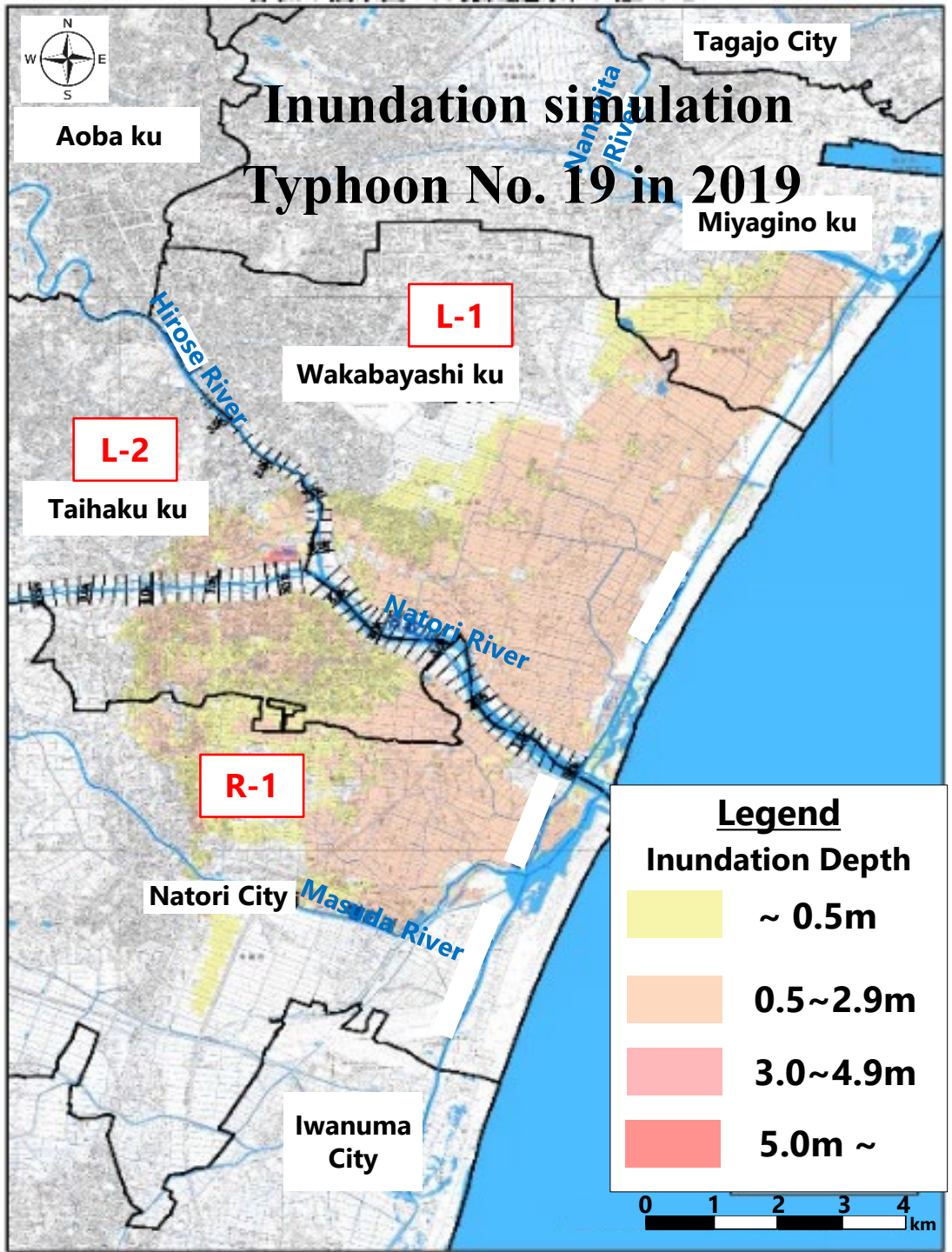
350billion JPY

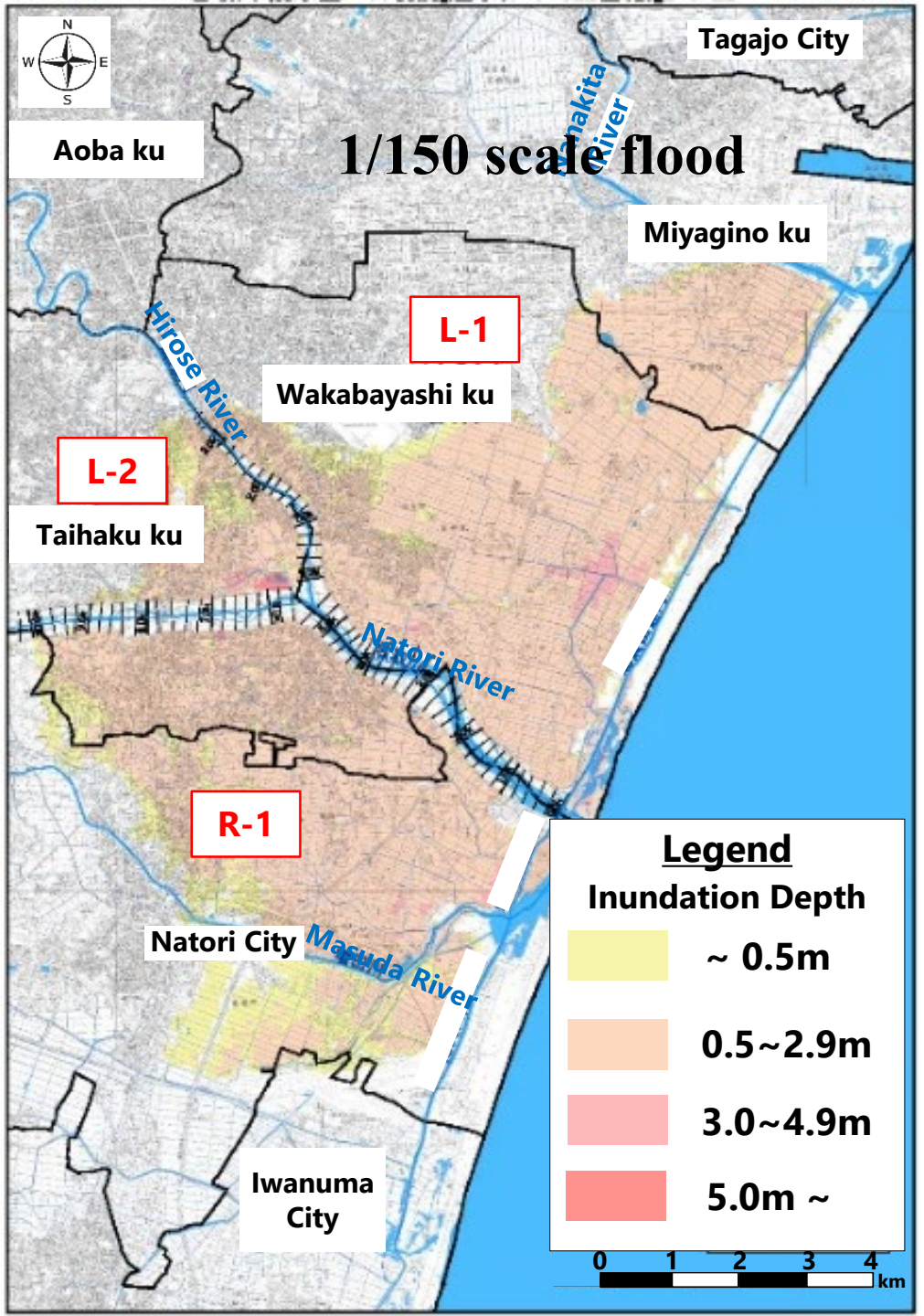
(2.5 billion USD)

one-third budget of Sendai

Inundated houses 150,000




Inundation simulation
Typhoon No. 19 in 2019
Tagajo City
Aoba ku
Miyagino ku
Wakabayashi ku
Taihaku ku
Natori City
Iwanuma City
L-1
L-2
R-1
Hirose River
Natori River
Masuda River
Legend
Inundation Depth
~ 0.5m
0.5~2.9m
3.0~4.9m
5.0m ~
0 1 2 3 4 km


1/150 scale flood
Tagajo City
Aoba ku
Miyagino ku
Wakabayashi ku
Taihaku ku
Natori City
Iwanuma City
L-1
L-2
R-1
Hirose River
Natori River
Masuda River
Legend
Inundation Depth
~ 0.5m
0.5~2.9m
3.0~4.9m
5.0m ~
0 1 2 3 4 km

Total past Benefit: 3.7 trillion JPY (26.4 billion USD)

