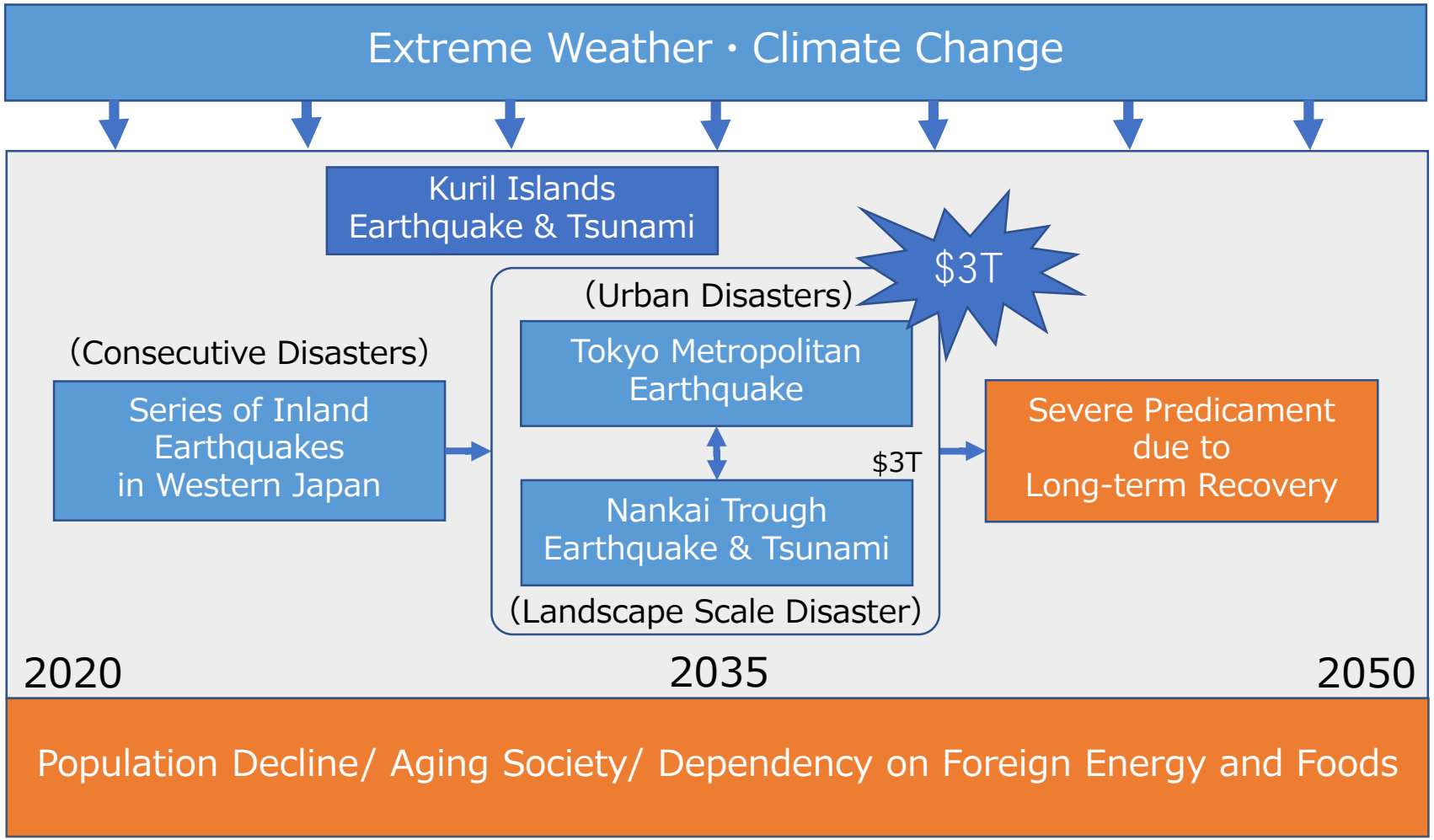
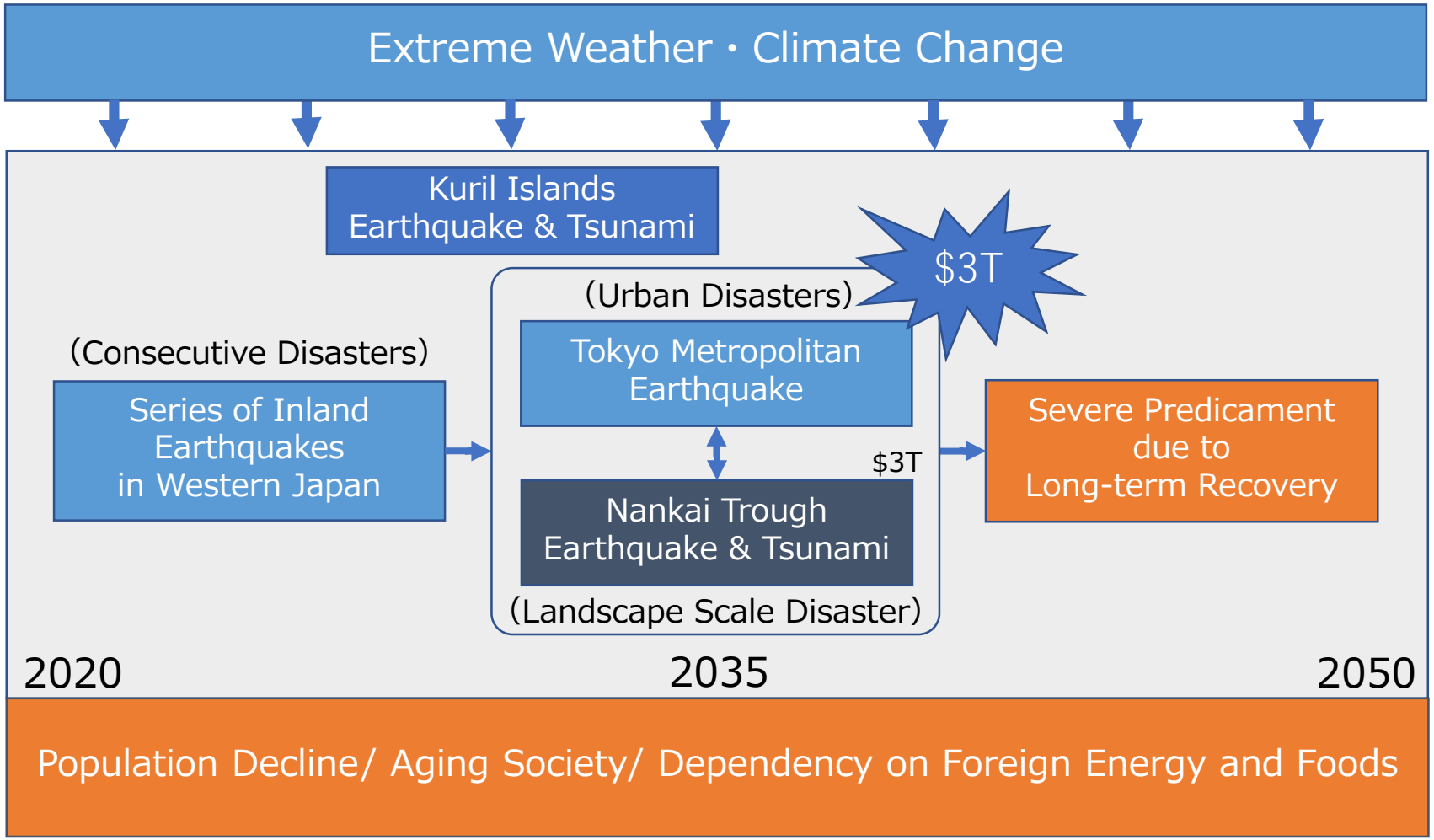
# Building Disaster Resilience to overcome Upcoming Catastrophic Disasters

