Developing decision supporting systems for local adaptation planning in Korea

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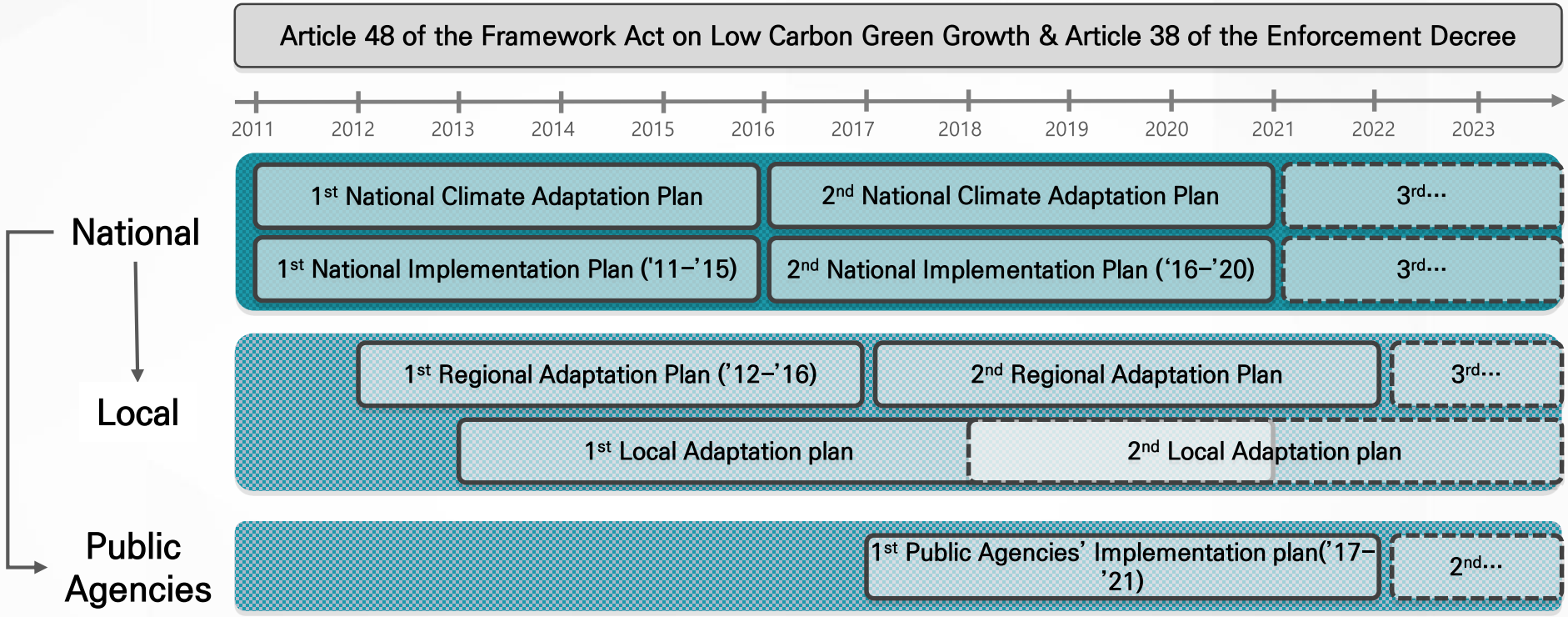
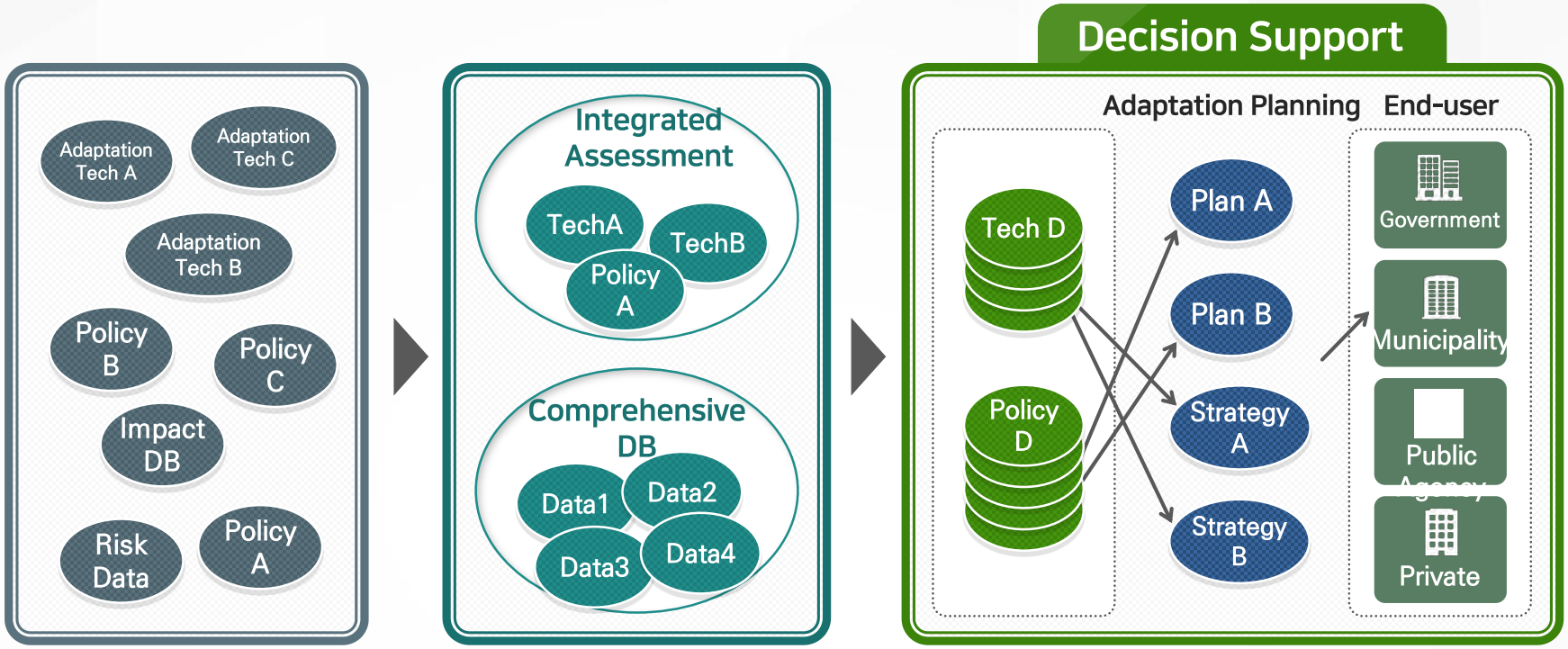
Background



Top-down governance / Lack of differentiation between institution levels / Lack of stakeholder participation / Lack of tools for decision-making

Project Aim



Q How can we increase the effectiveness of national and local climate change adaptation planning and implementation?