	Flow volume (m^3/s)	**Ratio of volume to Typ. Hagibis**	**Ratio of residential land to 2019**	**Benefit (With urbanization) (present value) (Million JPY)**
August 1986	2,690	0.82	0.76	754,952
August 1989	3,280	0.99	0.84	903,576
September 1994	2,270	0.69	0.89	544,042
July 2002	2,920	0.88	0.92	531,950
September 2011	2,180	0.66	1.00	302,755
September 2007	2,740	0.83	1.00	325,276
October 2019 Base case	**3,300**	**1.00**	**1.00**	**348,269**
Total	**-**	**-**	**-**	**3,710,819**

Future benefits: 112 billion JPY (8 billion USD)

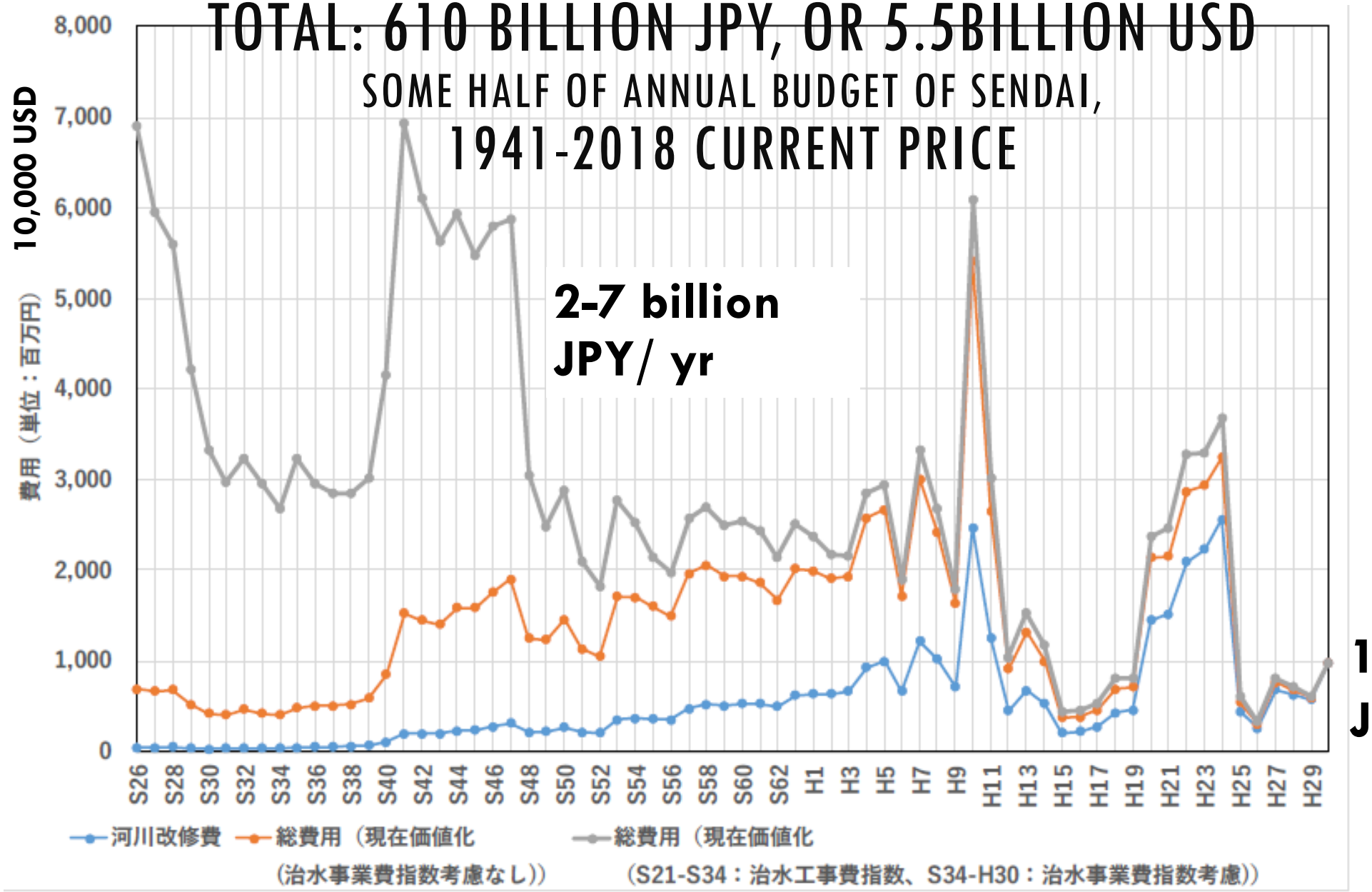
- average expected annual damage (EAD) reduction for 50 yrs
- base case: Flood protection works with the safety level of 1/150 yr flood
- The amount of EAD reduction for 10 flood scales based on 10 probability years selected
- multiplied by the interval probability to obtain the annual EAD reduction.