Haruo Hayashi, Ph.D.
Professor Emeritus,
Kyoto University

# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century



# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century



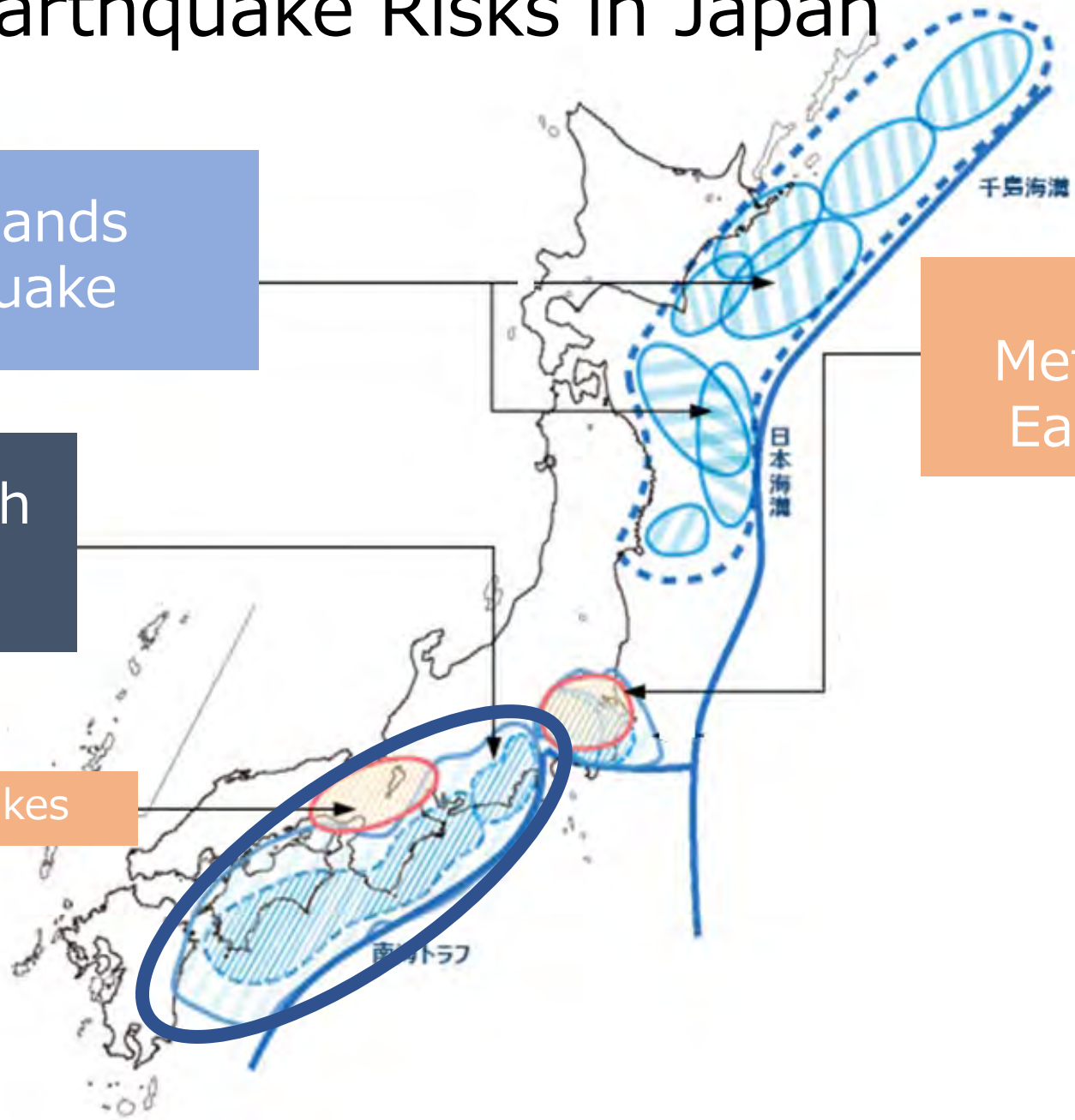
# Major Earthquake Risks in Japan

Kuril Islands Earthquake

Nankai Trough Earthquake

Western Japan Earthquakes

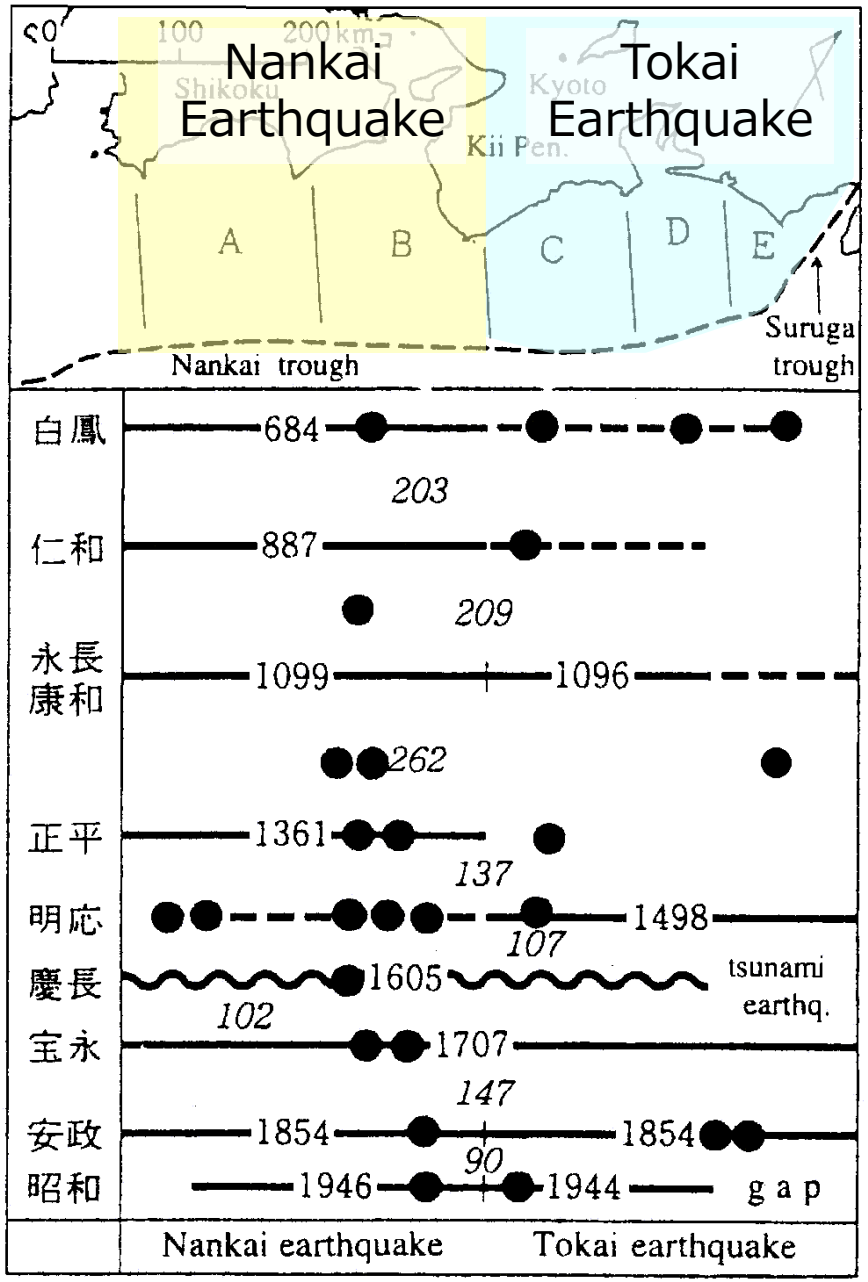
Tokyo Metropolitan Earthquake




Inter-plate Earthquake

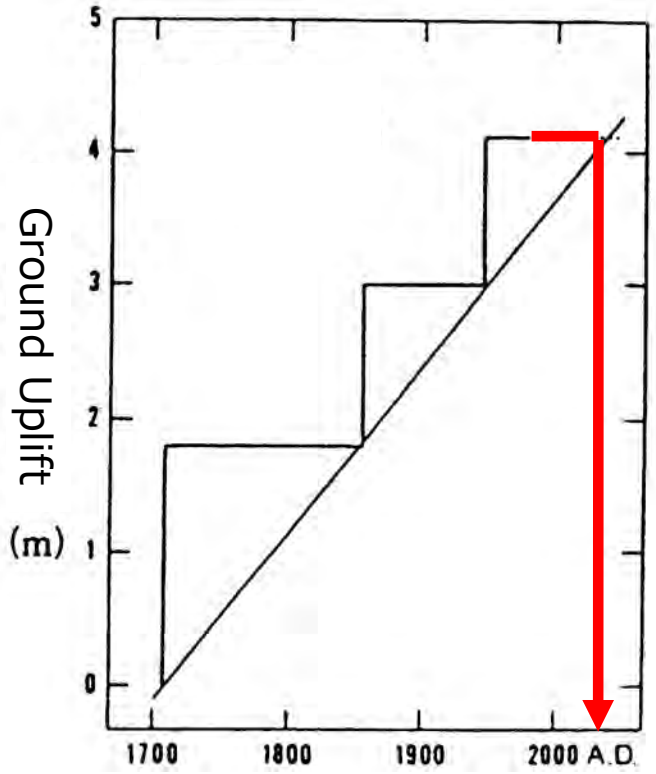
Near-field Earthquake

https://www.bousai.go.jp/kyoiku/hokenkyousai/jishin.html



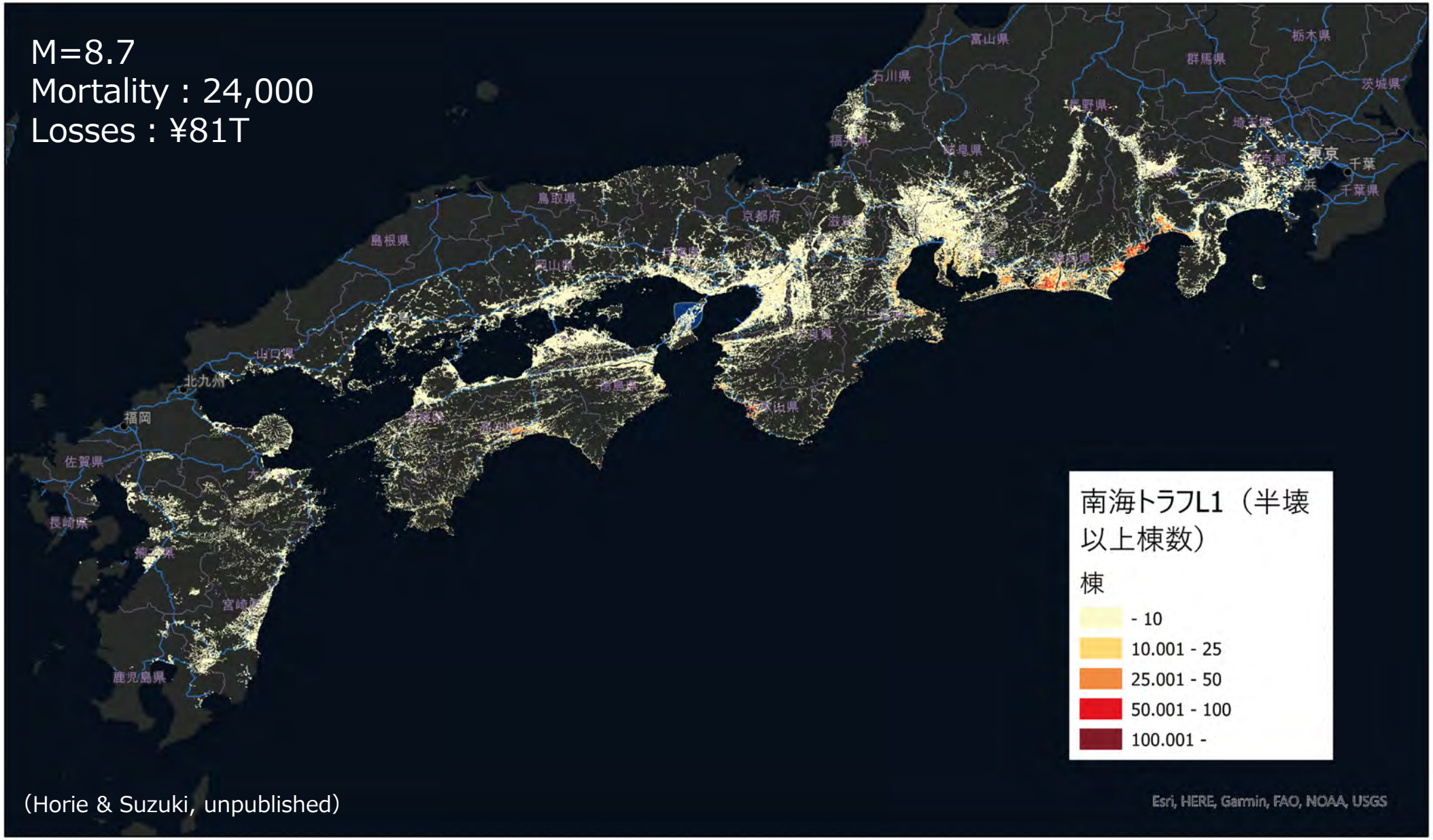

# Nankai Trough Earthquakes occur Almost Every Century Since 7th Century

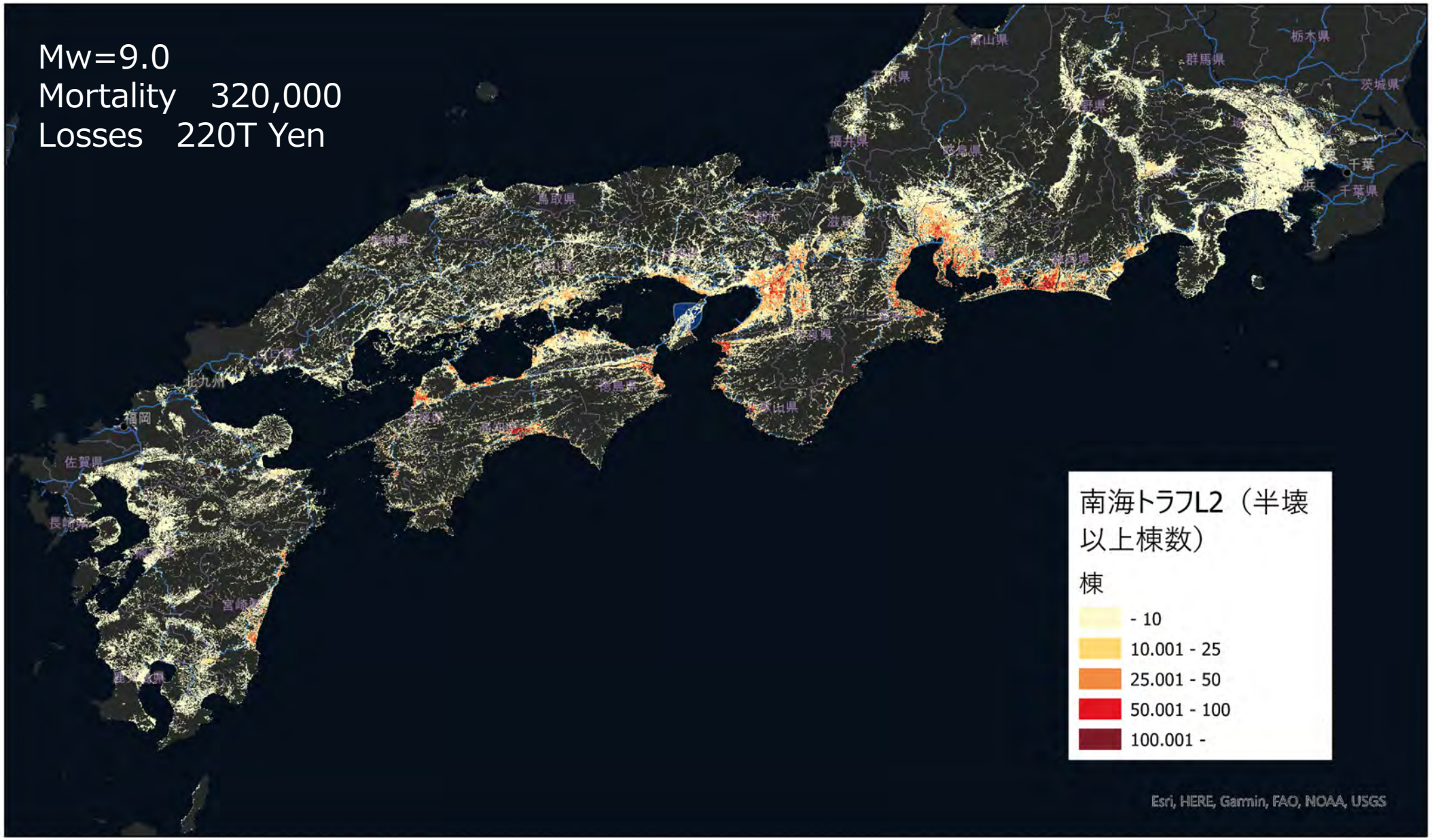
Next one will be **Around 2035**



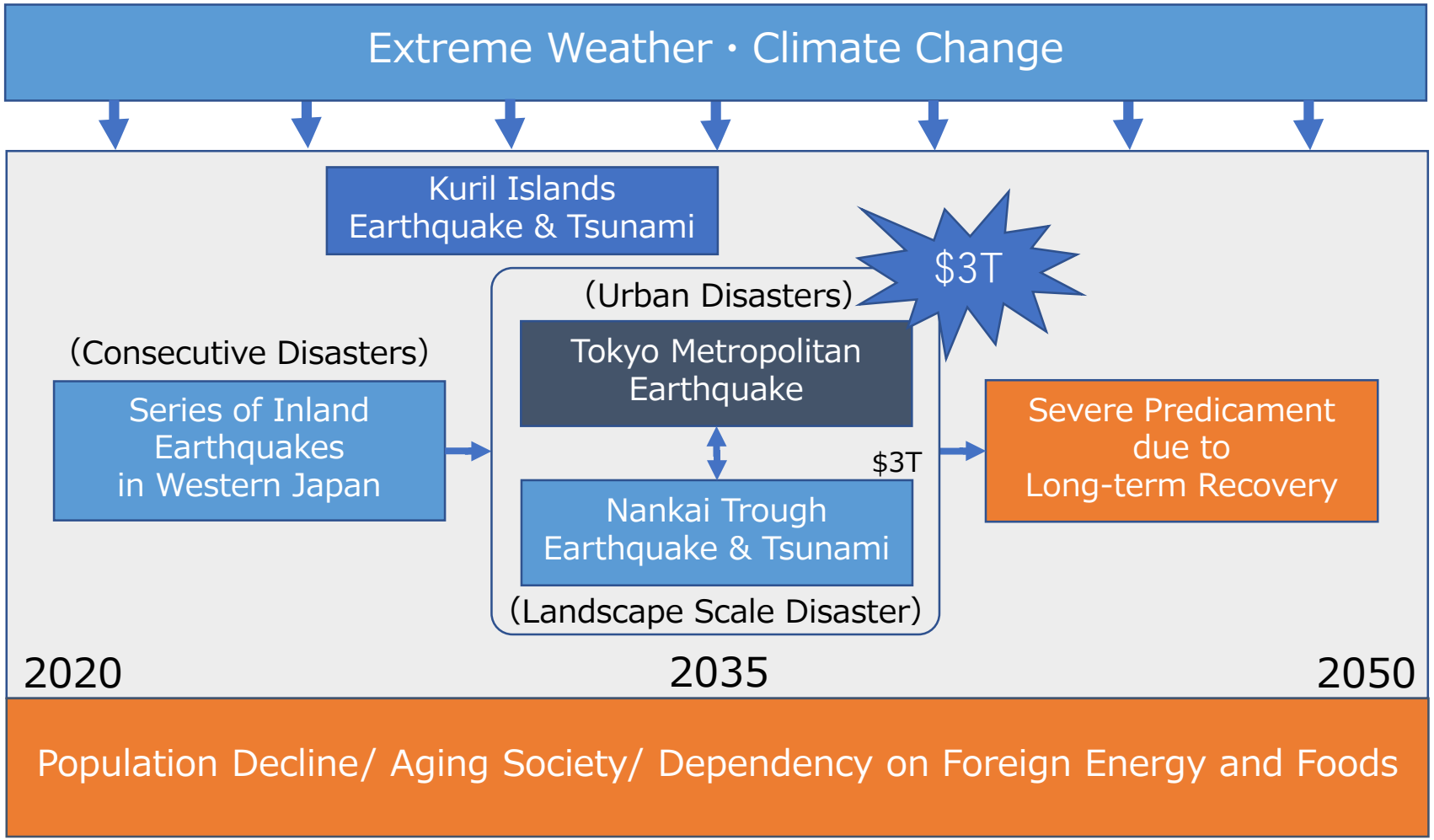

**2035**

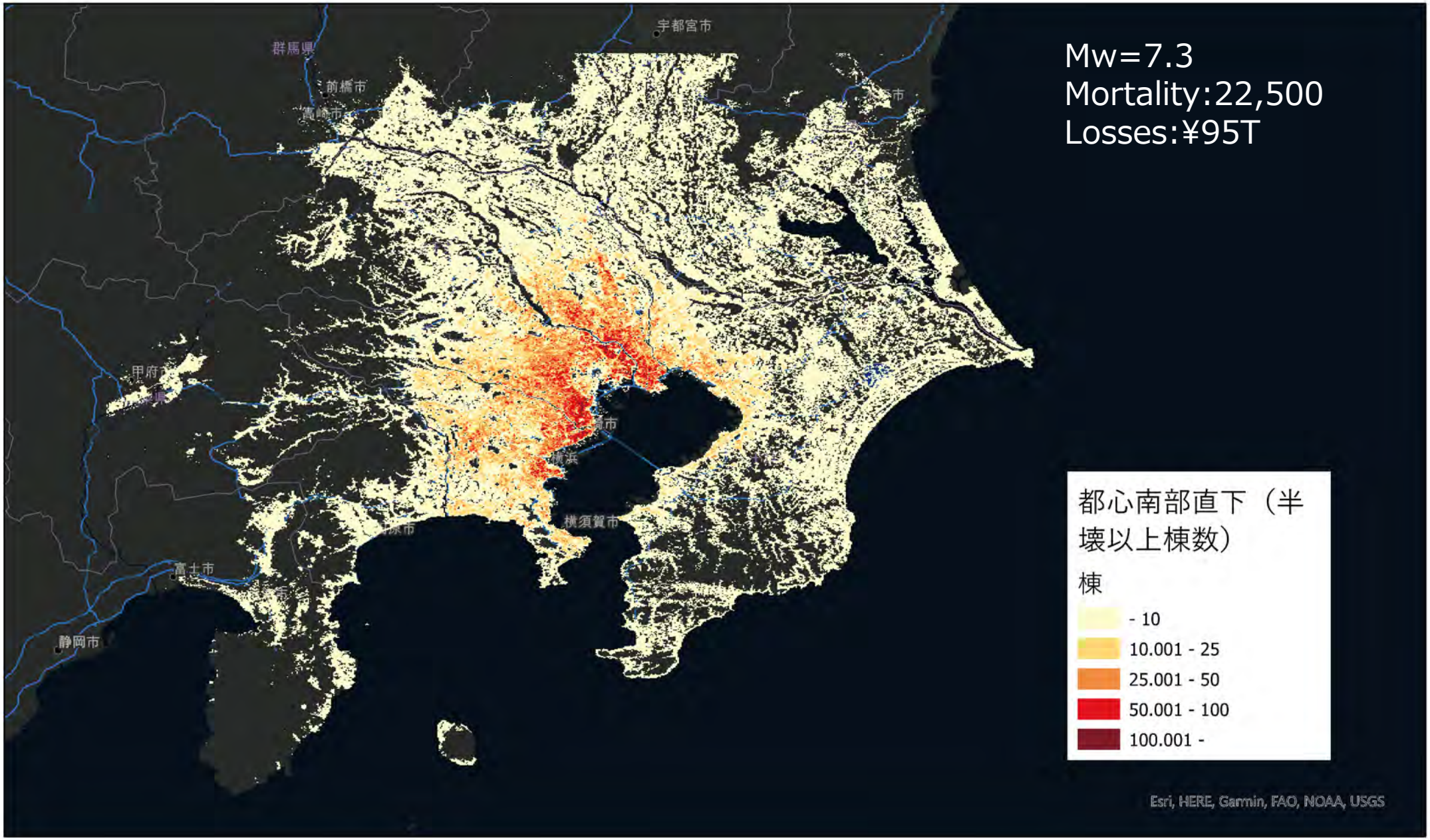
(Shimazaki & Nakata (1980))