A A decision support "system" that includes both information and tools for adaptation planning is needed for national and local governments

Project Scope

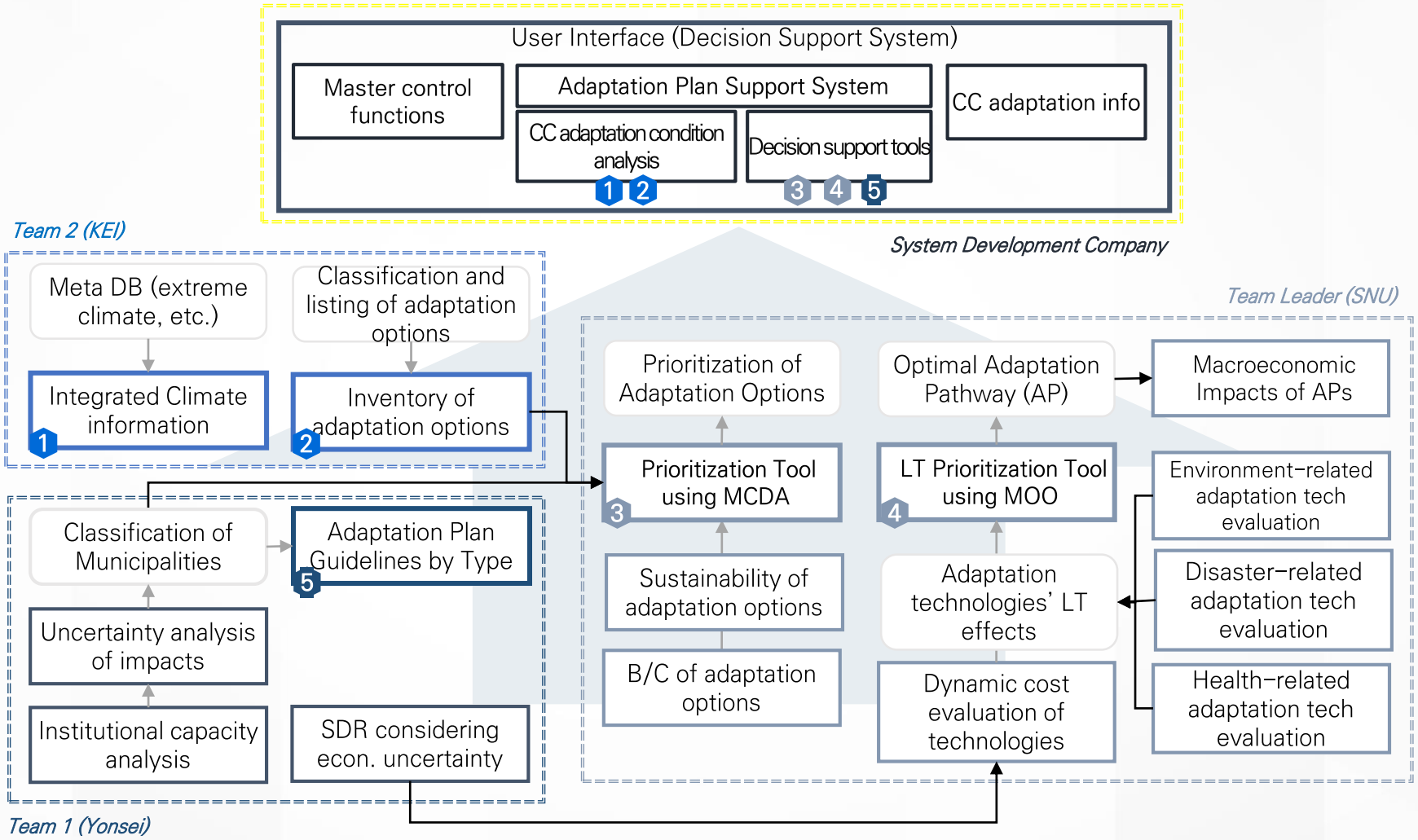
- **Decision support tools considering different levels of municipalities**
  - Relative prioritization of adaptation options using MCDA (Tier 1,2)
  - Quantitative analysis of selected adaptation options' effects (Tier 3)

- **Integrated Adaptation-related DB and Inventory**
  - Collect decentralized climate adaptation information
  - Detailed inventory of adaptation technologies and policies

- **Quantitative and scientific evaluation of adaptation measures and decision support methods**
  - Modeling effectiveness and dynamic cost evaluations of adaptation options
  - Decision support tools using optimization algorithms

- **Decision support considering uncertainties**
  - Improving reliability of decision support
  - Localizing decision support to better adjust to uncertainties

