Climate Change & Infrastructure

2022. 12. 08

Young-Il Song, Ph.D.

Korea Environment Institute

Contents

KEI

I. Climate Change

KEI

I. Climate Change

➢ Climate crisis status and prospect

- Global Climate Change Status (WMO, 2021, etc.)
  - Temperature: (Despite the La Niña phenomenon,) the average annual temperature in 2020 is 1.2℃ higher than that of pre-industrialization, (the highest on record)
  - Sea level: (As of 2018) 0.20m in sea level rise compared to 1901

- Climate Change in Korea (National Institute of Meteorological Science, 2021)
  - Temperature: The average annual temperature increased by 1.6℃ over the past 109 years (1912~2020) (based on 6 cities*)

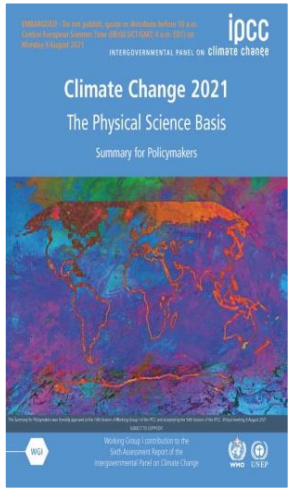
    * **6 cities: Seoul, Incheon, Gangneung, Daegu, Busan, Mokpo**
  - Precipitation: +135.4 mm (17.7 mm/10 years) increase over the same period

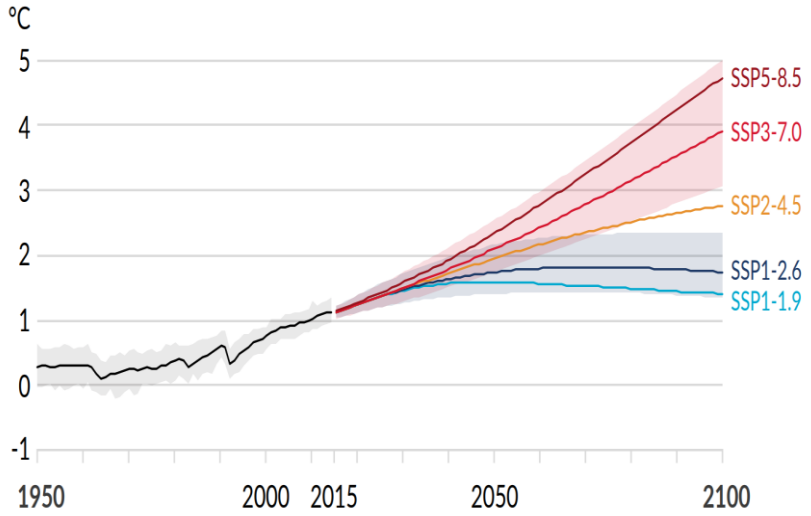
I. Climate Change

➢ from IPCC AR6 WG1(2021)

- Global warming level is already about 1.1℃.
- We will touch 1.5℃ warming level within 20-years (before 2040).

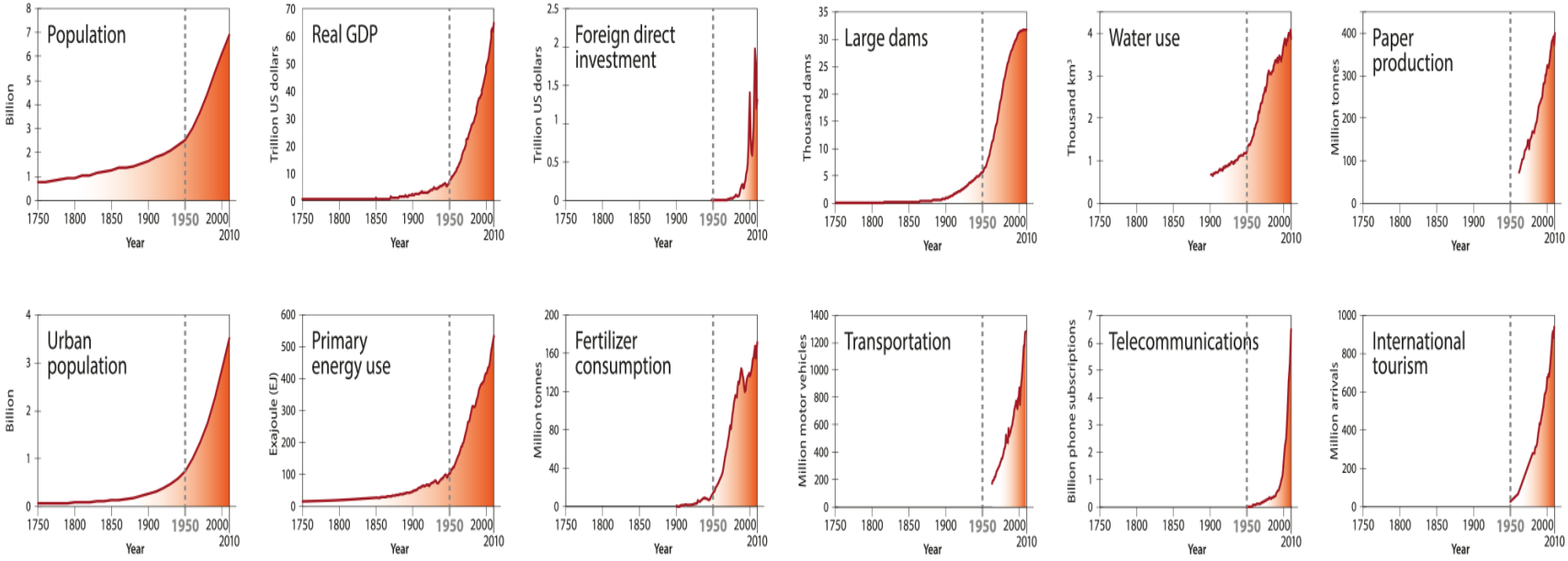
➢ importance of climate action ! (mitigation and adaptation !)