2. COSTS: LONG-TERM INVESTMENT IN FLOOD PROTECTION

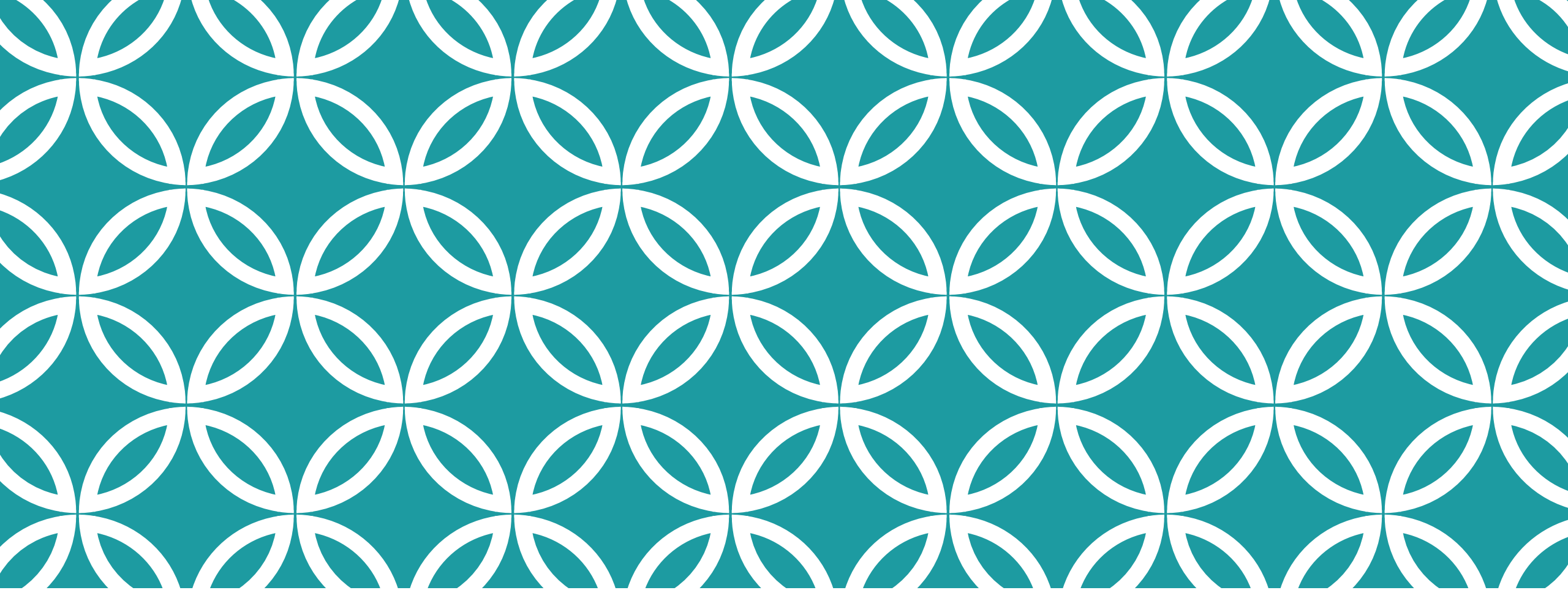
TOTAL: 610 BILLION JPY, OR 5.5BILLION USD

SOME HALF OF ANNUAL BUDGET OF SENDAI,

1941-2018 CURRENT PRICE



Total benefits	3.81 trillion JPY (26.4 billion USD)
Total costs	626 billion yen (4.4 billion USD)
Cost-benefit ratio B/C	**6.1**