Project Flow



Adaptation Planning Decision Support System Architecture

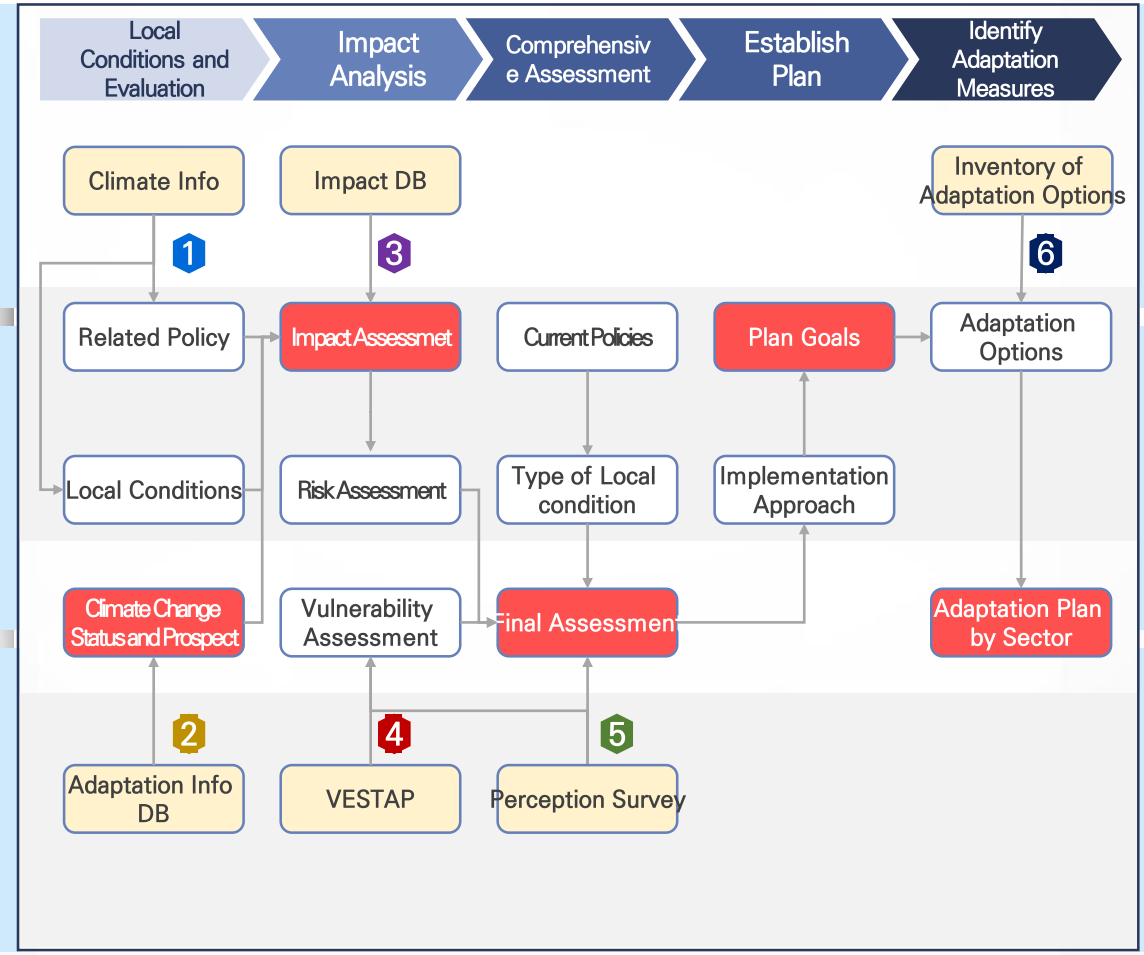
❖ System Features

- Decision support tools for each step of Korea's adaptation planning protocol

Support 1
- Check climate change information
- Query of future climate stressors and local risks

Support 2
- Query of adaptation information
- Adaptation information of local government

Support 3
- Information on local climate impacts
- News articles, disaster yearbook, etc.



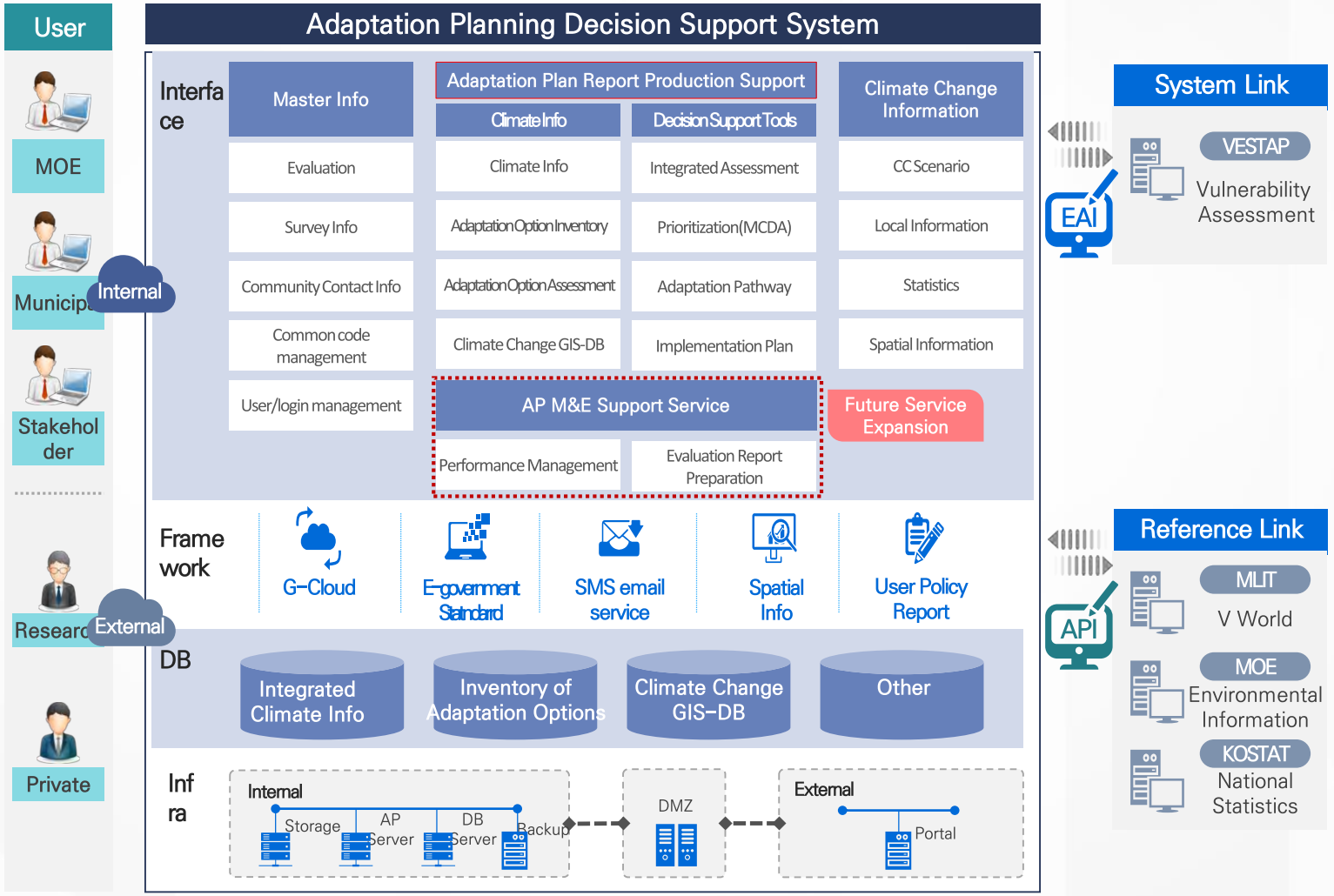
Support 4
- Search vulnerability assessment results derived from VESTAP