Great Acceleration

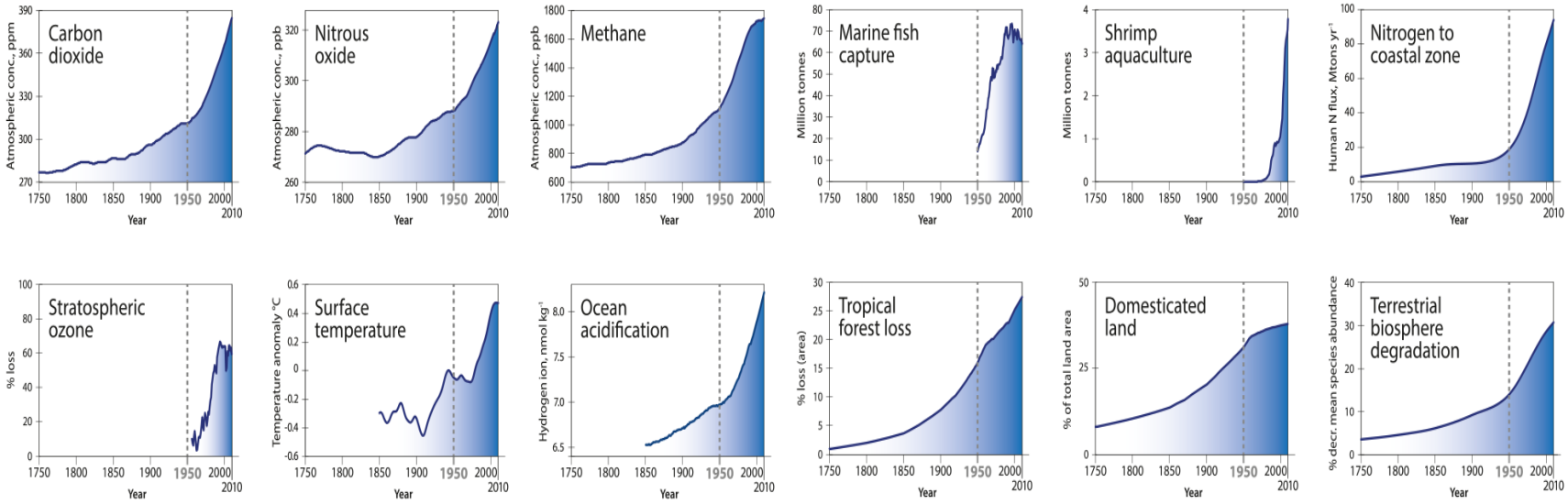
Socio-economic trends



(Steffen et al, 2015, Science)

Great Acceleration

Earth system trends

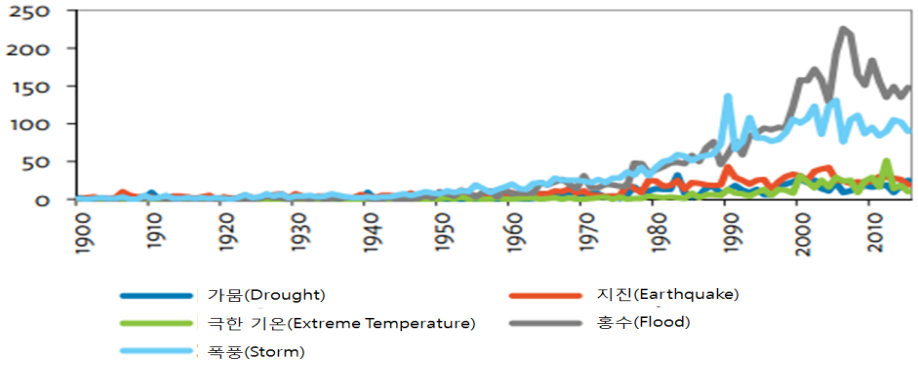


(Steffen et al, 2015, Science)

Economic Damage

➢ Continued Economic Damage due to Extreme Weather

- [illegible]
- [illegible]



<Natural Disaster Frequency Time Series>

Natural disaster	Total damage (100 million $)
Storm	10,430
Earthquake	7,710
Flood	6,960
Extreme temperature	600
Wildfire	580
Landslide	90
Drought	1

<Amount of damage due to natural disaster>

Climate change phenomenon

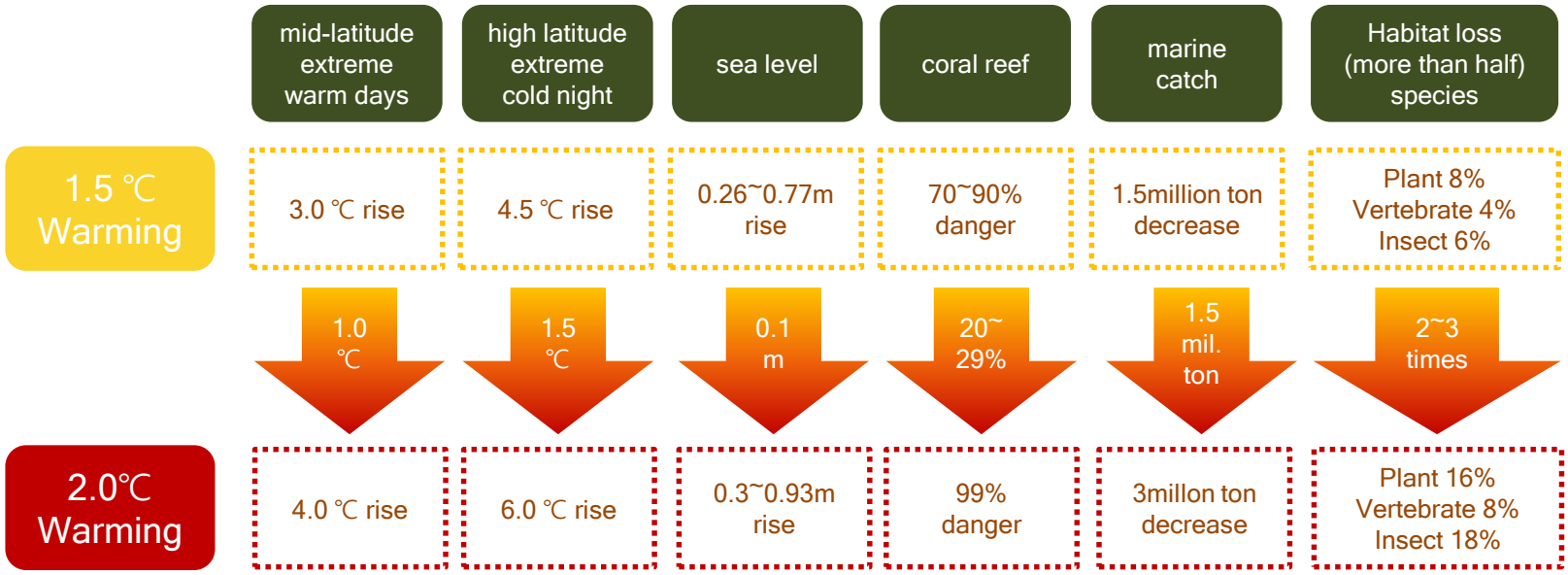
- [redacted]