M=8.7
Mortality : 24,000
Losses : ¥81T
南海トラフL1（半壊以上棟数）
棟
- 10
10.001 - 25
25.001 - 50
50.001 - 100
100.001 -
(Horie & Suzuki, unpublished)
Esri, HERE, Garmin, FAO, NOAA, USGS

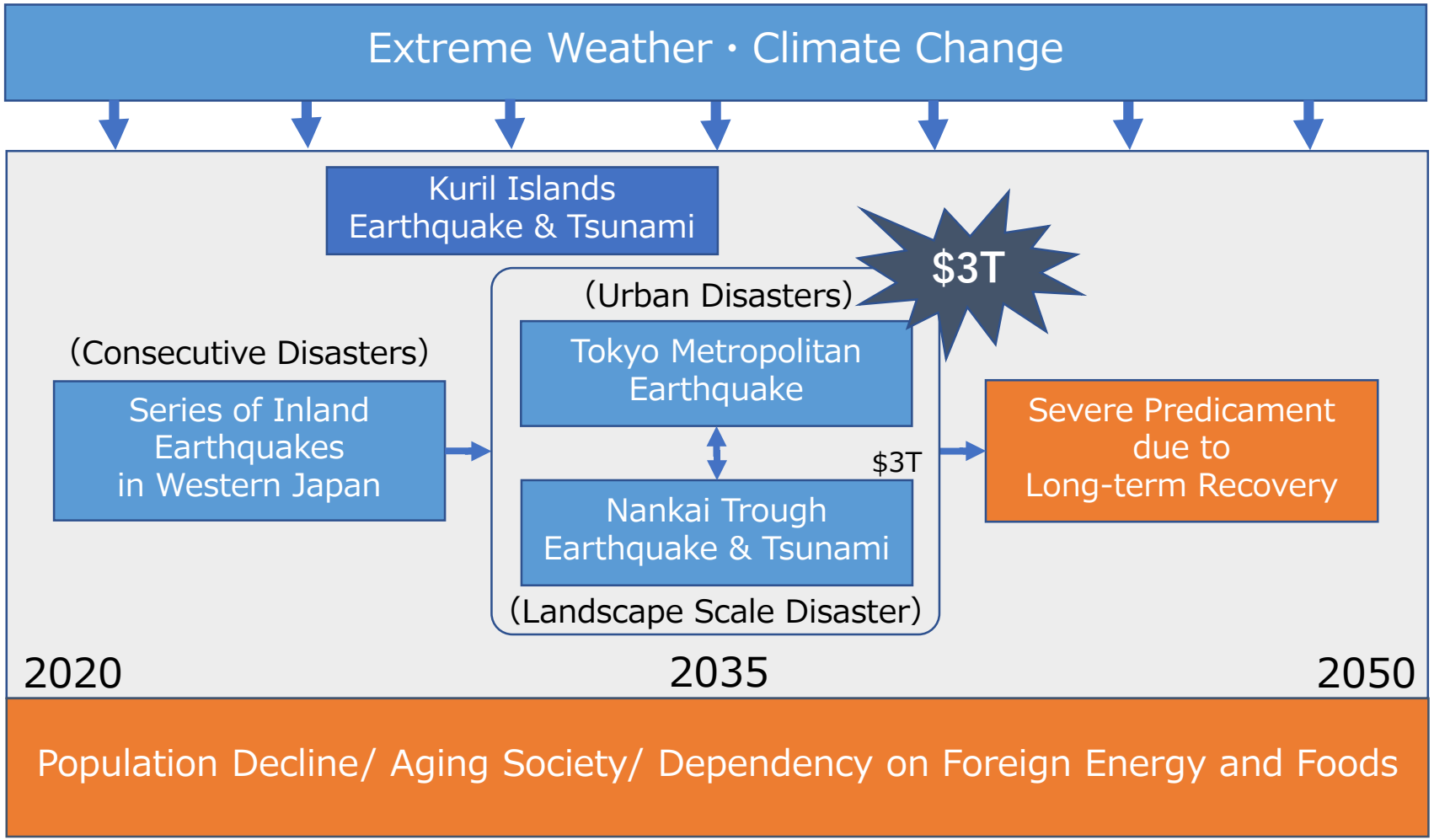

Mw=9.0
Mortality 320,000
Losses 220T Yen
南海トラフL2（半壊以上棟数）
棟
- 10
10.001 - 25
25.001 - 50
50.001 - 100
100.001 -
Esri, HERE, Garmin, FAO, NOAA, USGS

# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century




Mw=7.3
Mortality:22,500
Losses:¥95T
都心南部直下（半壊以上棟数）
棟
- 10
10.001 - 25
25.001 - 50
50.001 - 100
100.001 -
宇都宮市
群馬県
前橋市
甲府
横浜
横須賀市
富士市
静岡市
Esri, HERE, Garmin, FAO, NOAA, USGS

# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century



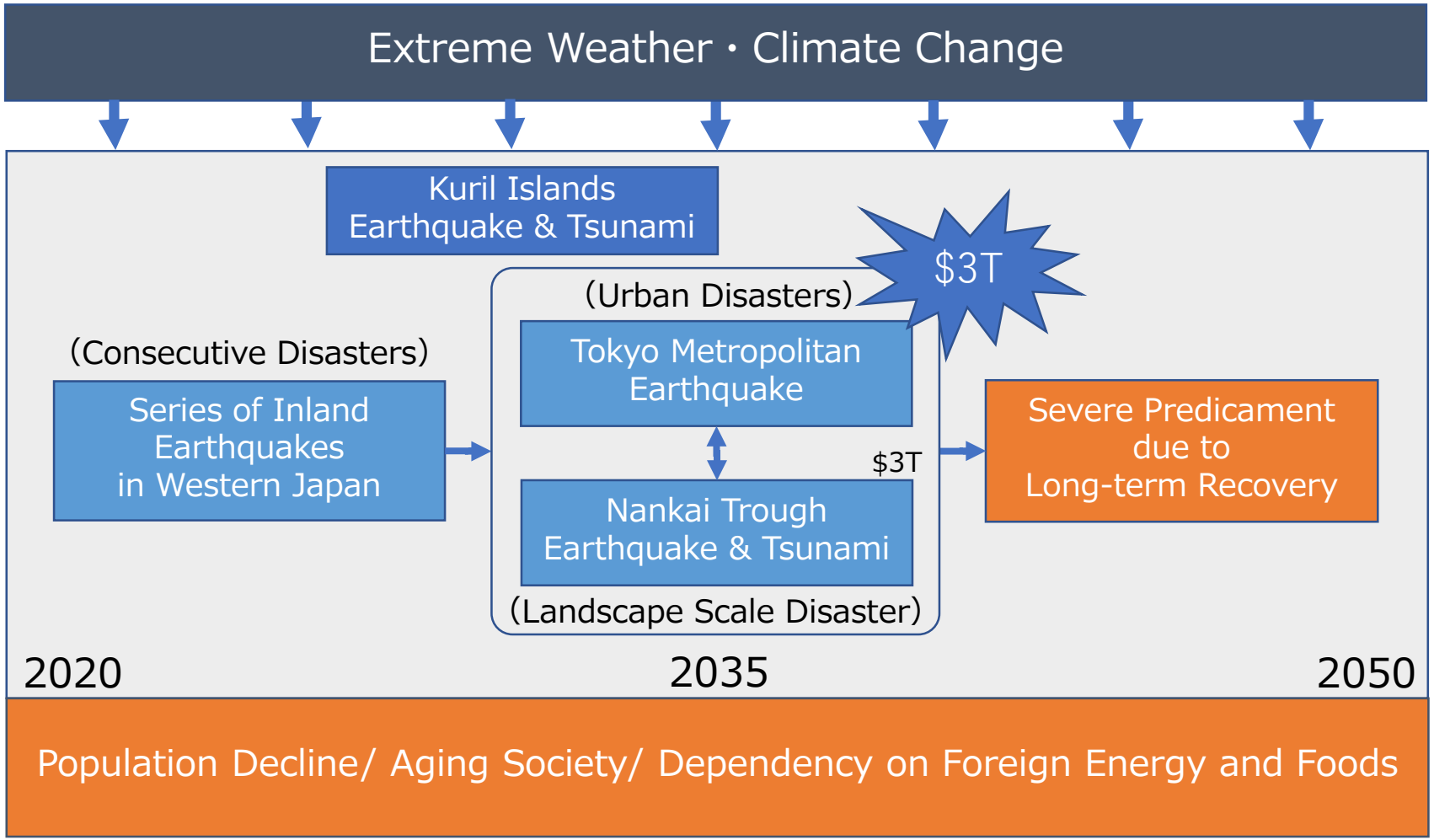
# Unprecedented Scale of Damage/Losses

| Earthquake Disasters | Nankai Trough | | Tokyo Metropolitan | | 2011 East Japan | 1995 Kobe |
|---|---|---|---|---|---|---|
| | 2012 (L2) | 2003 (L1) | 2013 | 2005 | | |
| Magnitude | **M9.0** | M 8.7 | **M7.3** | M 7.3 | M 9.0 | M 7.3 |
| Mortality/Missing | **80,000 - 320,000** | 24,000 | **5,000 – 22,500** | 11,000 | 19,294 | 6,434 |
| Injured | **257,000 – 623,000** | 300,000 | **90,000 - 120,000** | 240,000 | 6,100 | 44,000 |
| Buildings Collapsed | **627,000 – 1,346,000** | 450,000 | | 200,000 | 126,500 | 105,000 |
| Buildings Burned down | **50,000 – 750,000** | 90,000 | **38,000 – 412,000** | 650,000 | --- | 7,400 |
| Relocated | **----** | 6,000,000 | **7,200,000** | 7,500,000 | 480,000 | 320,000 |
| Direct Losses (trillion ¥) | **220** | 81 | **95** | 112 | 17 | 10 |

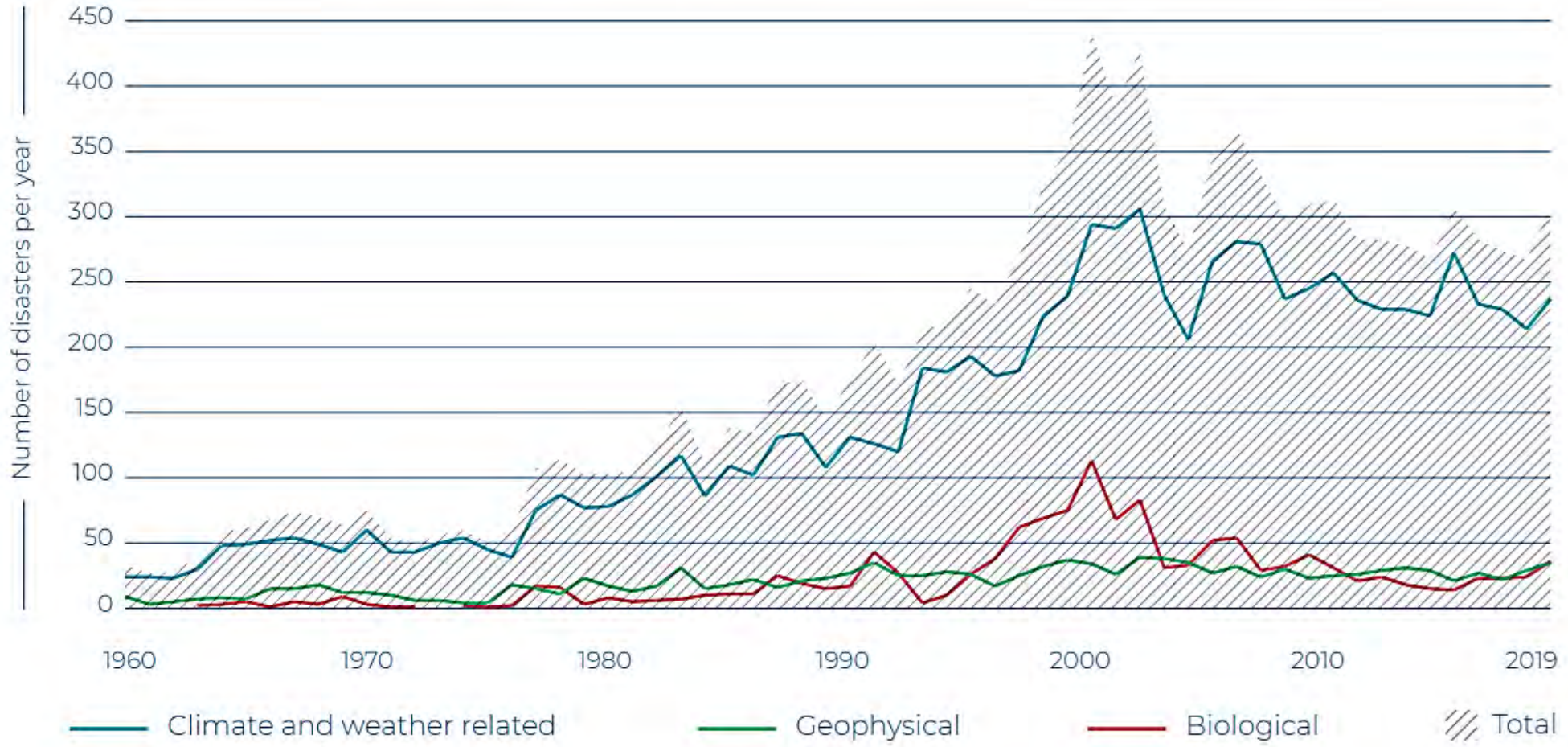
# Trillion US dollar Disaster
## (given $1=¥100)