Support 5
- Perception survey of citizens on climate impacts, adaptation measures

Support 6
- Search for detailed adaptation options
- Select based on priority of sector

Adaptation Planning Decision Support System Architecture

❖ Integrating System with Larger network of Planning Support Tools



Framework for Integrated Assessment of Adaptation Measures

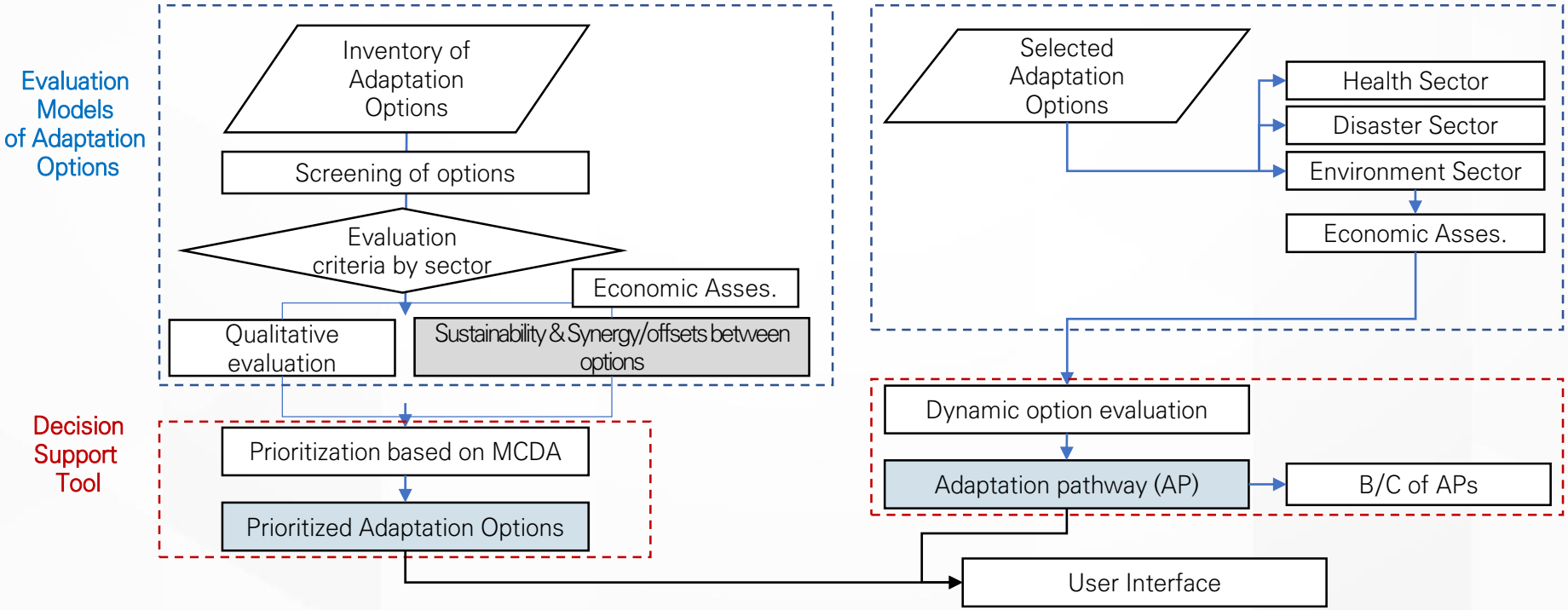
❖ Scope and Methods

Tier 1,2

- By utilizing TOPSIS among other MCDA methodologies to provide an adjustable prioritization model applicable to all regions and sectors.
- TOSPSIS is capable of interpreting the semantics of the results and has fewer rank mismatch problems and consider the correlation between evaluation criteria