Comparison factor		AR6 WG1 (2021)	AR5 WG1 (2013)
Greenhouse gas concentration	CO_2	410 ppm	391 ppm
	CH_4	1866 ppb	1803 ppb
	N_2O	332 ppb	324 ppb
Carbon dioxide concentration example		Unprecedented in the last 2 million years	Unprecedented in the last 800,000 years
Global average surface temperature (relative to pre-industrial)		1.09℃ rise (2011~2020)	0.78℃ rise (2003~2012)
Global average sea level (relative to 1901)		0.20m rise (2018)	0.19m rise (2010)
Total anthropogenic radiative forcing (relative to 1750)		2.72W/m_2 (2019)	2.29W/m_2 (2011)
Range of global average surface temperature rise from 2081 to 2100		1.0~5.7℃ rise (relative to pre-industrial)	0.3~4.8℃ rise (relative to 1986~2005)
Range of global average sea level rise from 2081 to 2100		0.28~1.02m rise (relative to 1995~2014)	0.26~0.82m rise (relative to 1986~2005)
Historical carbon dioxide total emissions		2390GtCO2 (1850~2019)	1890GtCO2 ((1861~1880)~2011)

I. Climate Change

1.5℃ and 2.0℃ Global Warming (IPCC SR1.5, 2018)

- [illegible]
- [illegible]



Disaster in Korea

2001~2002

Typhoon "Ruas"
Casualties 246person,
Damage, 5.15Billion US$
Precipitation, 870.5mm
Gangreung City

2003~2004

Casualties, 131person,
Damage, 4.22 Billion US$
Precipitation, 453.0mm
Typhoon "Maemi"

2005~2006

2007~2008

Typhoon "Nari"
Casualties 16person,
Damage, 0.16Billion US$
Precipitation, 300.0mm
Namhae City

Precipitation, 32% of normal yr.
Limited water supply, 3hr/day
Taebaek City Drought

2009~2010

2011

Heavy rain (449.5mm)
Casualties, 67명
Seoul & Kyunggi-do

2012

2014

Precipitation, 45% of normal yr.
Water retention rate, 18.9%
Chungcheongnam-do Drought

2015

2016

2017

Flood
Precipitation 300mm
Casualties, 4명
Cheongju

2018

Damage , 0.55 Billion US$
Precipitation, 310.0mm
Jeju Island
Typhoon "Kongray "

2020

Longest rainy season (54days)
Precipitation, 830.9mm,

II. Climate Change Adaptation

KEI

Resilience

- [illegible]
- [illegible]

[illegible]

Fig. Comparison of areas with and without resilience - recovery times and outcomes after disasters
<U.S. Climate Resilience Toolkit (https://toolkit.climate.go) refer to website>

Climate Resilience

- [illegible]

- [illegible]

  [illegible]

  building ‘resilience’ [illegible]