Unpreceded Scale of Damage/Losses due to Natural Disasters in Modern History

# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century



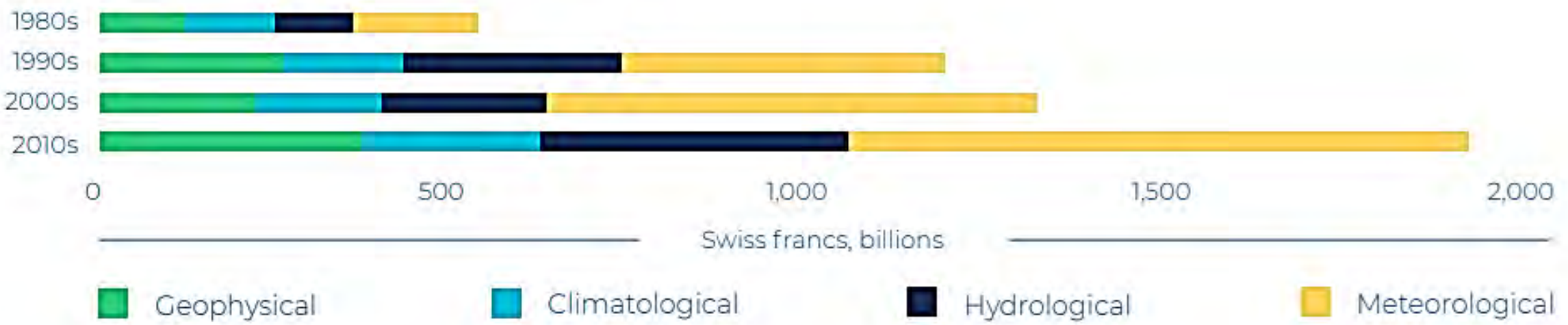
# Number of disasters due to natural hazards are increasing since 1980s
# Over 80% were Climate and Weather related




*Sources: The data has been compiled using EM-DAT, ReliefWeb, Dartmouth Flood Observatory and IFRC GO*

IFRC “World Disasters Report 2020”

# Estimated cost of disaster losses are increasing 2010-2019:$1,920B (2019:$150B )



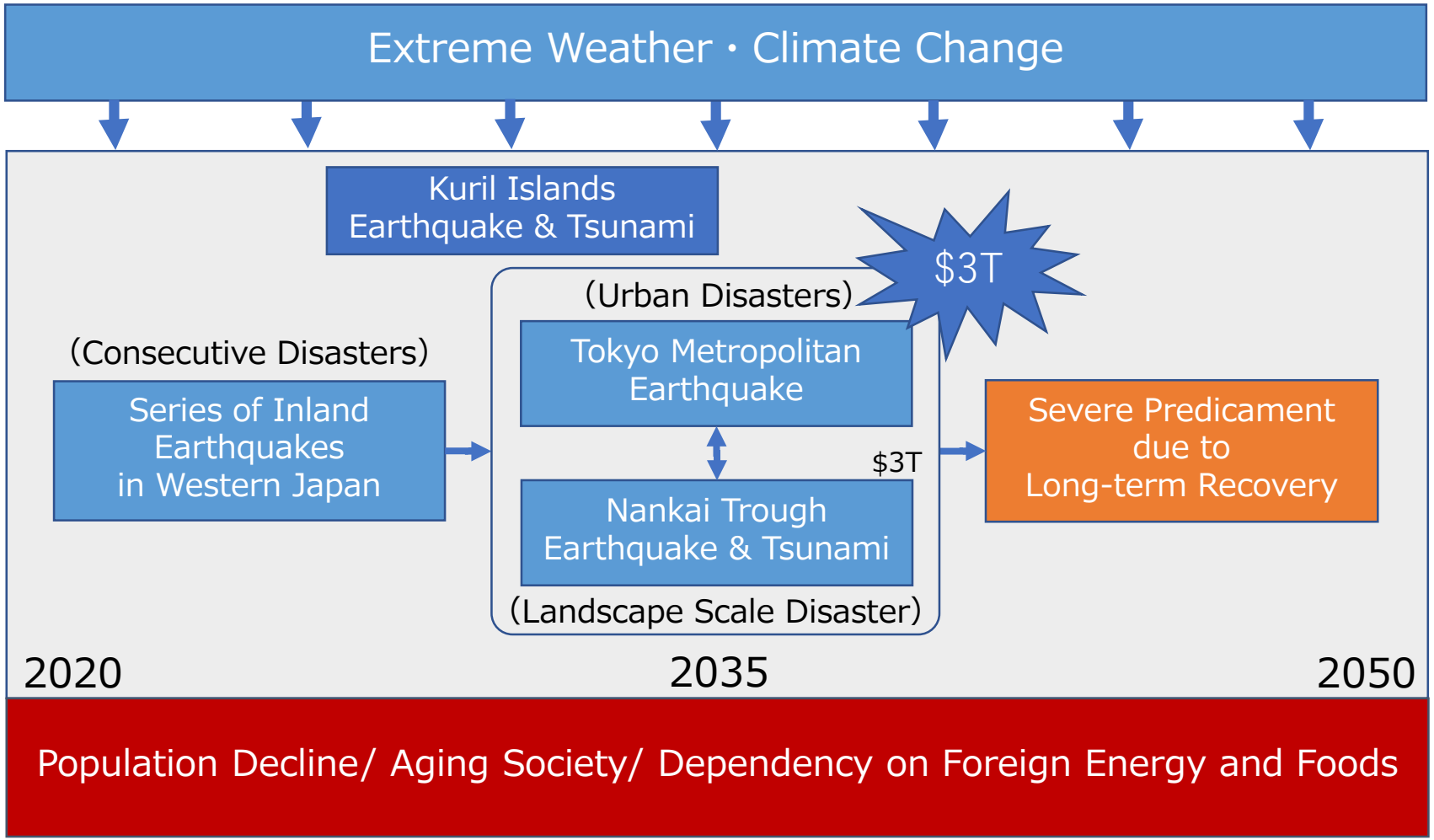

*Source: MunichRe, 2020*

*Note: This only includes disasters triggered by natural hazards. Categories are as used by MunichRe.*

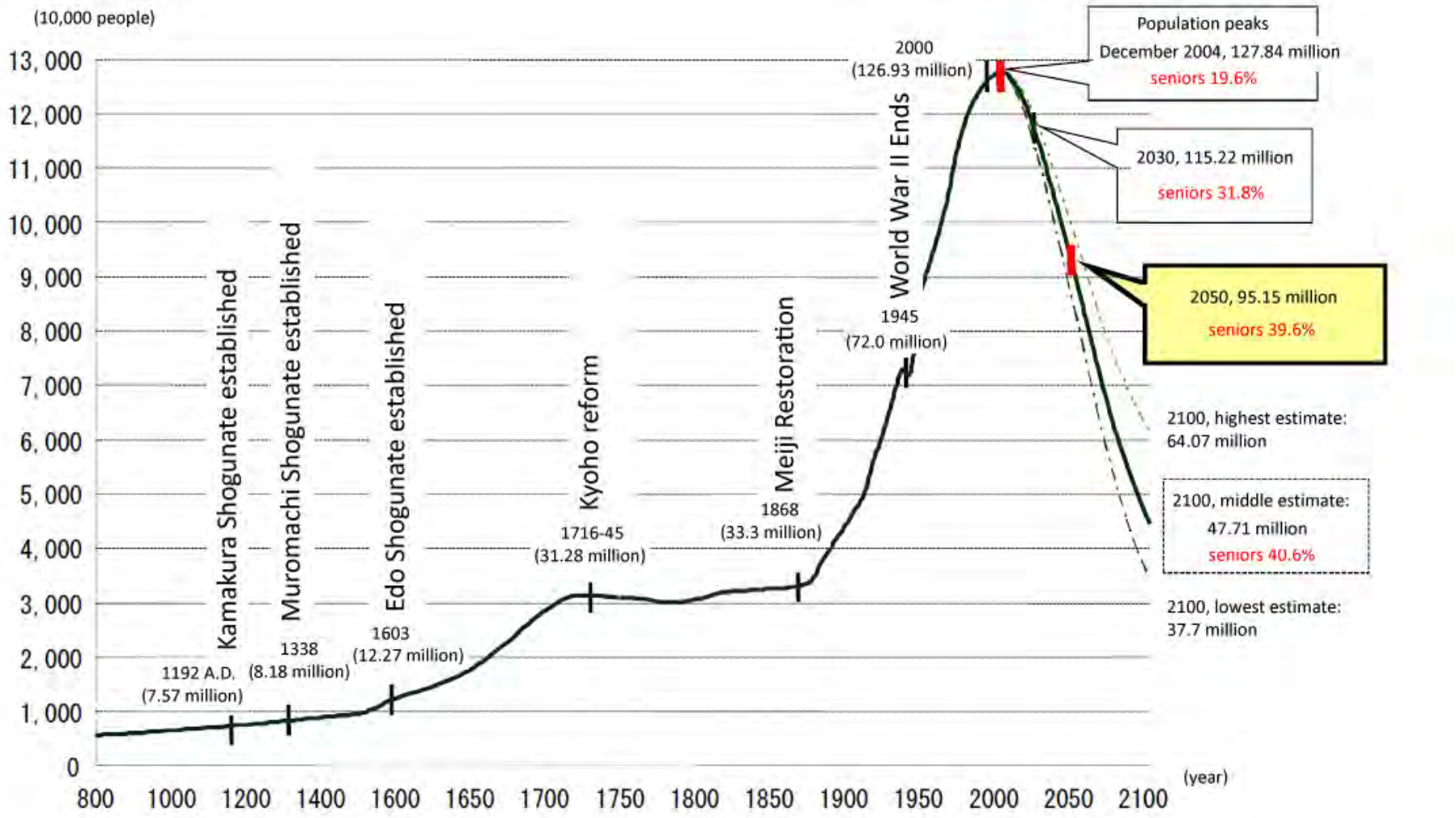
IFRC “World Disasters Report 2020”

⇨ A great challenge for Sustainable Development

# Japan must be Resilient for the Existential Risk due to Catastrophic Disasters in the First Half of 21Century

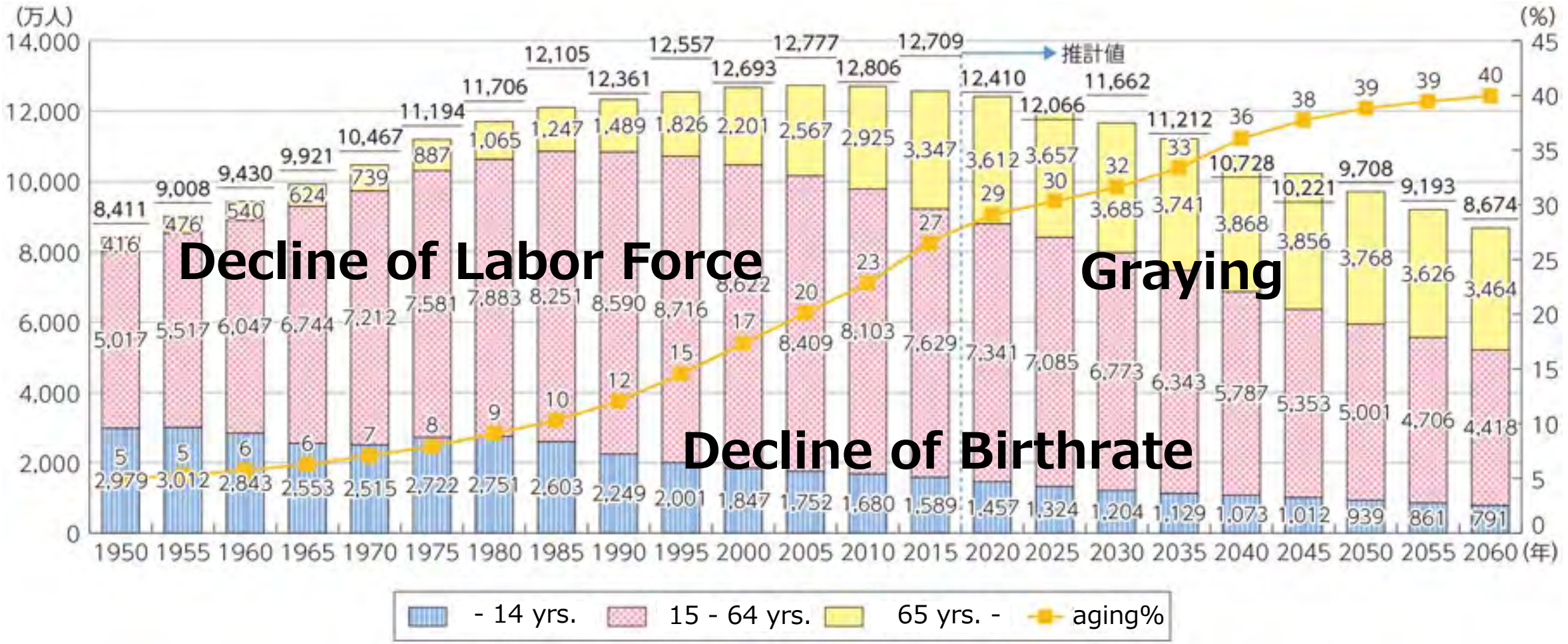


# First Population Decline in Japanese History



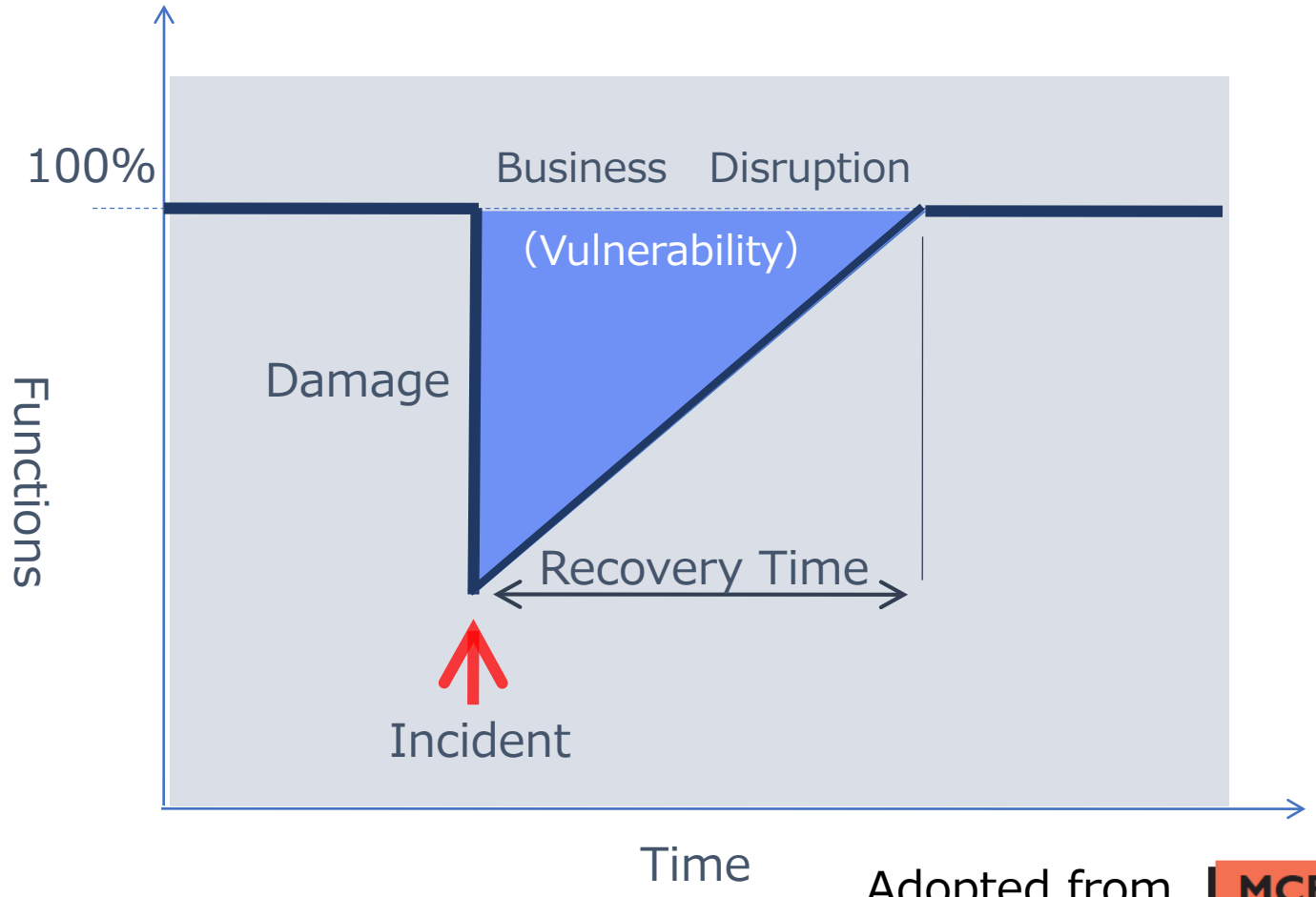

Source: Prepared by the National and Regional Planning Bureau, Ministry of Land, Infrastructure, Transport and Tourism, based on "Population Census" by the Ministry of Internal Affairs and Communications (MIC), "Population Estimates" by MIC, "Intercensal Adjustment of Current Population Estimates (2000-2005)" by MIC, "Population Projections for Japan: 2006-2055: Outline of Results, Methods, and Assumptions" by the National Institute of Population and Social Security Research, and "Long-term Time-series Analysis of Population Distribution Change in the Japanese Archipelago (1974)" by the National Land Agency.