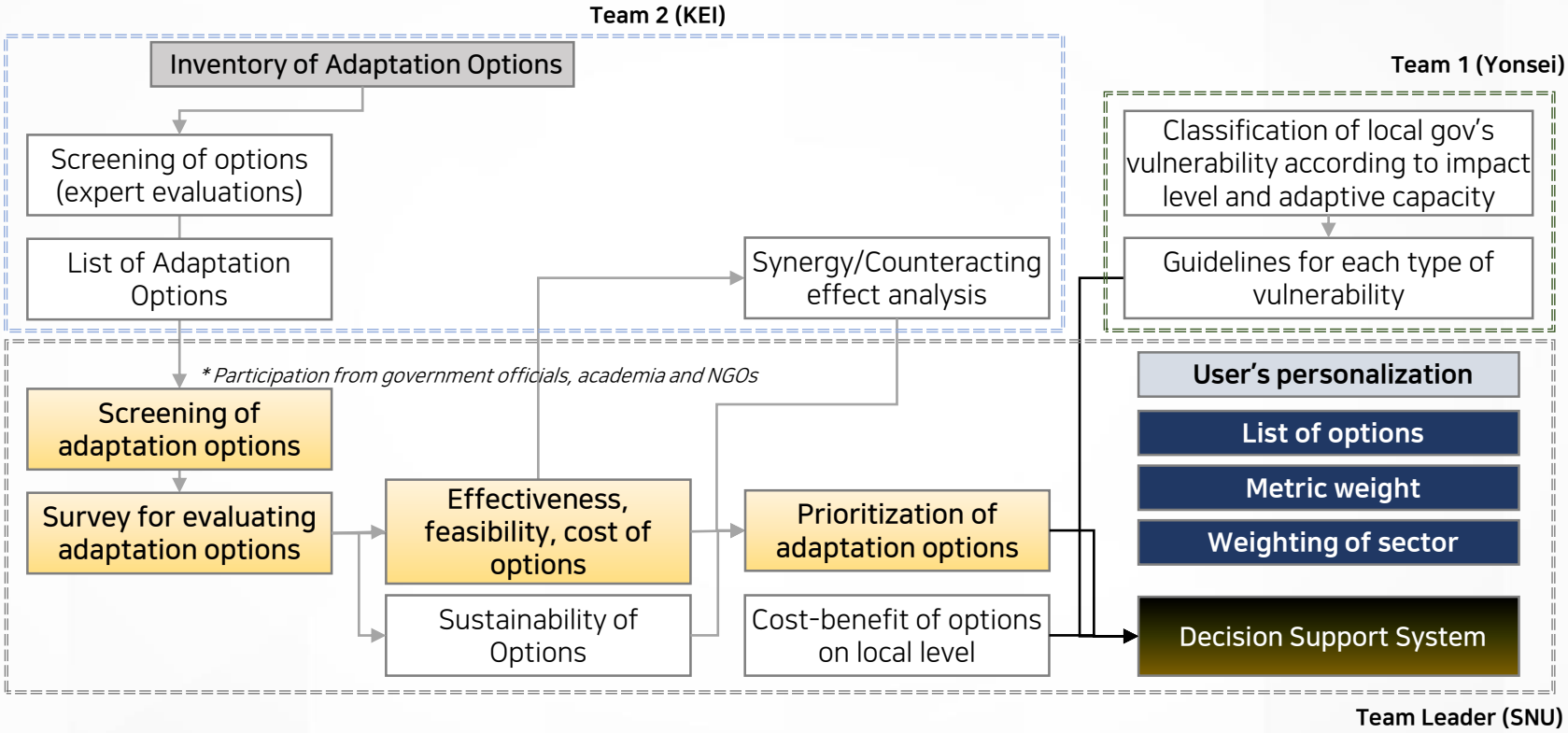
Tier 3

- Establish a model that derives optimal adaptation pathways using multi-objective optimization algorithm that considers multiple sector impacts and constraints across time



Framework for Integrated Assessment of Adaptation Measures

❖ Detailed Method of Prioritizing Adaptation Options using MCDA (Tier 1,2)



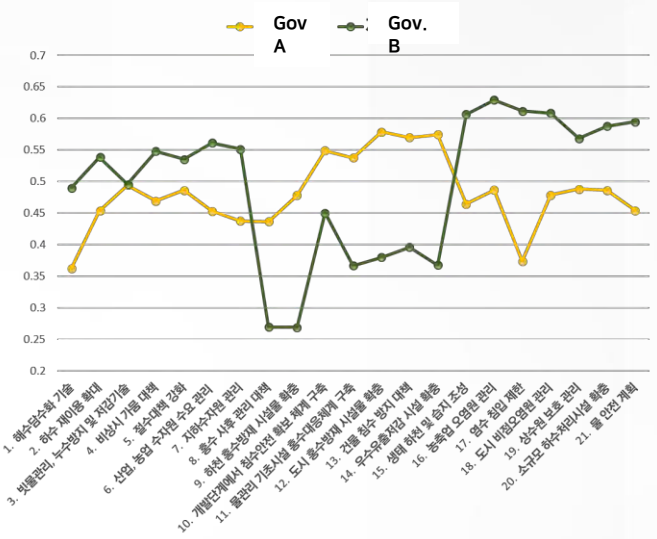
- Tier 1 & 2 prioritization of adaption options first requires a technical inventory and screening of options, then a evaluation criteria is setup for experts to use to assess options. Apart from traditional evaluation criteria, adaptation options are evaluated on their sustainability and local context specified cost-benefit analysis

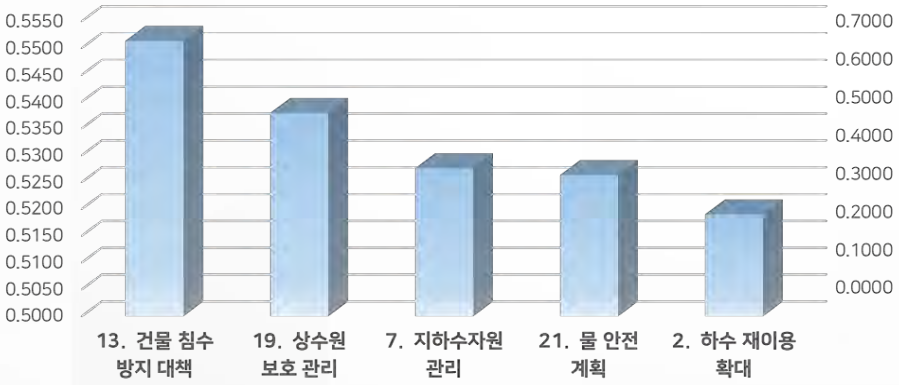
Method for Prioritizing Adaptation Measures (I)