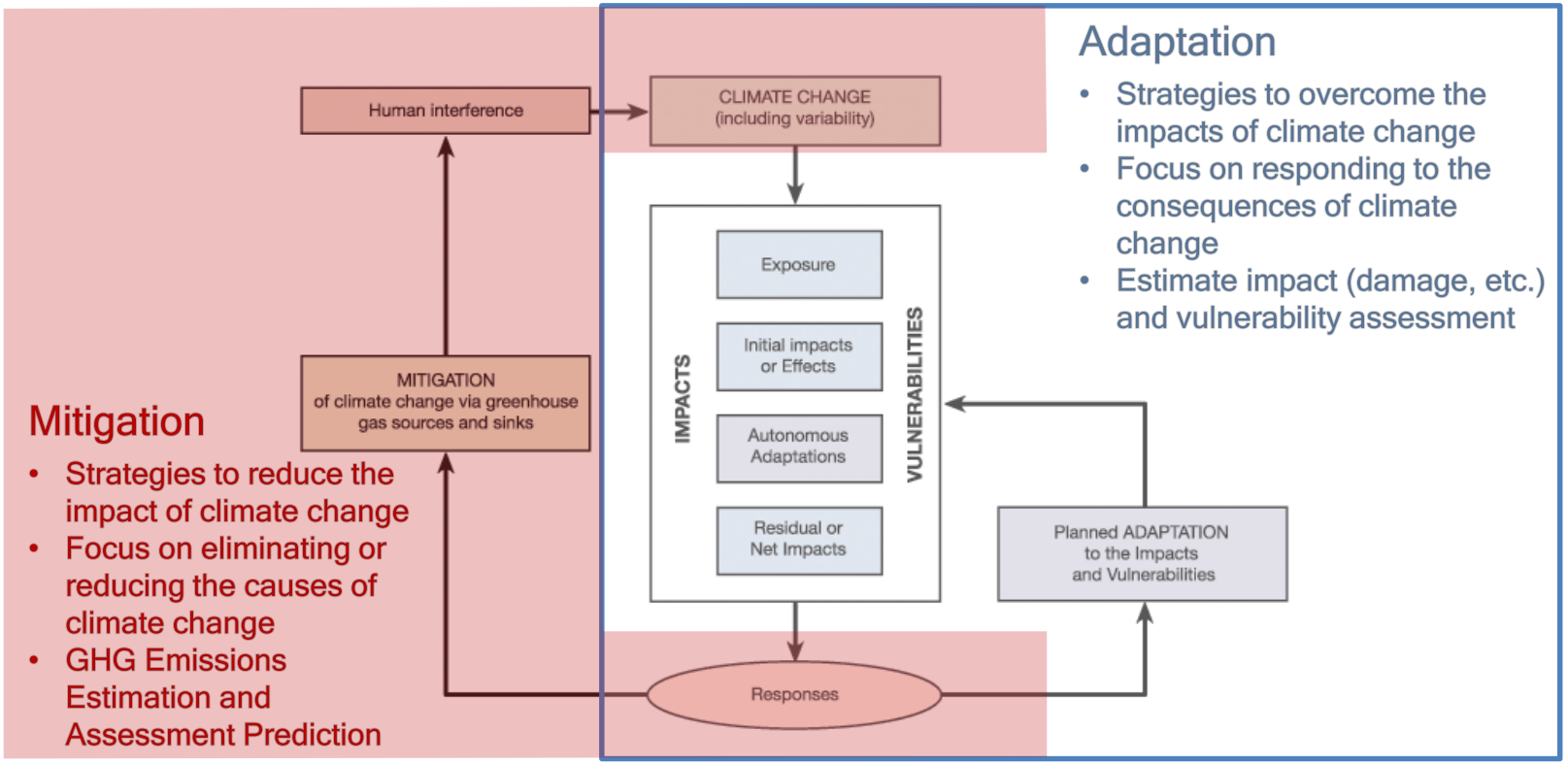
II. Climate Change Adaptation

Adaptation

- [illegible]
- [illegible]

Perspective	Range	Purpose	Related Sector	Planned period
Effect	Nation and local level cooperation	Positive impact improvement	Water, Agriculture, health, etc.	Short-range plan

Mitigation & Adaptation

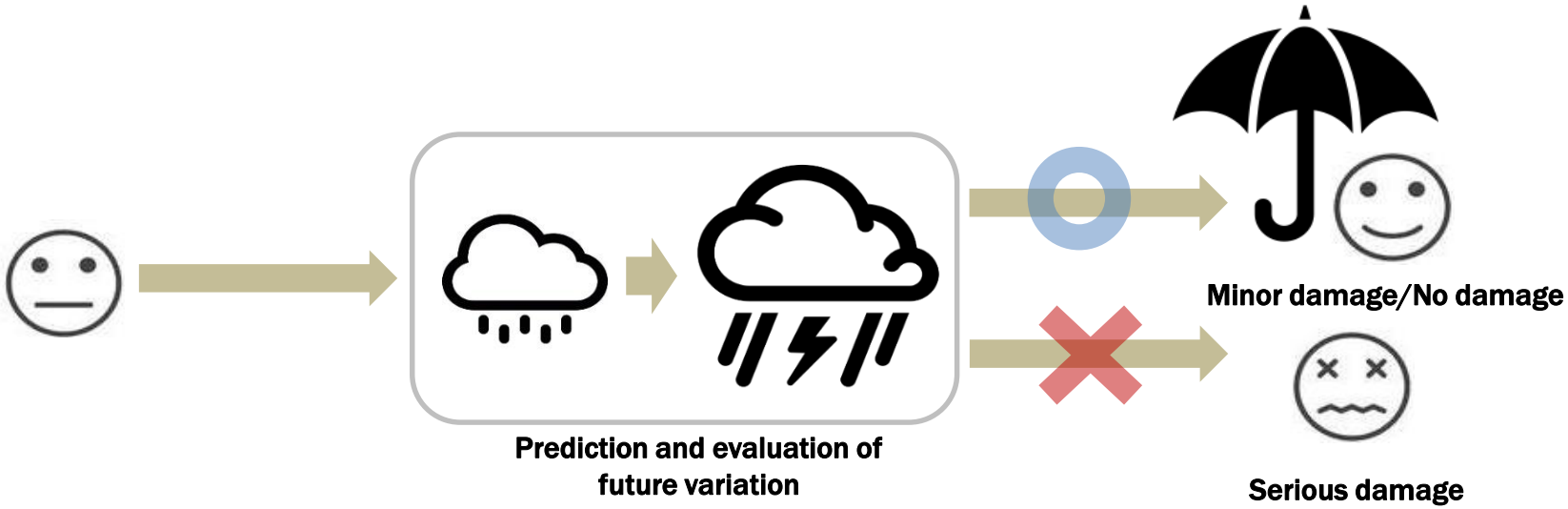


<THE SCIENCE OF ADAPTATION: A FRAMEWORK FOR ASSESSMENT (smit et al., 1999)>

II. Climate Change Adaptation

Adaptation

- [illegible]
- [illegible]



II. Climate Change Adaptation

Adaptation – Diverse Sectors

Monitoring and Protection

Ecosystem

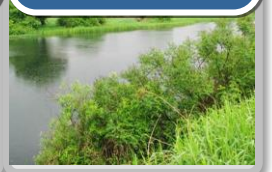
Forest

- Providing sound basis of adaptation with the optimized climate change prediction
- Protecting the vulnerable species and preserving biodiversity
- Improving the forestry productivity and preventing landslide

Agriculture

Marine/ Fishery

Water



- Improving the agricultural productivity by management of agricultural and livestock product in an adaptive manner
- Strengthening competitiveness of marine and fishery by coping with sea level rise and sea surface temperature increase
- Making water supply more stable and preserving aquatic ecosystem

Health

Infrastructure

Adaptation Business

- Taking adaptation action based on people's life style by protecting the vulnerable from extreme heat wave and infectious diseases
- Minimizing damage of citizen by operating early warning system and promoting insurance related in disaster
- Developing adaptation business and minimizing damage in energy and other industry