# Population Decline＝Deaths＞Births




https://www.soumu.go.jp/johotsusintokei/whitepaper/ja/h29/html/nc135230.html

# Need to Improve Disaster Resilience:
## To Survive Upcoming Catastrophic Disasters
## -Minimize both damage and recovery time-




Adopted from MCEER's Resilience Framework

# What is “Disaster Resilience”

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management.

(2017, UNDRR)

# Two Definitions of “Disaster Resilience” by UN

- The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (2009, UNISDR)

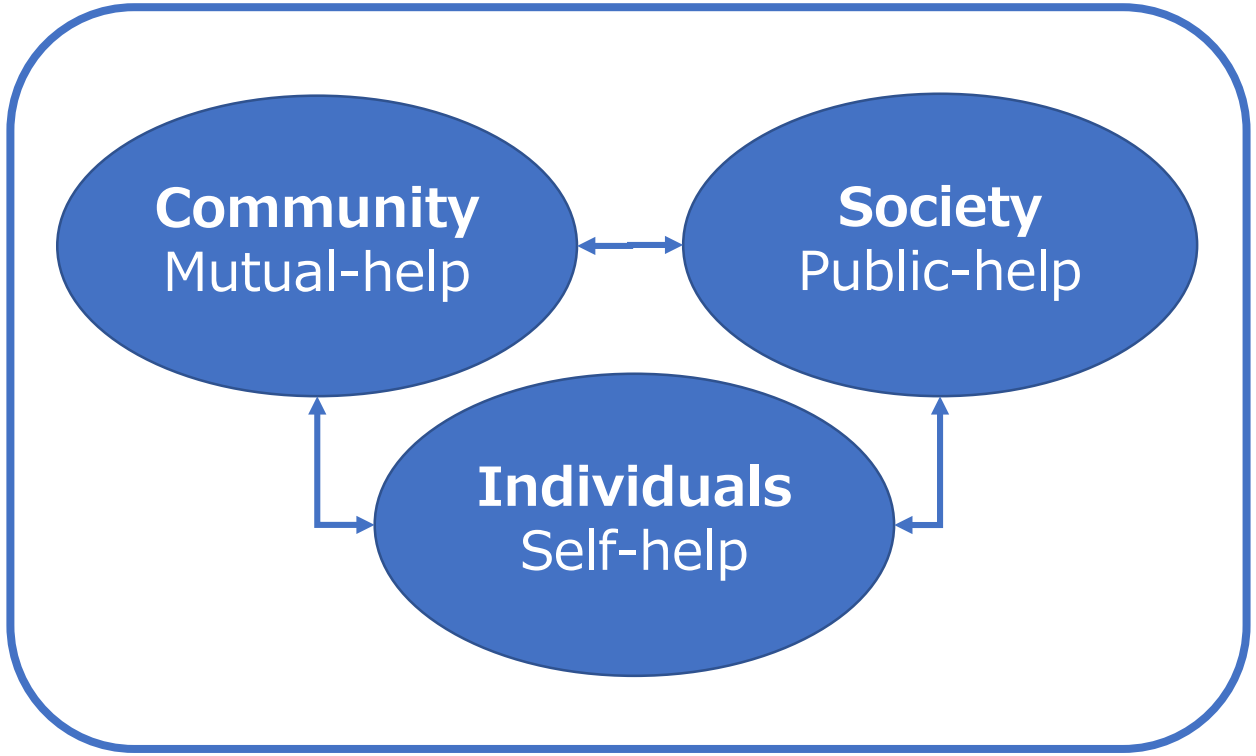
| | |
|---|---|
| 2011 | East Japan Earthquake Disaster |
| 2015 | Sendai Framework |

- The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, **adapt to, transform** and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions through risk management. (2017, UNDRR)

# Three Entities being resilient

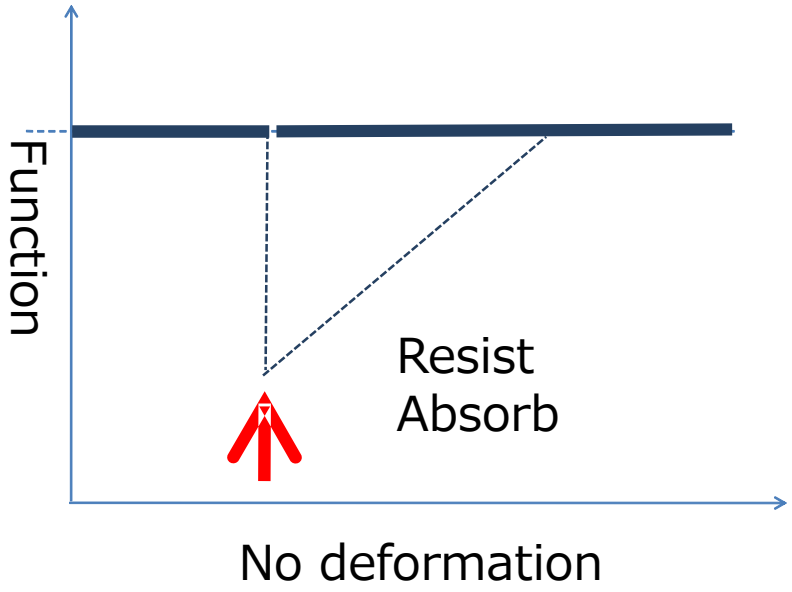
The ability of a system, community or society exposed to hazards

- A System:
  - Let us confine ourselves to “Human”
  - Individuals who help themselves
  - Self-help
- Community
  - A group of people who maintain personal relationships help with each other
  - Mutual help
- Society
  - Modern nations
  - Impersonal rules and regulations for social supports
  - Public help



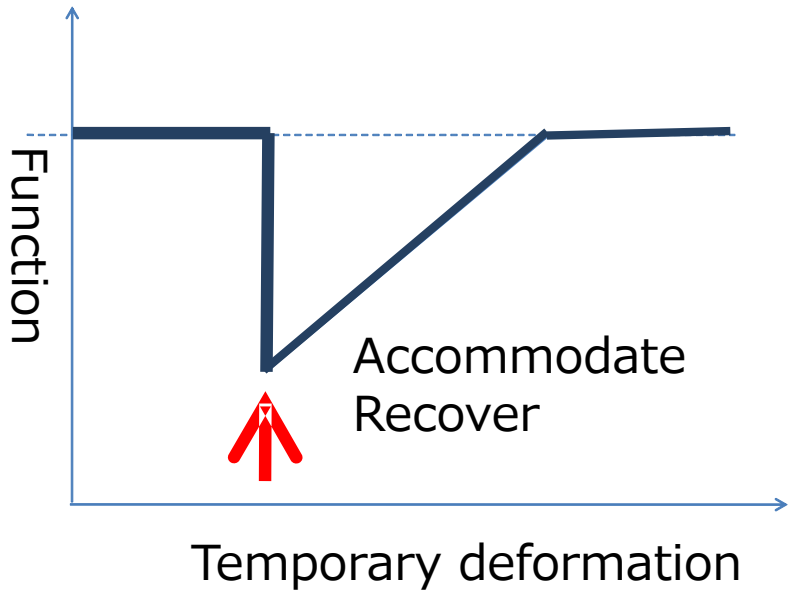
# Three Manifestations of Resilience Response

to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard



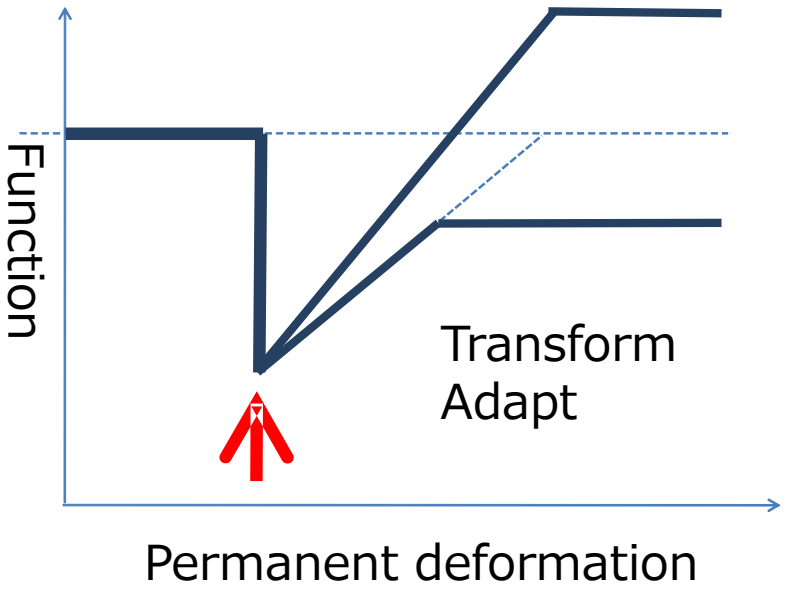

No deformation

Absorptive Capacity




Temporary deformation

Recoverable Capacity

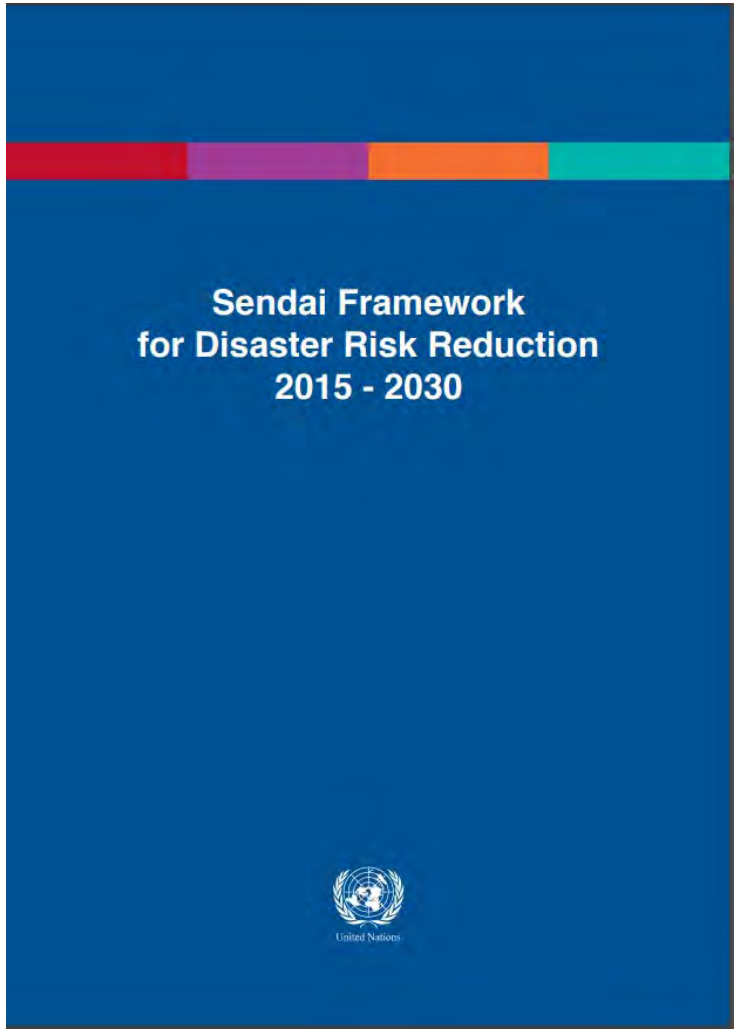



Permanent deformation

Transformative Capacity

# What we should do with the remaining time

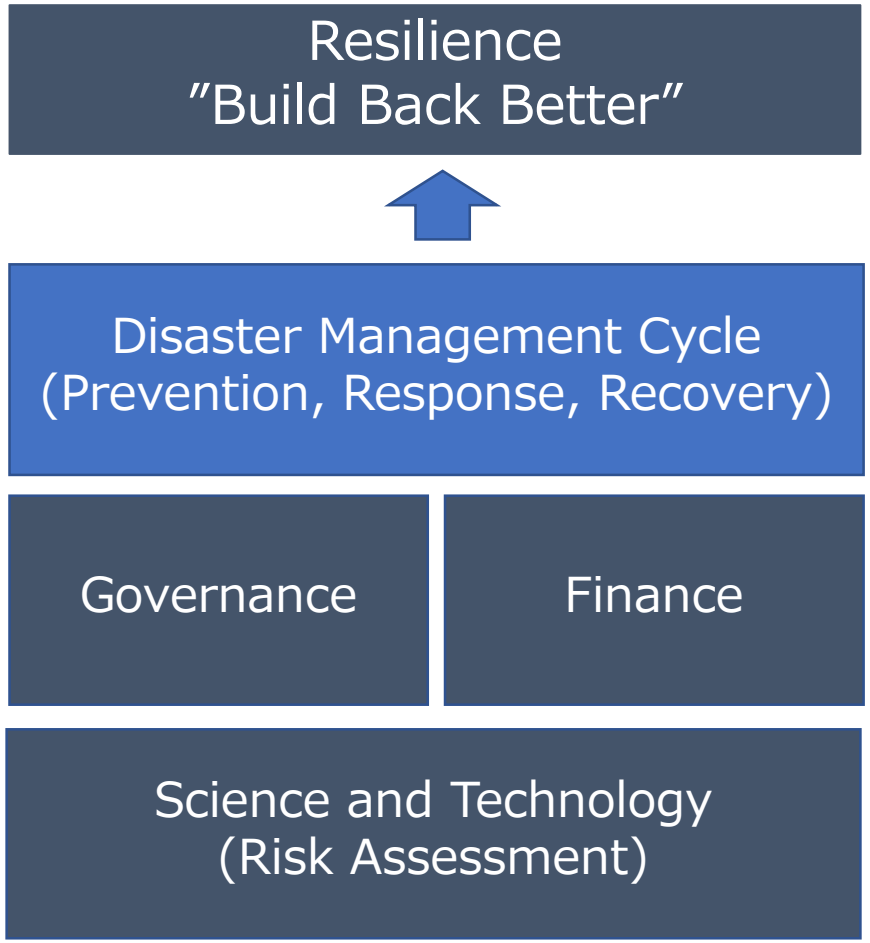
# The Sendai Framework for Disaster Risk Reduction 2015-2030