❖ Example of Prioritization Results

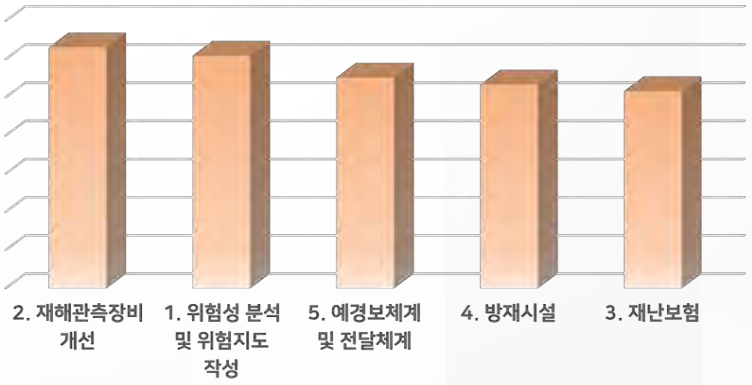
Tier 1,2

- Prioritization of each sector is based on evaluation criteria:
  - impact reduction effect, other sector impact reduction effect, carbon reduction effect, non-climate effect, urgency, feasibility, and sustainability
- Priority varies according to the characteristics of local government as shown in the figure on the right
  - Municipality A, located in coastal areas, has a high priority for flood policy, while municipality B, where ecological reserves occupy a large area, has high priority for water quality and aquatic ecosystem policy





< Prioritized Water Sector Adaptation Options >



< Prioritized Disaster related Adaptation Options >

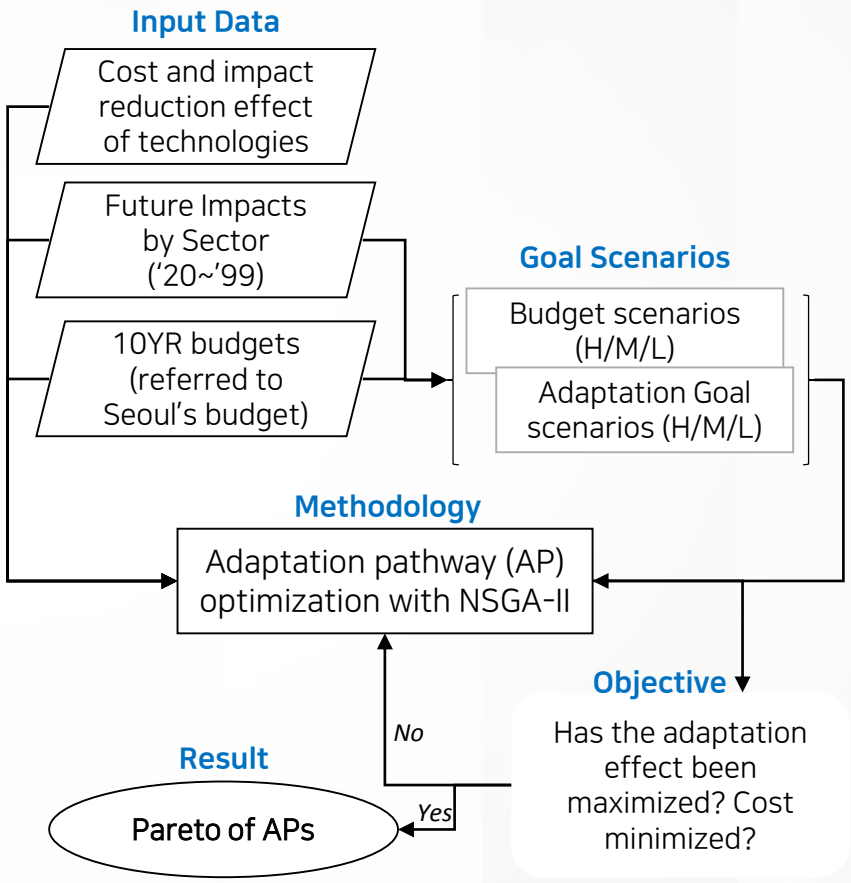
Method for Prioritizing Adaptation Measures (I)

❖ Prioritizing Adaptation Options using Adaptation Pathways (Tier 3)

Tier 3

- Optimal adaptation pathways are derived based on the results of the technical evaluation team, impact assessment data and constraint scenarios

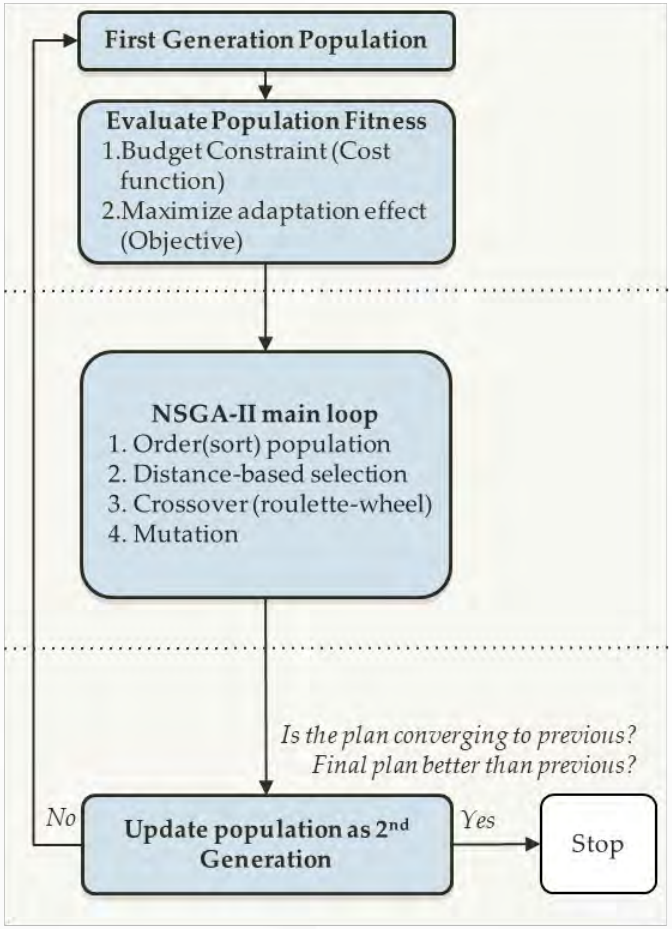
- Machine learning based multi-objective optimization algorithms, GA and NSGA-II algorithms, were applied to search for the optimal plans that minimize the cost and maximize the adaptation effect by sector for each 10 year planning periods