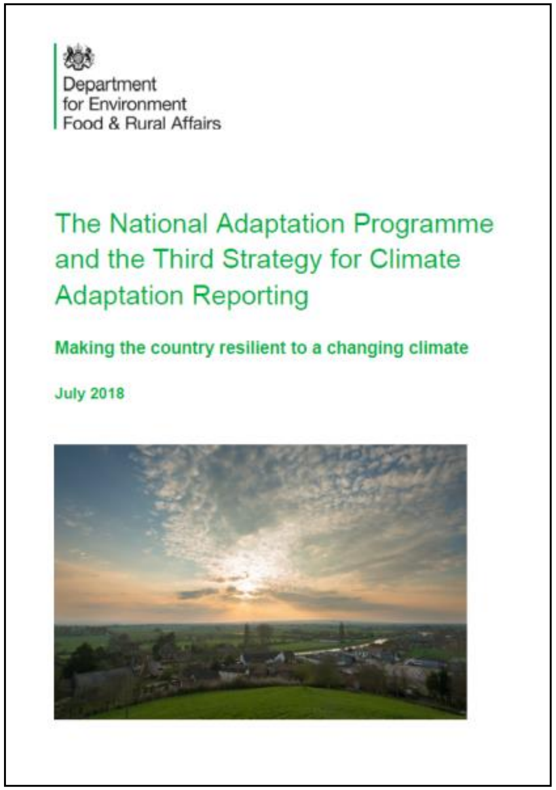
II. Climate Change Adaptation

Relationship between Climate Resilience & Adaptation

- ‘[illegible]’ of a region or country is understood as ‘[illegible]’ [illegible]
- [illegible]

  [illegible]

  → [illegible]



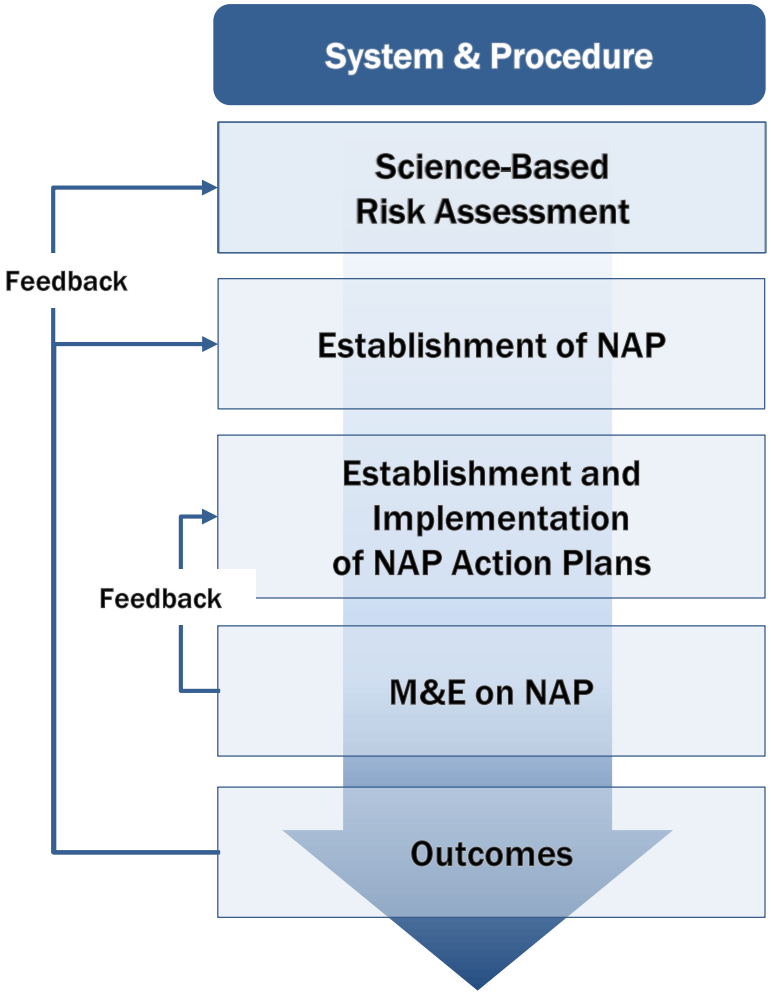
NAP(2018), Defra, UK

Relationship between Climate Resilience & Adaptation

- Chevron Climate Resilience (Business, Investor and Stakeholder example: Chevron, USA)

II. Climate Change Adaptation

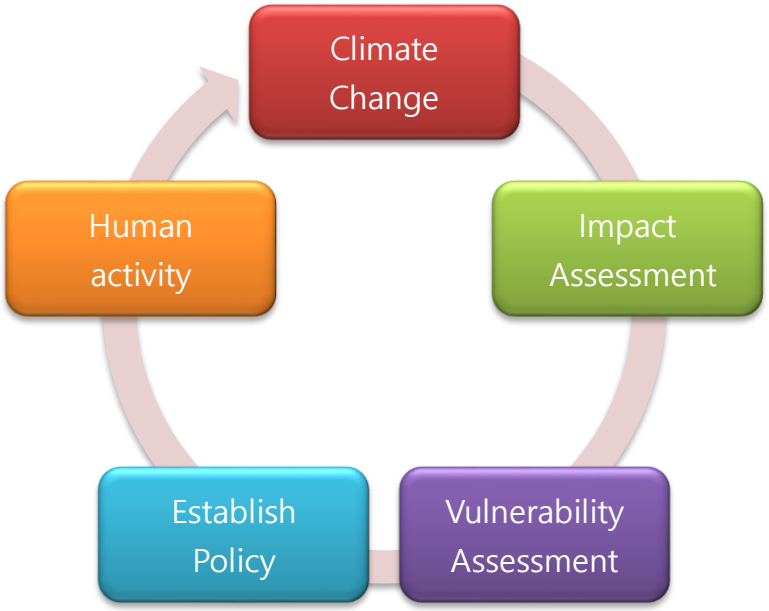
➢ Adaptation Planning and Monitoring Cycle



II. Climate Change Adaptation

➢ Simple Processes of Adaptation

- The effects of climate change are scientifically measured and evaluated
- The vulnerability assessment is conducted based on the measured data
- Establish policies by referring to the vulnerability assessment
- Human adaptation activities affects climate change



III. Climate Change Adaptation & Resilience

KEI

III. Climate Change Adaptation & Resilience

➢ Framework Act on Low Carbon Green Growth in Korea (April, 2010)

III. Climate Change Adaptation & Resilience

➢ 3rd National Climate Change Adaptation Plan in Korea(2021-2025)