- The Framework was adopted at the Third UN World Conference on Disaster Risk Reduction in Sendai, Japan, on March 18, 2015.
- It aims to achieve the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries over the next 15 years.
- It outlines seven clear targets and **four priorities for action** to prevent new and reduce existing disaster risks:

https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

# Four Priorities for Action

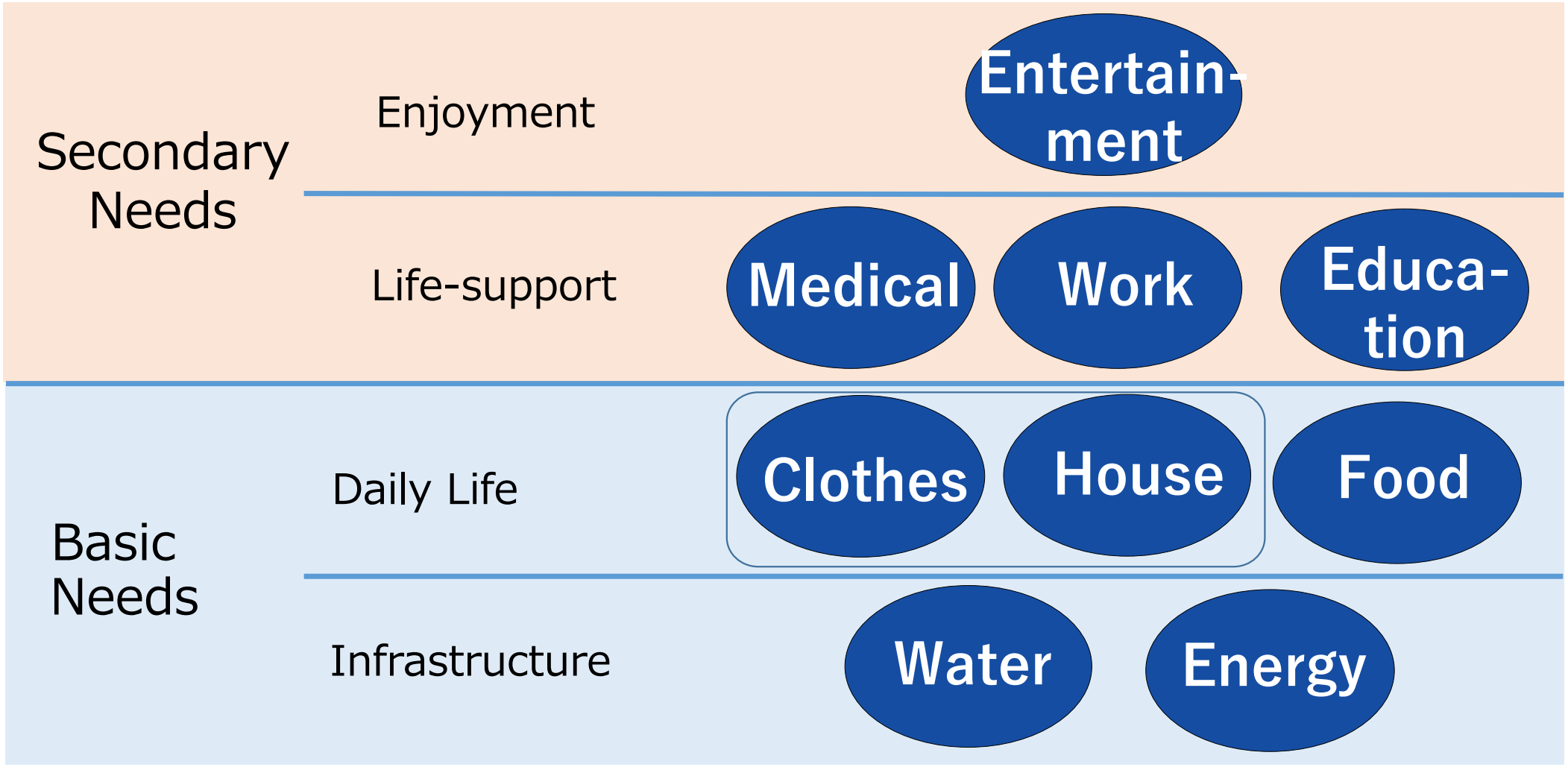



1. Understanding disaster risk
2. Strengthening disaster risk governance
3. Investing in risk reduction
4. Enhancing disaster preparedness for collective response, and to “build back better” in recovery, rehabilitation and reconstruction

# 1. Deepening and elaborating **understanding of disaster risk**

- It shall be established science and technology for improving disaster resilience and sustainability of societies with the ultimate three goals: 1) Maintaining and improving the **physical, mental and social well-being of individuals**, 2) Strengthening the **capacity for mutual support in communities**, and 3) the **coherent realization of disaster risk reduction, climate change adaptation, and sustainable development in society**.
- It shall be developed **a disaster management system with an all-hazards approach**, conversing multi-disciplinary knowledge covering all phases of disaster management, including forecasting/prevention, emergency response, and recovery/restoration
- It shall be realized the **consilience of knowledge for disaster resilience** using information infrastructure to disseminate to society as proposed by the recommendation titled “Developing an Online Synthesis System (OSS) and fostering Facilitators to realize consilience,” from Science Council of Japan in 2020.

# Improving Individual Well-being in various aspects of life

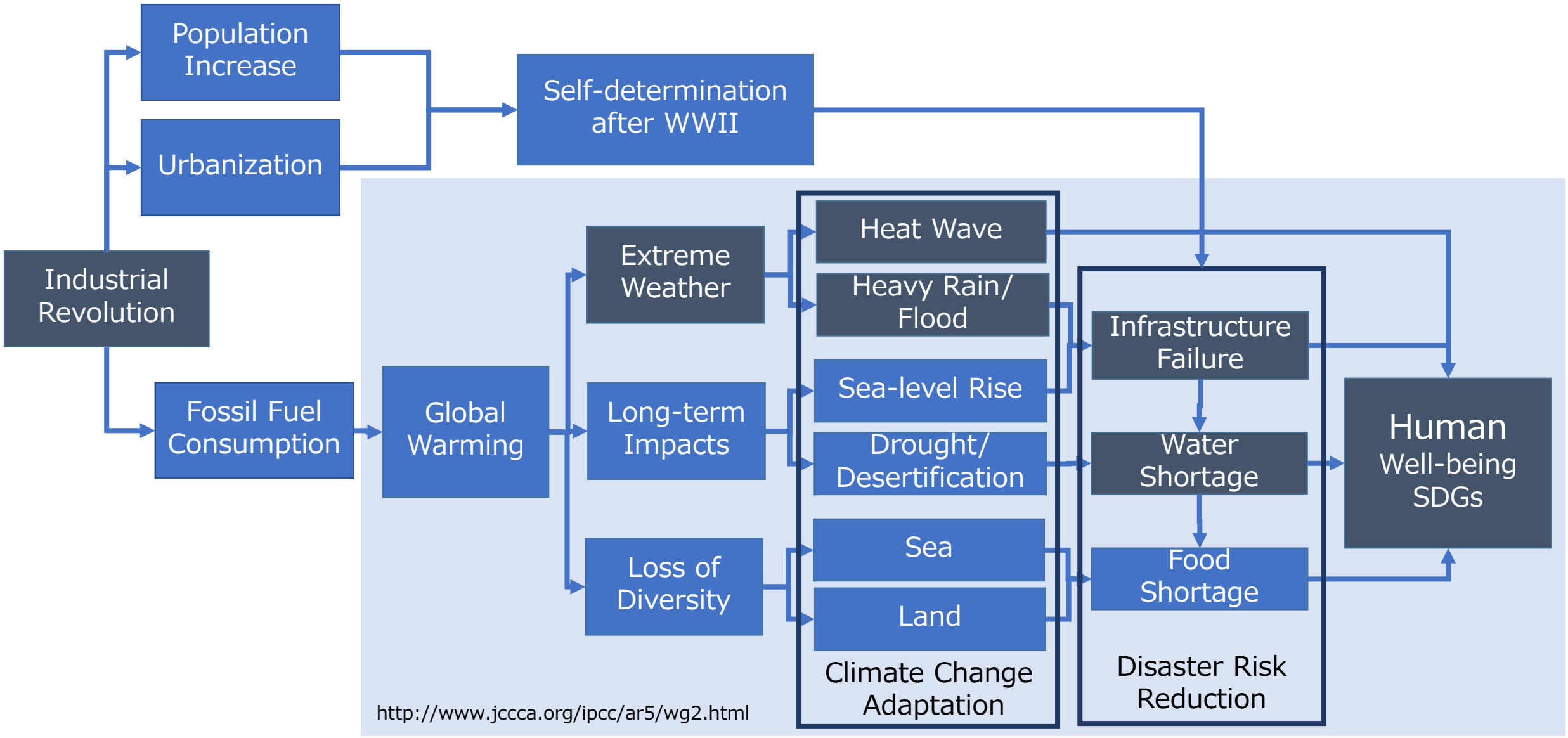


# Mutual support among people is the key for community resilience

# Japanese Welfare Discussion identifies Two Types of Mutual Help: System based/ private

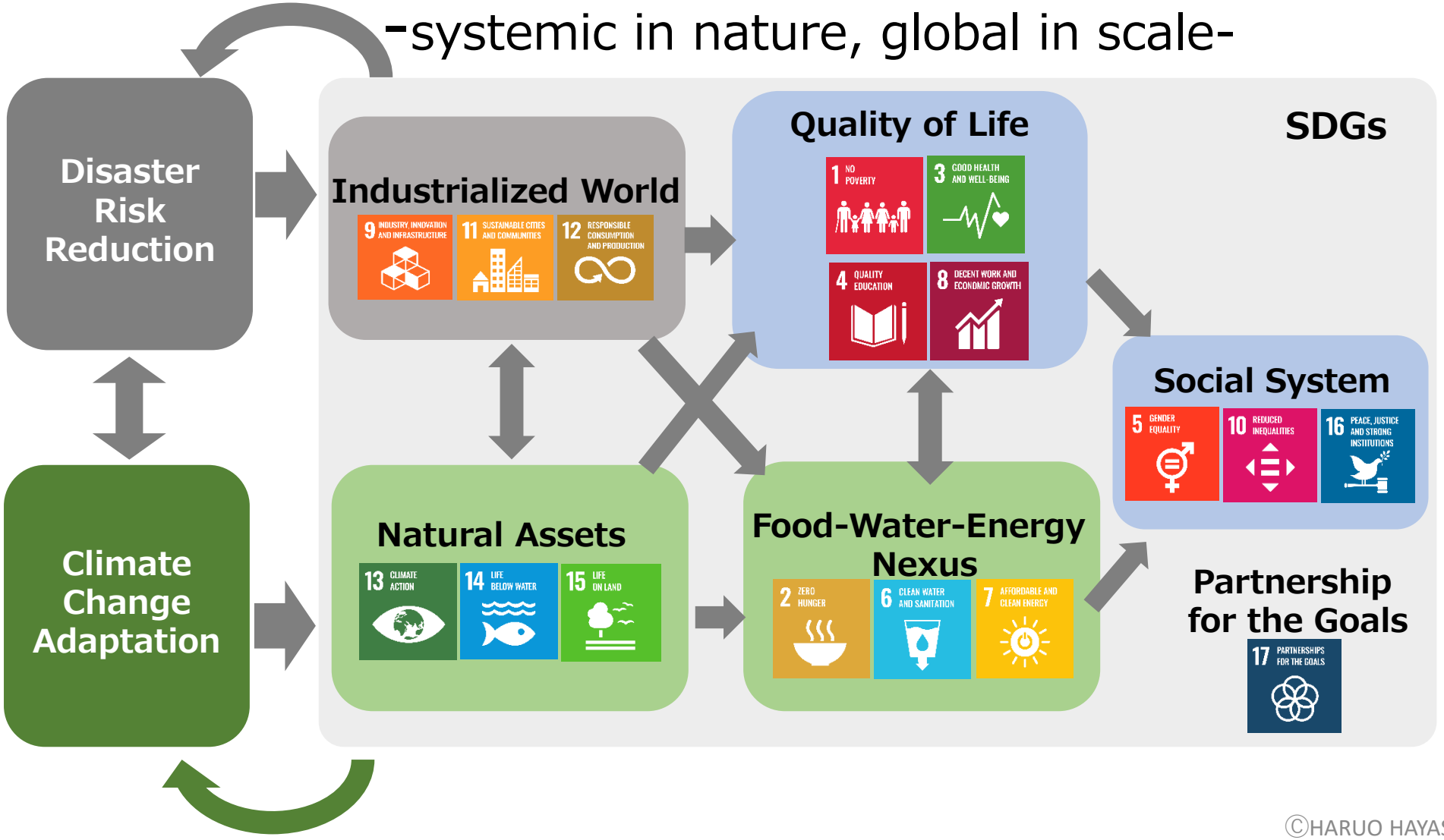
| | Mutual Help | Public Help/Self Help |
|---|---|---|
| Based on Laws | Mutual Help Through System (Insurance, Mutual Aid) | Public Help |
| Based on Private Network | Mutual Help Through Private Network | Spontaneous Actions |
| | | Purchase of Market Products/Services |

# Social Resilience: Coherent solution for systemic risk initiated by industrial revolution



# Coherence among DDR, CCA, & SDGs requires "Consilience" of Relevant Knowledge in terms of "Planetary Health"

-systemic in nature, global in scale-



# Basic Reference

Recommendation by SCJ 2020

## Building a sustainable global society by strengthening disaster resilience: - Developing an "Online Synthesis System (OSS)" and fostering "Facilitators" to realize consilience –

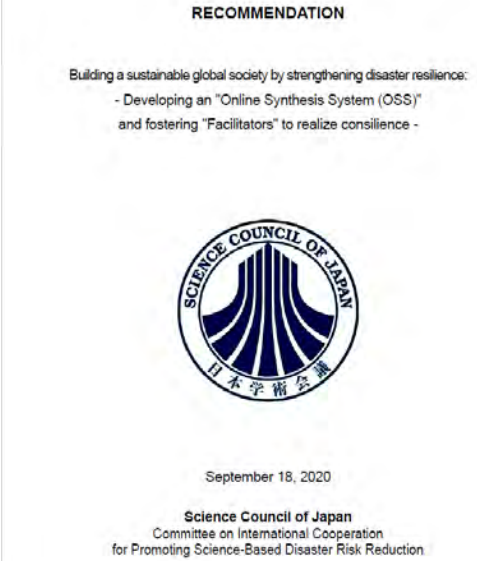
提言

災害レジリエンスの強化による持続可能な
国際社会実現のための学術からの提言
－知の統合を実践するためのオンライン・
システムの構築とファシリテータの育成－

SCIENCE COUNCIL OF JAPAN
日本学術会議

令和2年（2020年）9月18日
日 本 学 術 会 議
科学技術を活かした防災・減災政策の国際的展開に関する検討委員会

Available from:
https://reliefweb.int/report/world/building-sustainable-global-society-strengthening-disaster-resilience-developing-online