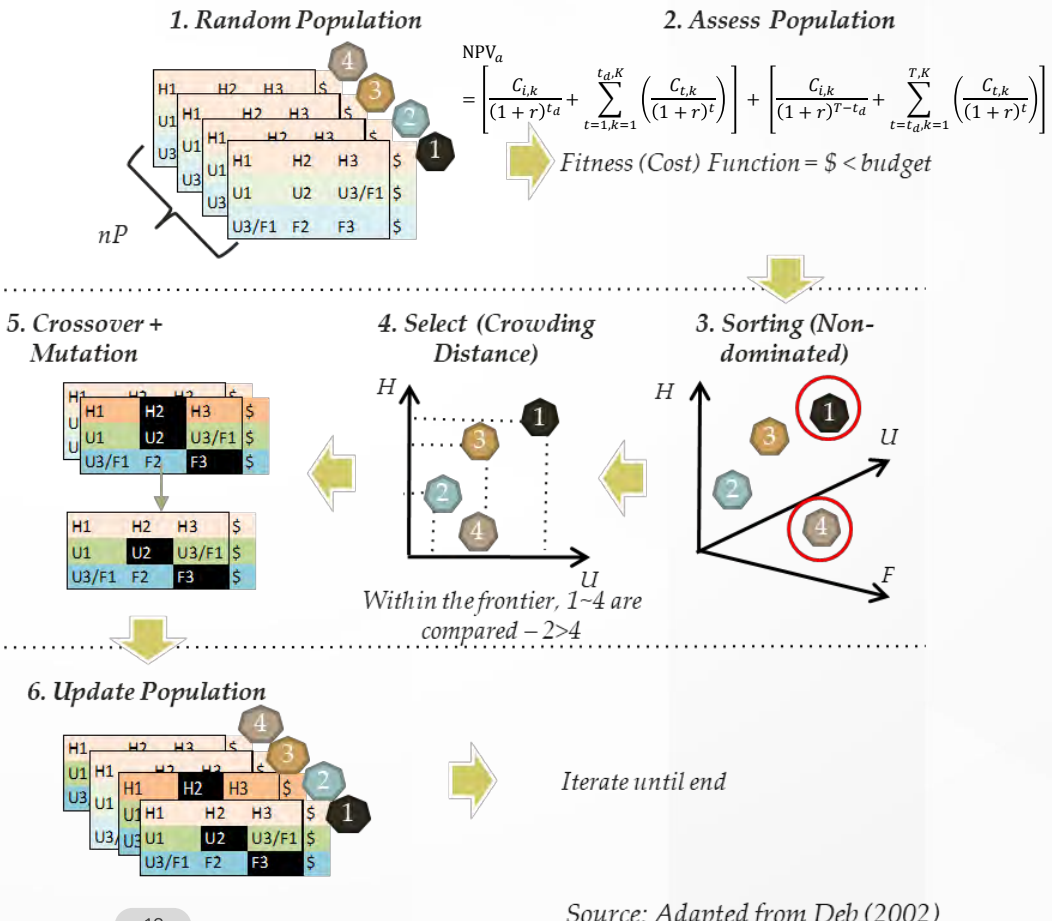


Method for Prioritizing Adaptation Measures (I)

❖ Application of Optimization Algorithm to search for Adaptation Pathways (Tier 3)

- Machine learning based optimization allows for efficient heuristic search of optimal plans based on set parameters
- Non-dominated Sorting Genetic Algorithm (NSGA-II) disintegrates the multi-objectives to separately but also considering the balance of maximizing the objectives



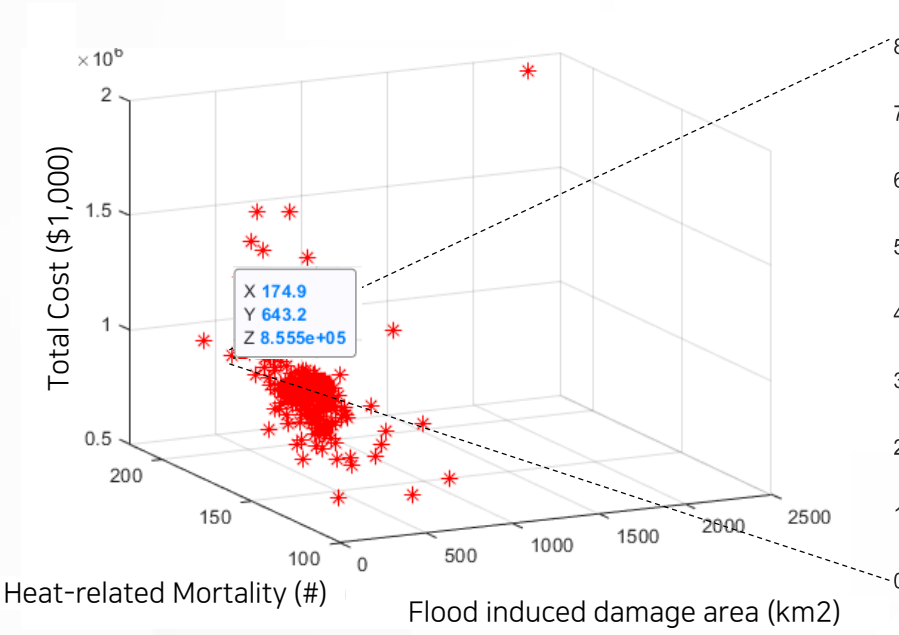


Source: Adapted from Deb (2002)