Vision	Realization of a climate-safe nation with the people

Goal	◈ Enhancing the climate resilience of all sectors of society in preparation for a rise in global temperature of 2℃ ◈ Promoting science-based adaptation by building climate monitoring and forecasting infrastructure ◈ Realization of adaptation mainstreaming in which all actors implementing adaptation participate

3 major policies	① Improving adaptability to climate risks	• **Water management considering future climate risks** • Maintain ecosystem health • **Enhancing the adaptability of the entire country** • Establishment of a sustainable agricultural and fishery environment • Establish a health damage prevention system • Strengthening adaptive capacity in the industrial and energy sector
	② Strengthening of monitoring, forecasting and evaluation	• Establishment of a comprehensive monitoring system • Scenario production and forecasting advancement • Strengthening the provision of evaluation tools and information
	③ Realization of adaptive mainstreaming	• Strengthening of climate adaptation promotion system • Lay the foundation for improving climate resilience • Establishment of climate adaptation cooperation system and raising awarenes s

Core Strategy	Improving climate resilience	Protection of the Vulnerable	Activation of citizen participation	New Climate Regime response

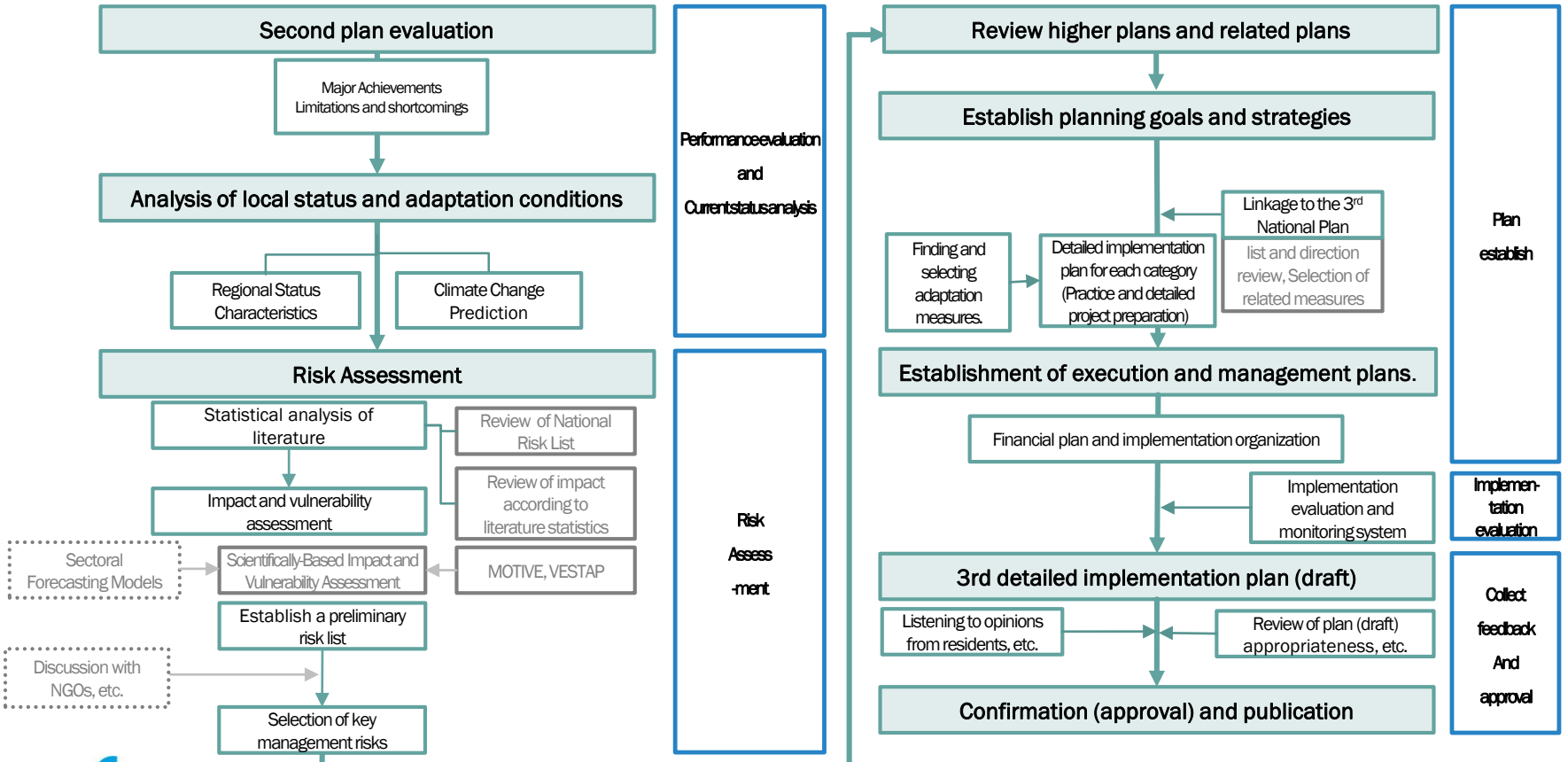
III. Climate Change Adaptation & Resilience

List of Risks (Water Sector)

	Hazard	Exposure	Impact	Risk
1	Temperature rise Drought	In land water-streams	Deepening drought Increasing dryness due to a decrease in base flow	Increasing dryness of streams due to temperature rise and drought
2	Temperature rise Drought	In land water-streams	Green algae Water deterioration Increased possibility of flowing nonpoint pollutants and harmful substances	Green algae and water deterioration due to temperature rise and drought
3	Temperature rise Heavy rain	In land water-streams	Reduction of Fish Habitat Changed to river water due to immersion Destruction of habitat	Increased negative impact on aquatic ecosystems due to temperature rise heavy rain
4	Heavy rain Precipitation increase	In land water-streams Nearby basin	Flooding risk Increased amount of evapotranspiration and runoff in streams Increased flood damage	Increased flooding and watershed flood damage due to heavy rain
5	Temperature rise Drought	Groundwater (streams, dams)	Reduction of groundwater in streams Lower the groundwater level	Reduction of groundwater in streams and dams due to temperature rise and drought
6	Drought	Groundwater	Groundwater quality degradation	Groundwater quality degradation due to drought
7	Temperature rise Drought	Stream facility	Reduction of water treatment plant capacity Reduction of Intake ability Reduction of Water use	Reduction of Intake ability due to temperature rise and drought