RECOMMENDATION

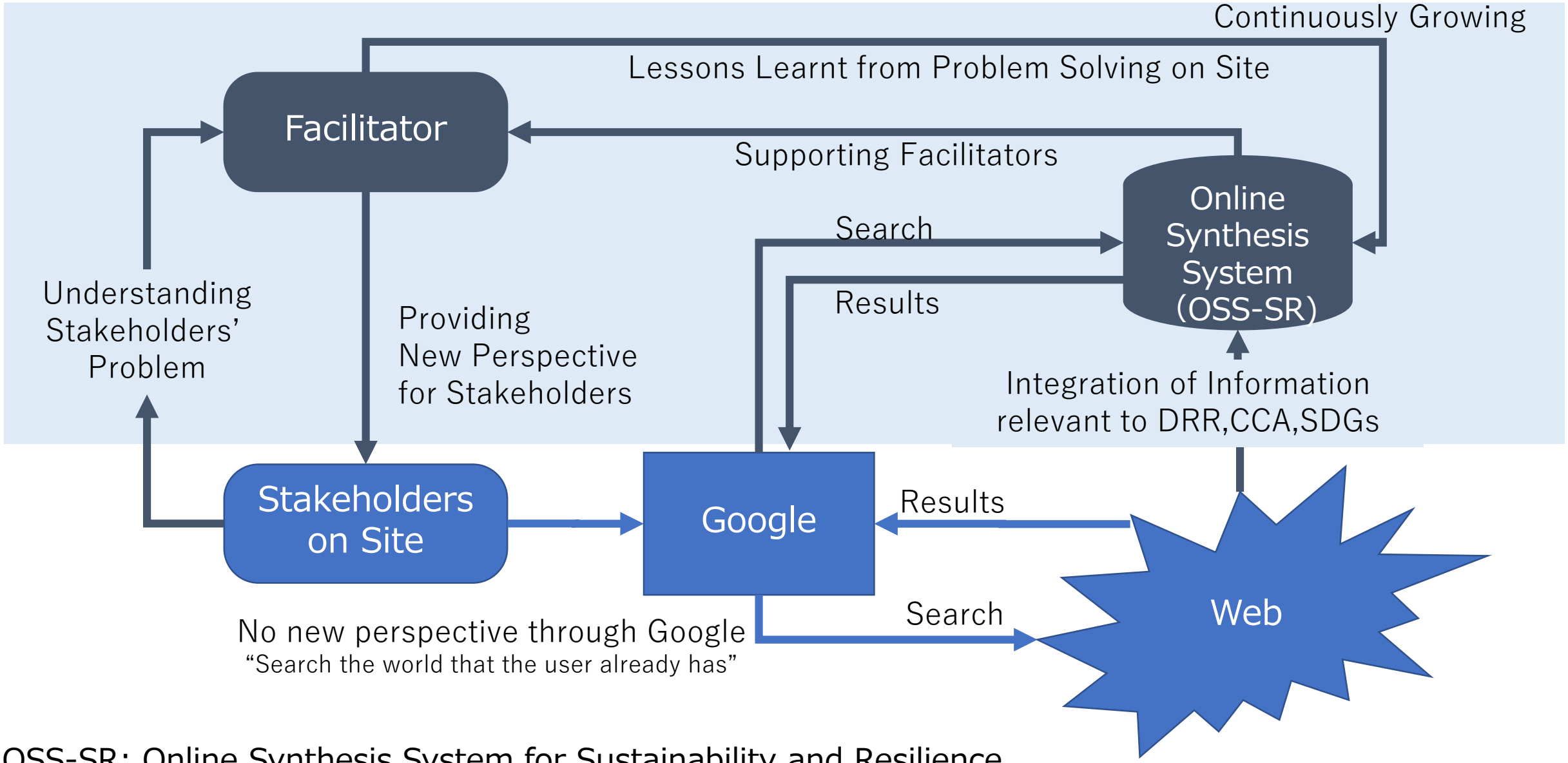
Building a sustainable global society by strengthening disaster resilience:
- Developing an "Online Synthesis System (OSS)"
and fostering "Facilitators" to realize consilience -

SCIENCE COUNCIL OF JAPAN
日本学術会議

September 18, 2020

Science Council of Japan
Committee on International Cooperation
for Promoting Science-Based Disaster Risk Reduction

# Tools for Consilience for Disaster Resilience: Facilitators and OSS-SR



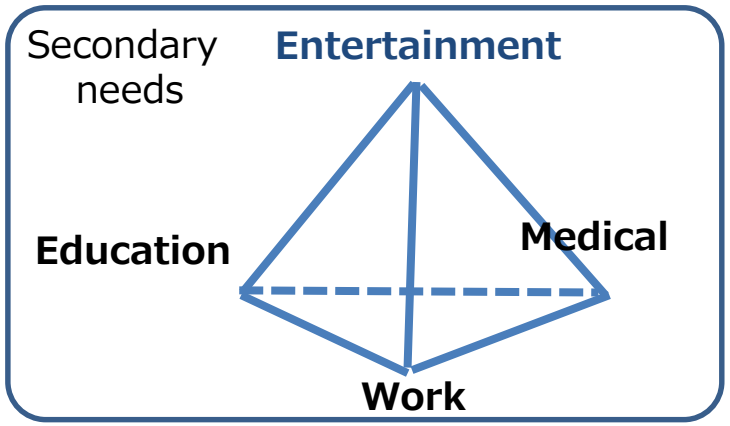

OSS-SR: Online Synthesis System for Sustainability and Resilience

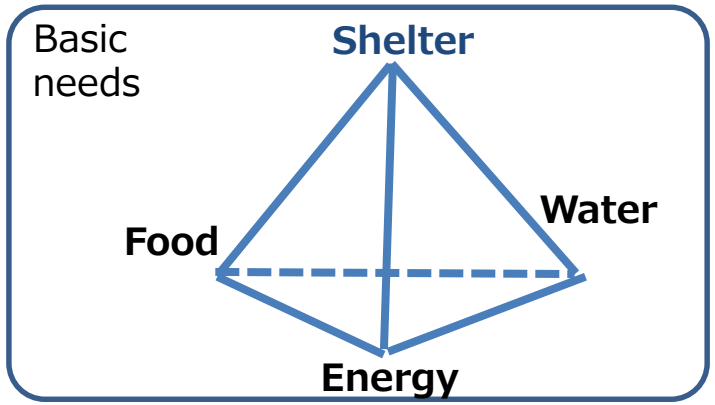
# 2. Establishing new **governance** to cope with disasters

- It shall be established the governance contributing to the transition to **an autonomous, decentralized, and cooperative society** as suggested by the irreversible changes caused by the COVID19 pandemic.
- It shall be ensured **transnational resilience** where multiple countries cooperate with each other in addition to improving the national resilience of land, nations, and people in each country.
- It shall be stimulated **risk communication on catastrophic disasters** nationally and globally, started with discussions at Science Council of Japan.

# COVID19 Suggests a Transition to ADC Society

Basic needs stay physical, Secondary needs go Cyber




## Centralized Society
Local/Physical

Physical World

Population Increase

Urbanization

Globalized
Supply Chain
Climate Change/
Disasters

COVID-19

New Normal

E-commute
Tele-service
Digital economy

ICT
Innovation

Resilient
Lifestyle

## Autonomous/Decentralized/ Cooperative Society
Glocal/Cyber・Physical

Cyber World

Planetary
Health

**Transnational Resilience**

Physical World

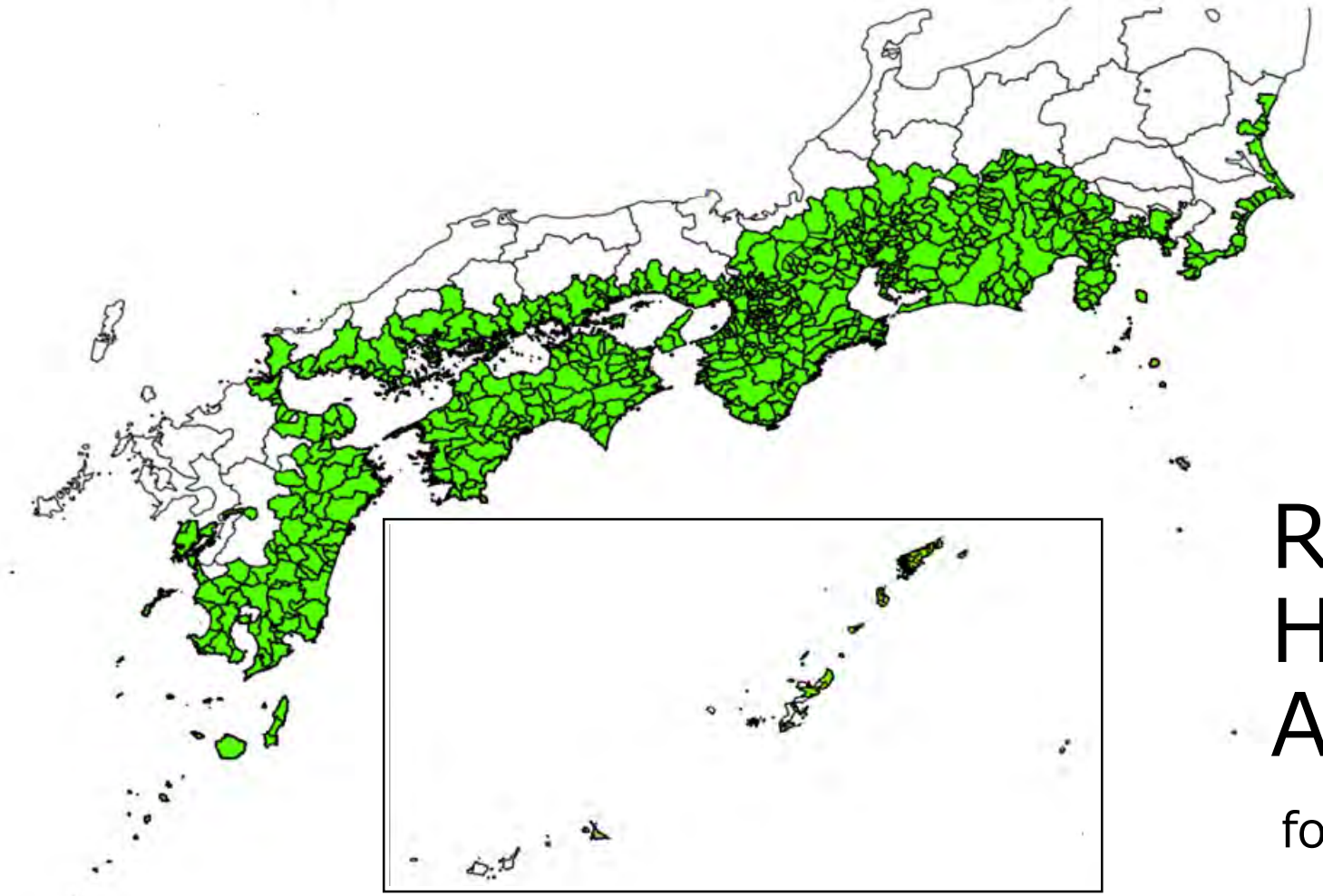
Local Resilience

Local Production for
Local Consumption

# 3. Ensuring **investment** in financial expenditure, capacity development, and technological development in response to disasters

- It shall be established the role of **investment in reducing human activities and asset accumulation at risk exposed to disasters** such as medium to long-term spatial reorganization plans and maintenance of critical social infrastructure.
- It shall be promoted the concentrated investment in (1) improvement of qualitative and quantitative **enhancement of market services** to improve self-help capacity and (2) **enhancement and diversification of insurance and mutual aid programs** to provide mutual assistance aid based on the system.
- It shall be enhanced individual resilience capabilities to deploy strategic capacity development programs to respond disasters more efficiently and effectively utilizing **digital transformation (DX)**.

# Geographically 707/1724 Jurisdictions may be impacted by upcoming Nankai Earthquake

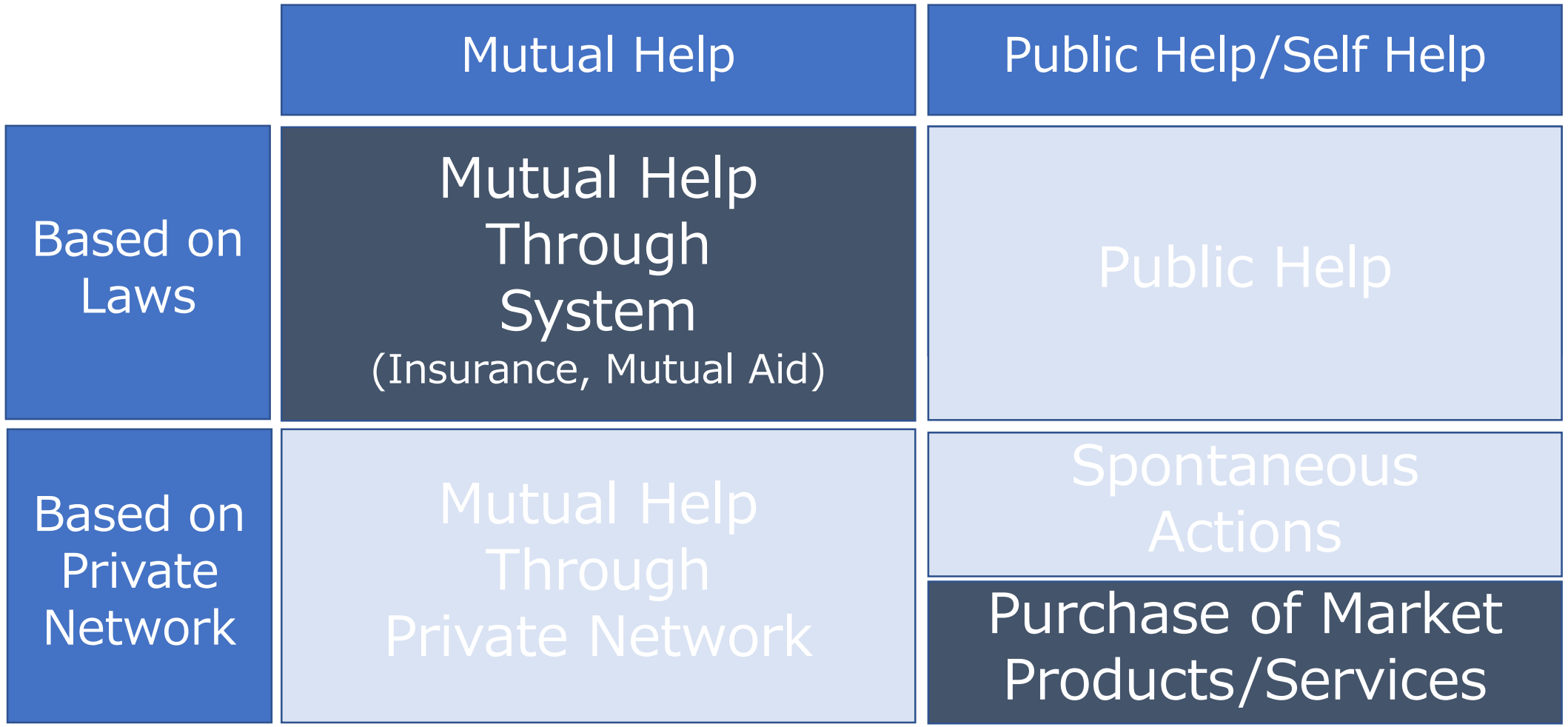


https://www.bousai.go.jp/jishin/nankai/pdf/nankaitrough_chizu.pdf

## Reduce Exposure Human Activities & Asset Accumulation

for 22nd century and After

# Japanese Welfare Discussion suggests Two promising resilience elements with population decline




→ Importance of Collaboration with Private Sector

# 4. Establishing proactive measures to enable **Build Back Better**

- It shall be strengthened the **transformative capacity** to build a new society after a disaster with the awareness that "in an emergency, we can only do what we normally do," as well as a system that promotes proactive measures using DX.