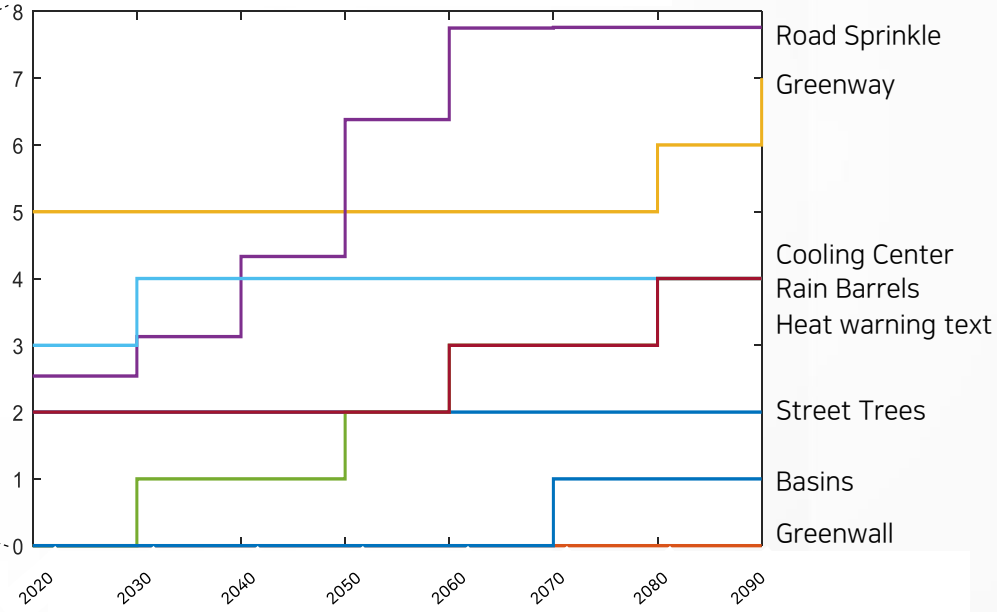
Method for Prioritizing Adaptation Measures (II)

❖ Simulation Results

- The results of optimizing 100 different adaptation pathways through 1000 iterations for each scenario show various costs and adaptation effects
- Figure 1 shows the total adaptation effects and costs of adaptation pathways that converge from optimization
- Figure 2 shows an example of the implementation scales of technology in a sample adaptation pathway



<Figure 1> Convergence of Optimized Adaptation Pathway(AP)s

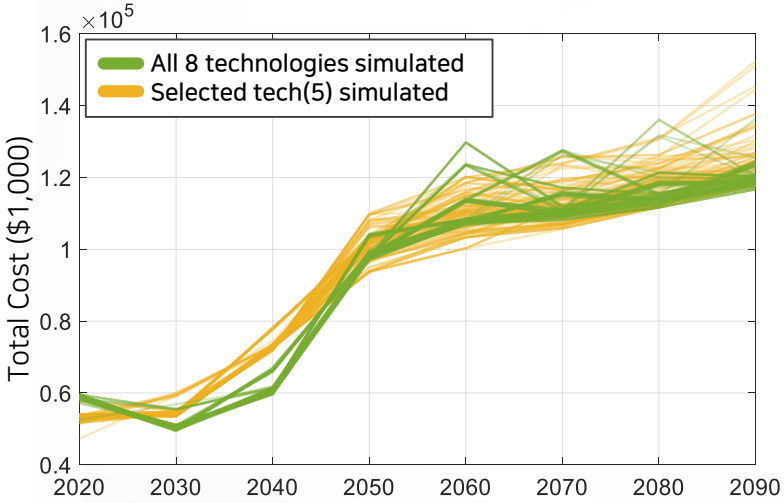


<Figure 2> Implementation Scale of Adaptation Measures across Time for sample AP

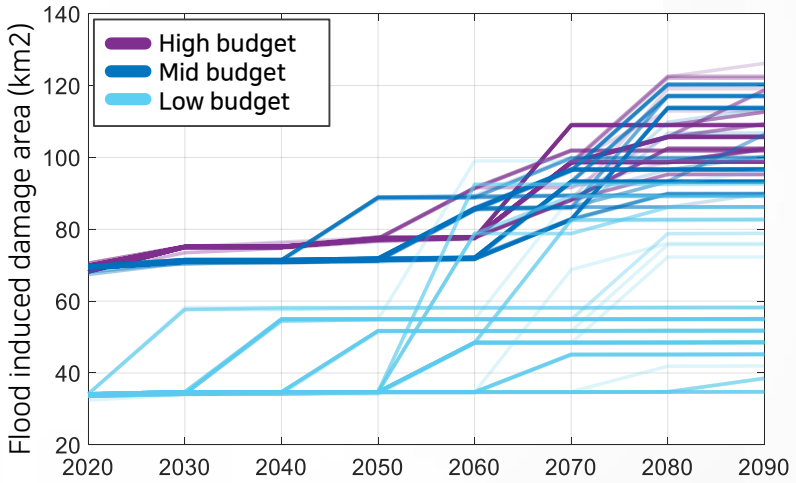
Method for Prioritizing Adaptation Measures (II)

❖ Simulation Results

- <Figure 3> shows the cost differences of the adaptation paths when the adaptive technology is selectively applied
- <Figure 4> shows the difference in the adaptation effect (e.g. flood damage area) over time due to the difference in the timing of technology implementation according different budget constraint scenarios (high/mid/low).



<Figure 3> Total cost of APs with different assortment of technology



<Figure 4> Adaptation effect based on budget constraints

- This model has been developed so that optimal adaptation plans can automatically feedback user preferences – change sector priority of adaptation effect and/or budget constraint limits
- Adaptation effects and costs can be identified by checking the timing and scale of the adaptation measures included in optimized adaptation pathways

Local Government Forums

- A series of forums have been is held to gather feedback on the decision support system from future users (local officials and experts)

1. Confirm the necessity of the decision support system: solve the lack of expertise of government officials (or subcontractor) responsible for creating adaptation plans, reduce the budget for outsourced adaptation planning, etc
2. Feedback on the Decision Support System so far:

① Develop "reliable climate information" and "standardized assessment tools" to establish climate change adaptation plans
② A system of automated report creating and submission through the support system is attractive
③ Create opportunities to network with other local government officials - local government forums; This will improve the use of the support system and be an opportunity to share opinions among local officials

❖ Busan city Forum (2019/2/11)

❖ Incheon city Forum (2019/9/24)

❖ Chungcheong Province (2019/10/25)

Thank you