Adaptation Options for Climate Change Risk

- Linking Adaptation Options and Risk



Adaptation Options for Climate Change Risk

▪ Linking Adaptation Options and Risk

Risks	Adaptation Options
(Land) Land transportation suspension and increase in accidents due to heavy rain and snow	• Analysis of protection against heavy rain and snow shock for aging transportation facilities • Warning and operation of evacuation/blocking facilities for highways and railroad facilities in areas with high frequency of heavy rain and snow • It is necessary to maintain existing measures, and to strengthen predictability according to weather changes. • Reinforcement of areas at risk of collapse of steep slopes based on the results of disaster risk assessment and regular inspection of vulnerable slopes
(Water) Increased flood damage in rivers and basins due to heavy rain	• **Support for the establishment of a monitoring system such as real-time understanding of river water level and remote monitoring and control of drainage pumping stations to strengthen local government's ability to respond to floods** • **Diversification of urban flood response projects reflecting local conditions, such as the installation of deep rainwater storage tunnels** • **Increase the design frequency for water infrastructure** • **Establishment of artificial intelligence (AI) based flood forecasting platform**

III. Climate Change Adaptation & Resilience

3rd National Climate Change Adaptation Plan

-
  -
    - ✓
    - ✓ in habitually flooded areas
      (10~30 years →

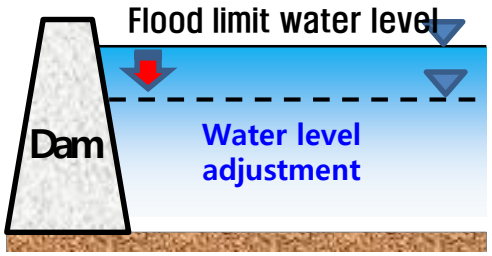
III. Climate Change Adaptation & Resilience

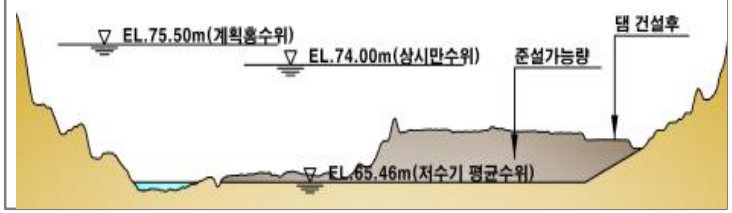
3rd National Climate Change Adaptation Plan

-
  -
    - ✓ 200 years →
    - ✓

Securing additional flood control capacity

Flood limit water level
Coordination pilot operation





<K-Water, Policy direction for watershed management in preparation for climate crisis, 2020>

III. Climate Change Adaptation & Resilience

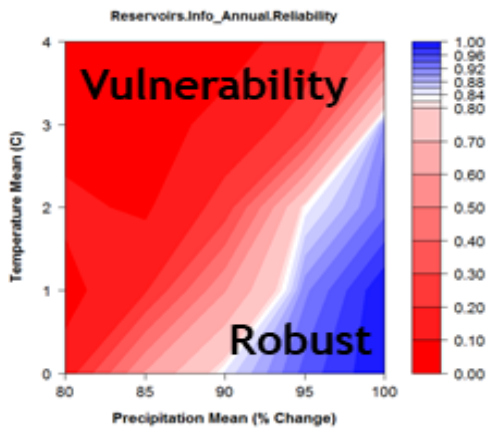
3rd National Climate Change Adaptation Plan

Sustainable flood management in preparation for climate change

- [redacted]
  - [redacted]
    - ✓ [redacted]
    - ✓ [redacted]

Climate change vulnerability evaluation for dam

Test-based dam vulnerability assessment by reflecting Future climate change



<K-Water, Policy direction for watershed management in preparation for climate crisis, 2020>

III. Climate Change Adaptation & Resilience

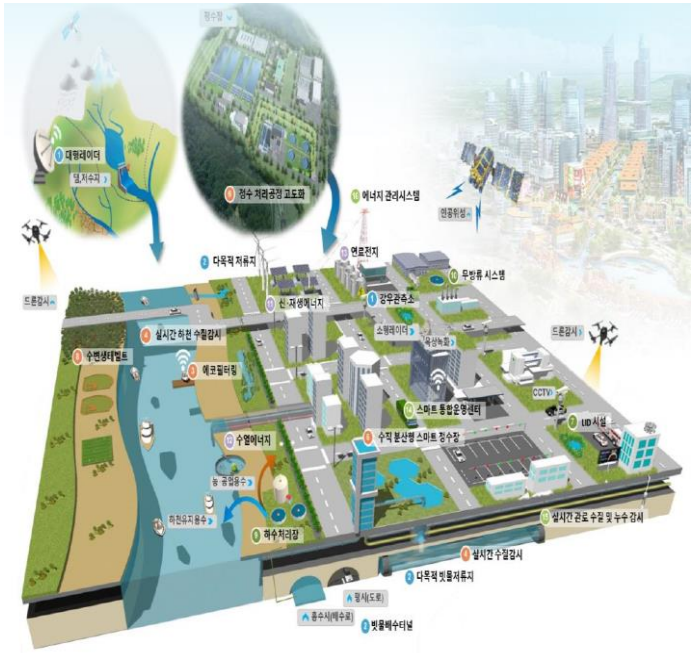
3rd National Climate Change Adaptation Plan

▪

- •
- ✓
- ✓ **Creating a** ‘water **safe city’**

Creating water circulation city

Connection of green-grey infrastructure
In urban area



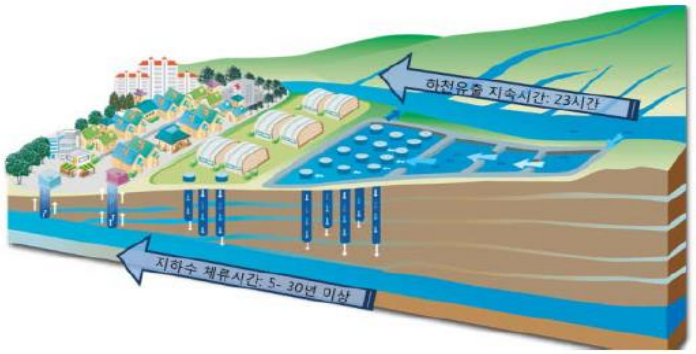
<K-Water, Policy direction for watershed management in preparation for climate crisis, 2020>