- It shall be presented **a vision of society after a catastrophic disaster** (sustainability, green energy/zero carbon, national spatial planning, transition to an autonomous decentralized and cooperative community in terms of finance, economy, industry, international cooperation, etc.

- It shall be prepared the plans for recovery with presented vision in advance since the **window of opportunity for framing plans is short in time**.

# 関東大震災100年 復興デジタルアーカイブ

## ヒストリー ［震災・復興・現代］


京橋

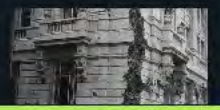

銀座

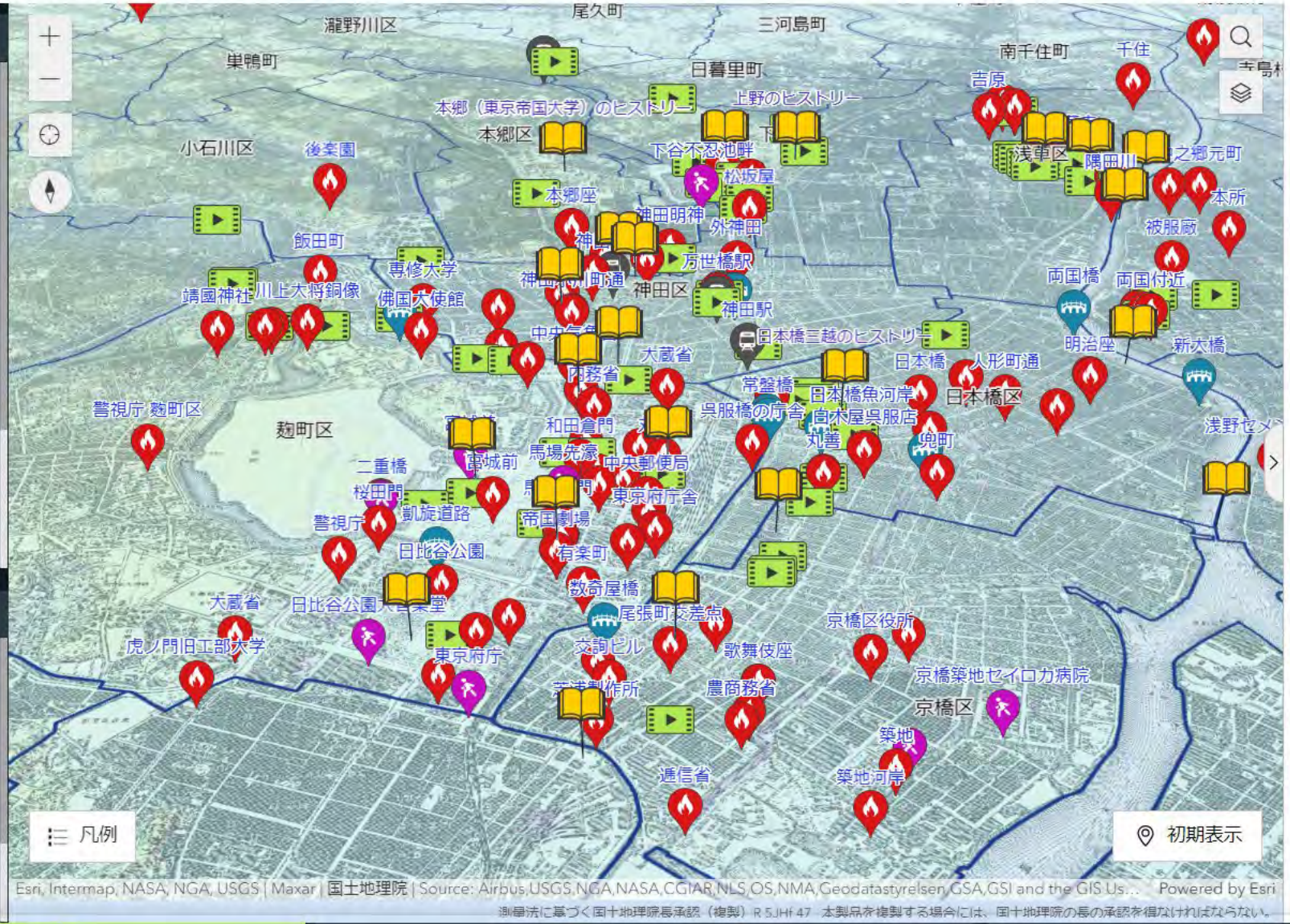

芝

## 動画


焼失した如水会館と崩落した一ツ橋

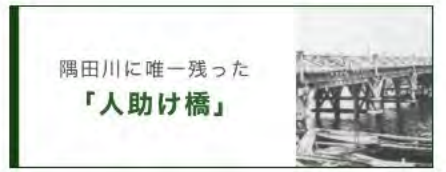

地割れした和田倉濠付近の道

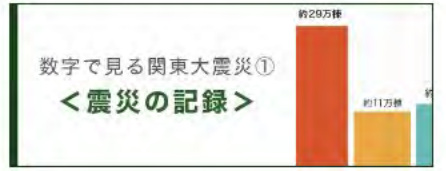





## 各種解説



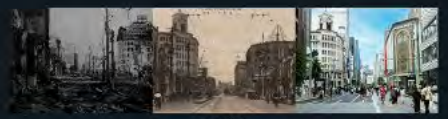

大震災の被害編 | 復興まちづくり編 | 防災都市づくり編

1923年 — 2023年

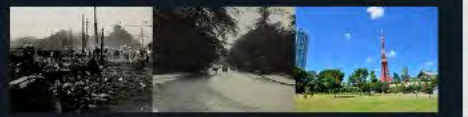
# 関東大震災100年 復興デジタルアーカイブ

## ヒストリー 【 震災・復興・現代 】

京橋



銀座



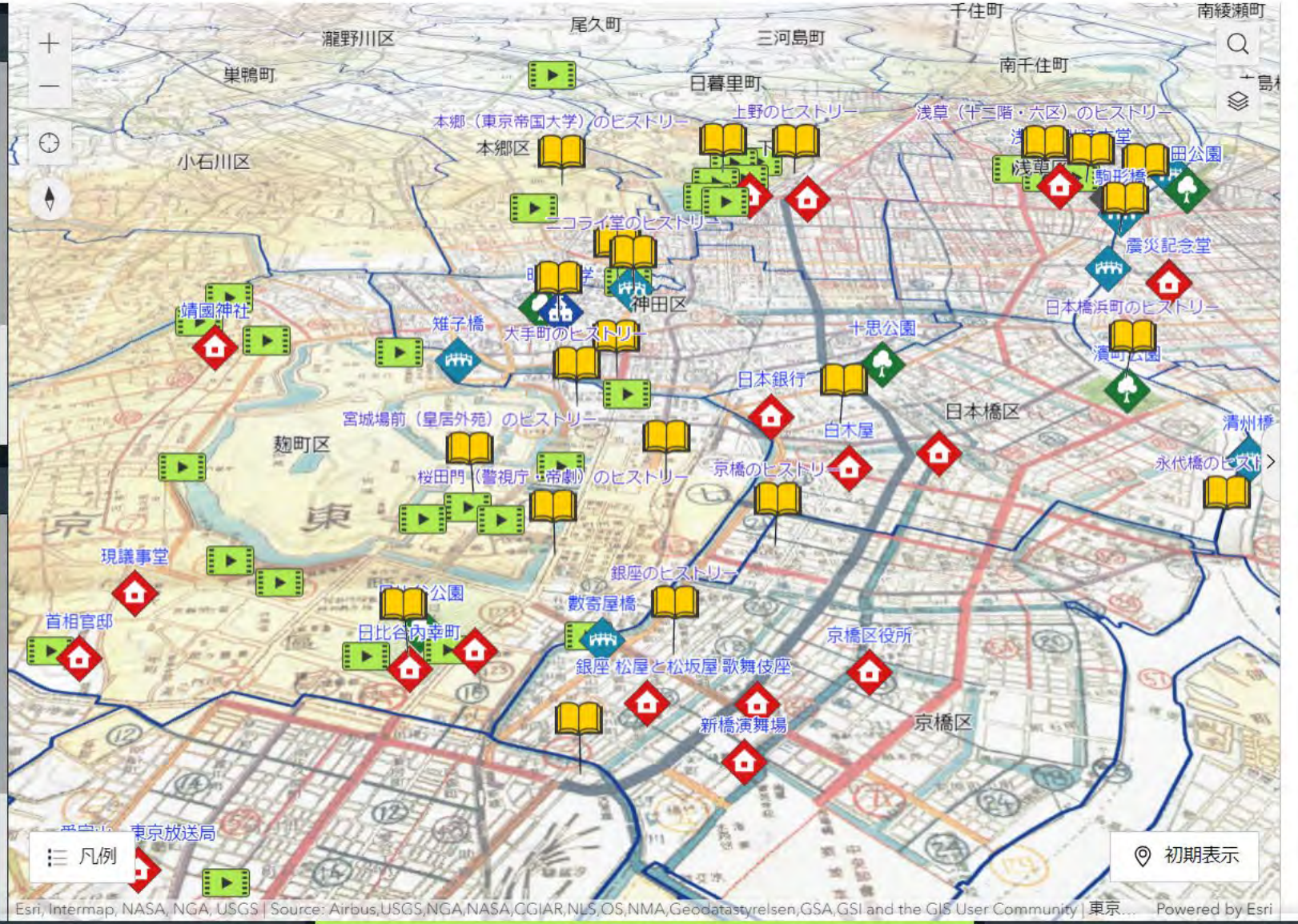
## 動画

帝室林野管理局庁舎の消火活動

トタン小屋の生活

閣議を終えた閣僚

参謀本部から桜田門を見る




## 各種解説




2/2

大震災の被害編 | 復興まちづくり編 | 防災都市づくり編

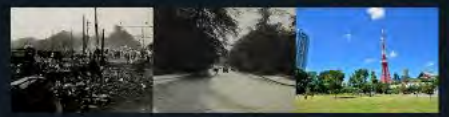
1923年 — 2023年

# 関東大震災100年 復興デジタルアーカイブ

## ヒストリー 【震災・復興・現代】


京橋


銀座


芝

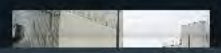
## 木密関連事業

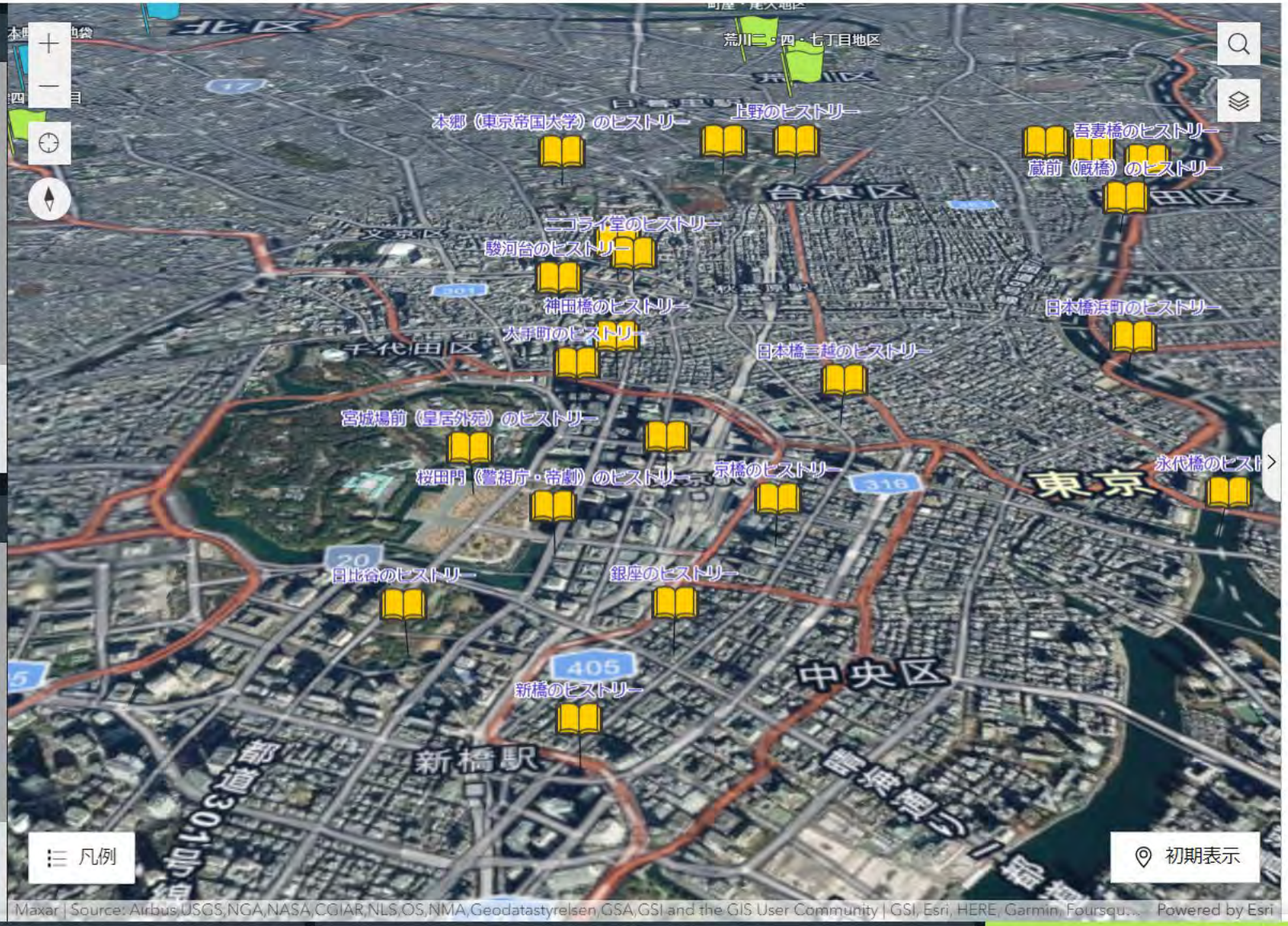

補助142・143号線


松島三丁目


南小岩七・八丁目

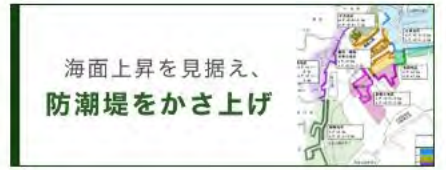

荒川二・四・七丁目地区






## 各種解説





2/2

大震災の被害編 | 復興まちづくり編 | 防災都市づくり編

1923年 — 2023年

This presentation was made based on the materials available in

# Recommendation
# Ensuring Resilience to Overcome Catastrophic Disasters

August, 2023

Science Council of Japan

url: https://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-25-t351-3.pdf

English version will be available soon