III. HOW TO SHARE BENEFITS AND COSTS AMONG MULTI-STAKEHOLDERS

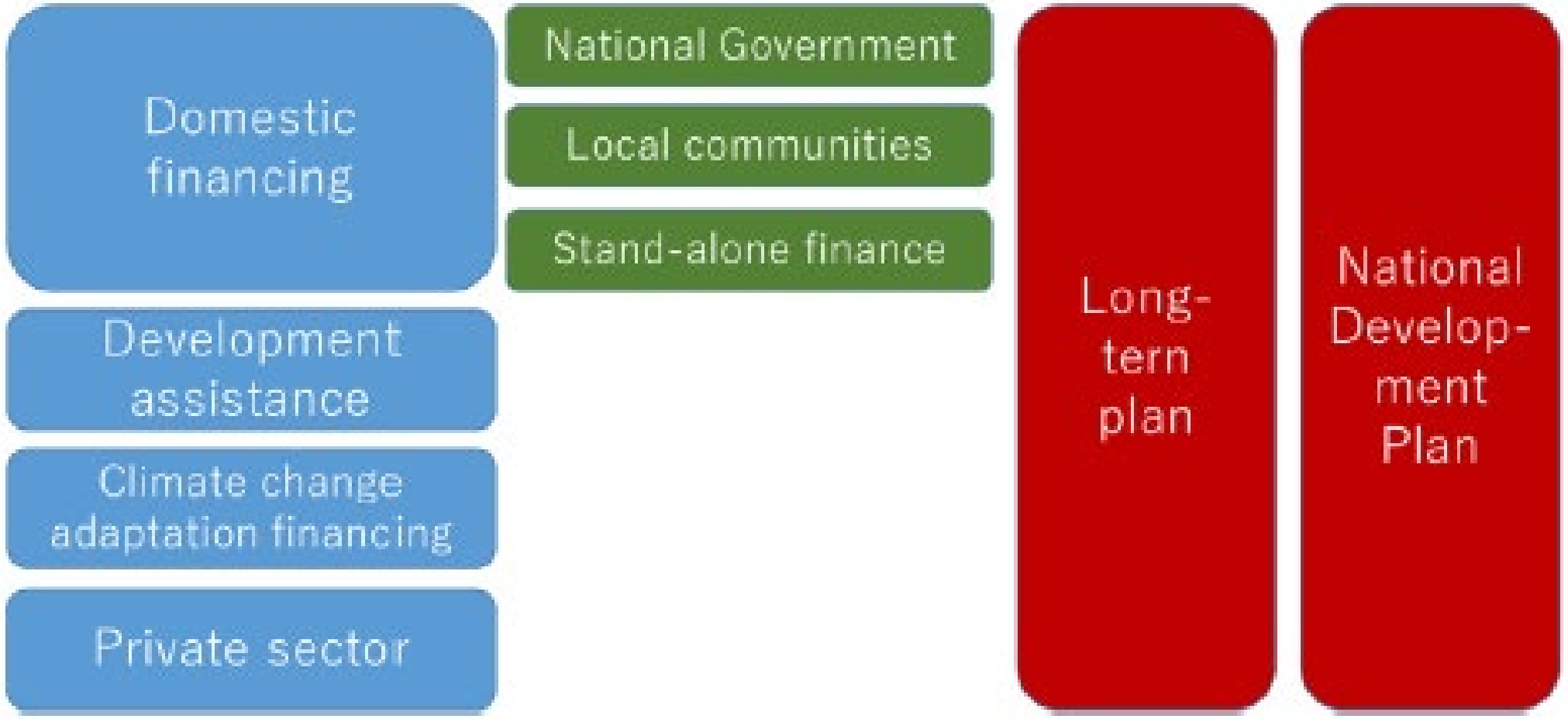
1. WHOLE-A-SOCIETY FOR INVESTING IN DRR

ROLE OF LOCAL COMMUNITY IN SENDAI OPERATING GATE

WOMEN LEADER
SENDAI IWAKIRI ELEMENTARY SHOOL

ANY CHANCE OF INVOLVING PRIVATE FINANCE? KAWAMACHI TERRACE IN NATORI CITY

2. Concept: financing investment in DRR



ELSEVIER
Progress in Disaster Science
journal homepage: www.elsevier.com/locate/pdisas

Ishiwatari, M., & Surjan, A. (2019). Good enough today is not enough tomorrow: Challenges of increasing investments in disaster risk reduction and climate change adaptation. *Progress in Disaster Science*,[25] *1*,

IV CONCLUSION

consideration

Issues to apply developing countries

- computer resources
- the datasets of hydrology, geography, and socio-economy.

Limitation

- Replacing cost
- Attracting investment
- Climate change

CONCLUSION

proposed methodology of economic analysis for long-term investment in flood protection in the past at river basin scale.

for assessing the past and future benefits

consider effects of past urbanization and inflation.

Natorigawa River basin including Sendai City, Japan

70 years investment was efficient with cost-benefit ratio of 6.1

THANKYOU

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