3rd National Climate Change Adaptation Plan

- ■
  - •
    - ✓

Flood storage using artificial reclamation

- Technics for linking artificial aquifer and reservoir
- Countermeasures for flood & urban water circulation



<K-Water, Policy direction for watershed management in preparation for climate crisis, 2020>

III. Climate Change Adaptation & Resilience

Efforts for Coping with Climate Change in Water Area

Involvement in CC response National Plan

- The 2nd National Climate Change Response Plan (2021~2040) : Top level plan
- The 3rd CC Adaptation Plan(2016~2020)
- Implementation of CC adaptation reporting system (2016)

Increase of existing dam flood control capacity

- 24 Dams, 2003-2025, 1.9 Billion US$
- Construction of emergency spillway,
- Installation of parapet wall, etc.

Emergency waterway construction

- Response to local drought and resolution of water imbalances('14~'15)
- Boryong Dam : 115,000㎥/day, 금호강 : 127,000㎥/day

Strengthening CC research and forecasting capabilities

- Establishment and operation of the National Drought Information Center('17~)
- Proceed drought forecast analysis, vulnerability map production
- Study on the vulnerability of water resource facilities based on climate stress test

Reduction of carbon emission, use renewable energy

- Operation of tidal power plant(Capacity 1,364MW)
- Securing 466,000 tCO2 CDM per year
- Improve the flow rate, through local waterworks efficiency projects and modernization projects

IV. Conclusion

KEI

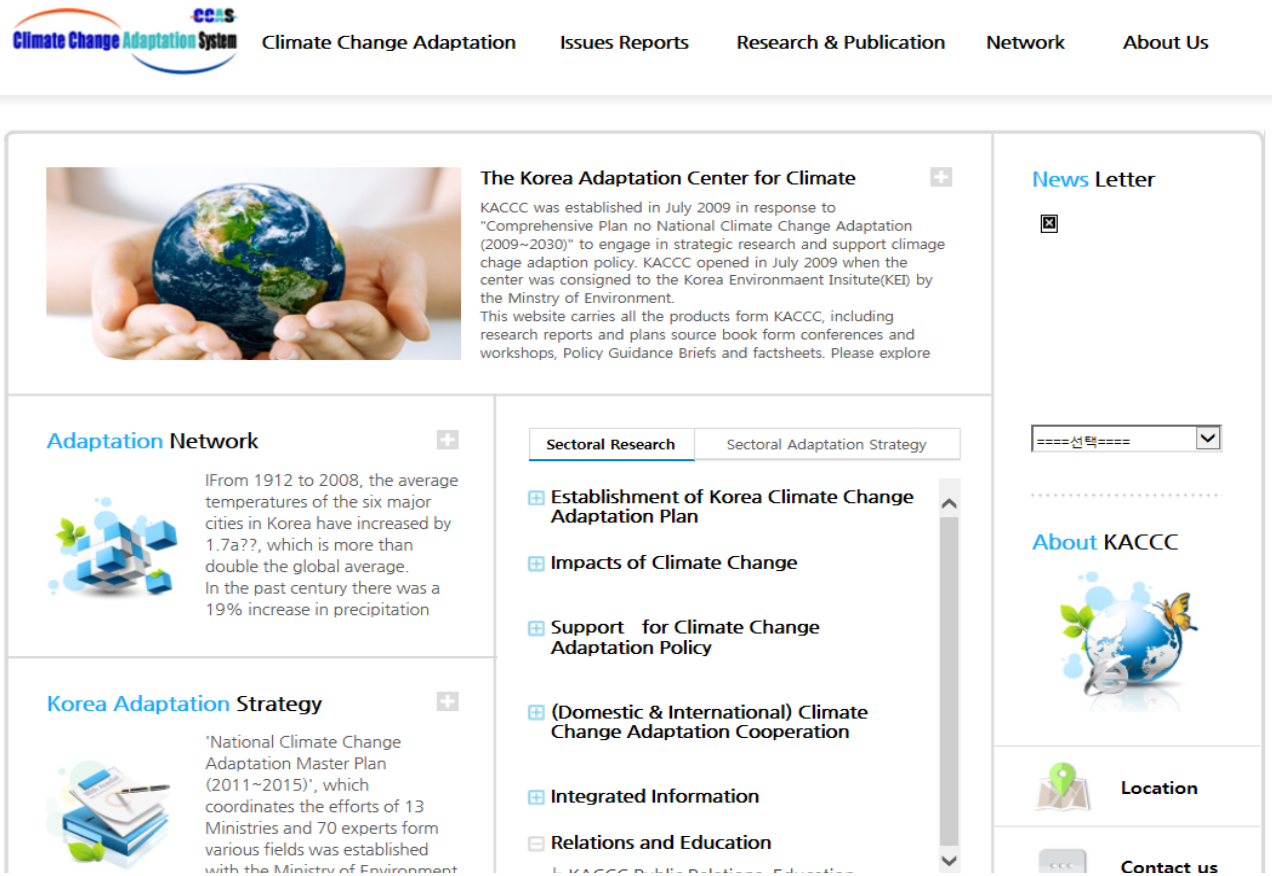
IV. Conclusion

➢ Way forward/ Recommendations

- Build capacities for implementing adaptation plan
- Need for coordinated spending on CCA
- The key to enhance adaptation action is through clear and coordinated multi-sectoral involvement and participation
- Ensuring good governance through monitoring, evaluation and capturing feedbacks in the project cycle
- Need to consider co-benefits
- As risk continues to change, so must the planned response

Thank you for your attention

yisong@kei.re.kr
https://www.kei.re.kr/eng/



KEI Korea Environment Institute