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The Vulnerability Assessment for Local Adaptation to Climate Change in Korea

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Contents

- **Climate change** brought about various changes. Such as …
  - ✓ a rise in **temperature and sea level**
  - ✓ an increase in **precipitation**

- IPCC advised **the importance of adaptation measures** to minimize negative effects by climate change.

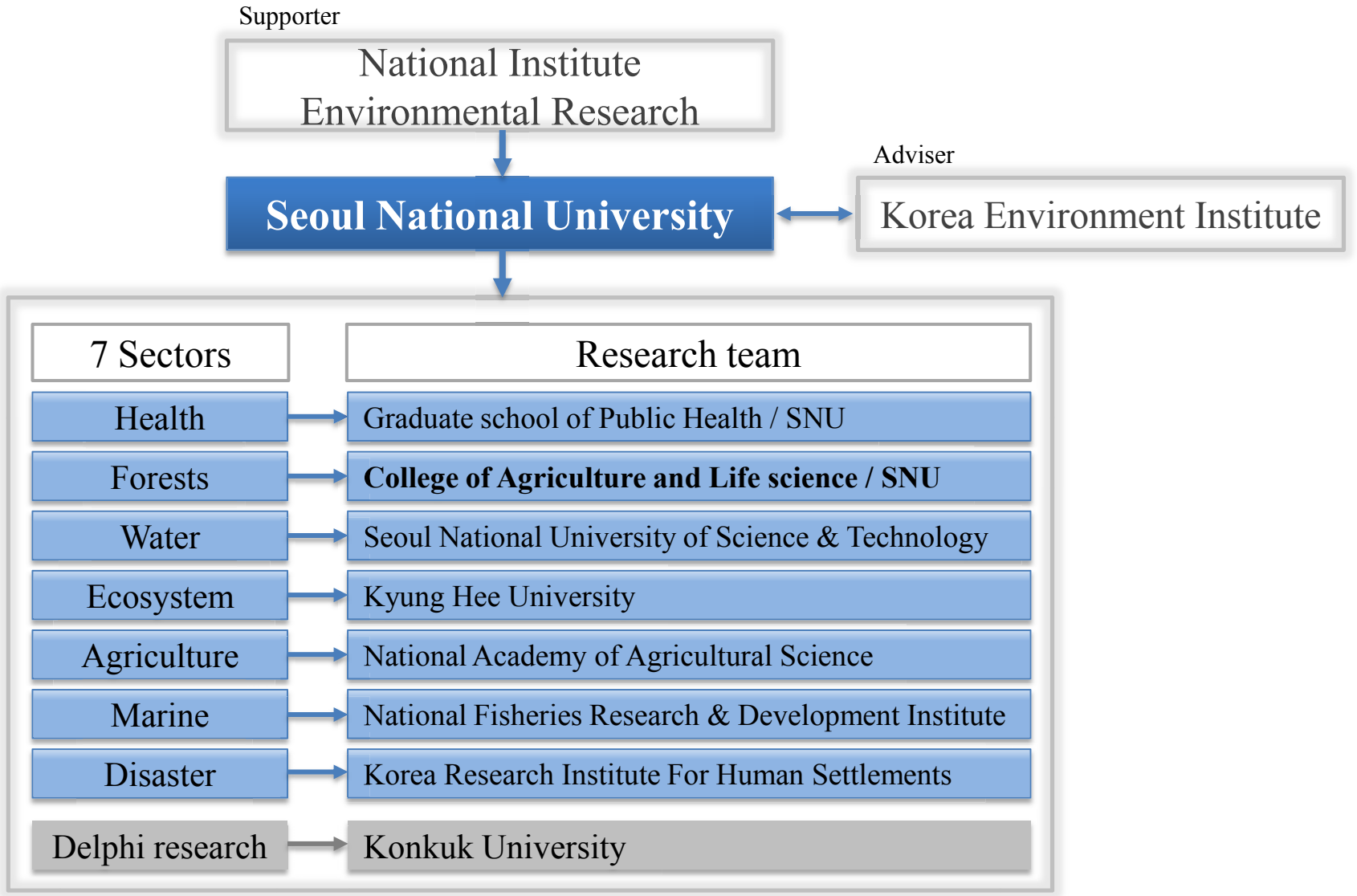
- The Republic of Korea established **the national adaptation measures** to respond climate change.

- Then the government demanded that **local governments establish detailed adaptation plans**.

- However, local governments have **limitations**
  - ✓ a lack of **funds**
  - ✓ a lack of **human resources**.
- Therefore, the **governments should supply** local governments with funds and human resources.
- Also, **government should assess vulnerability** of important sectors and **provide the result** to local governments.
- Vulnerability assessment is very **important for local governments**. Because, local governments can use the results to **demand financial assistance** and **distribute funds**.

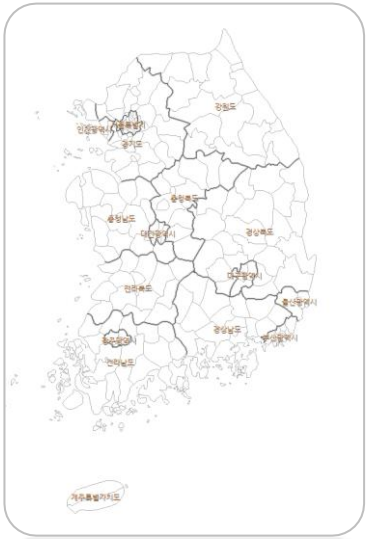
Contents

✓ Organization



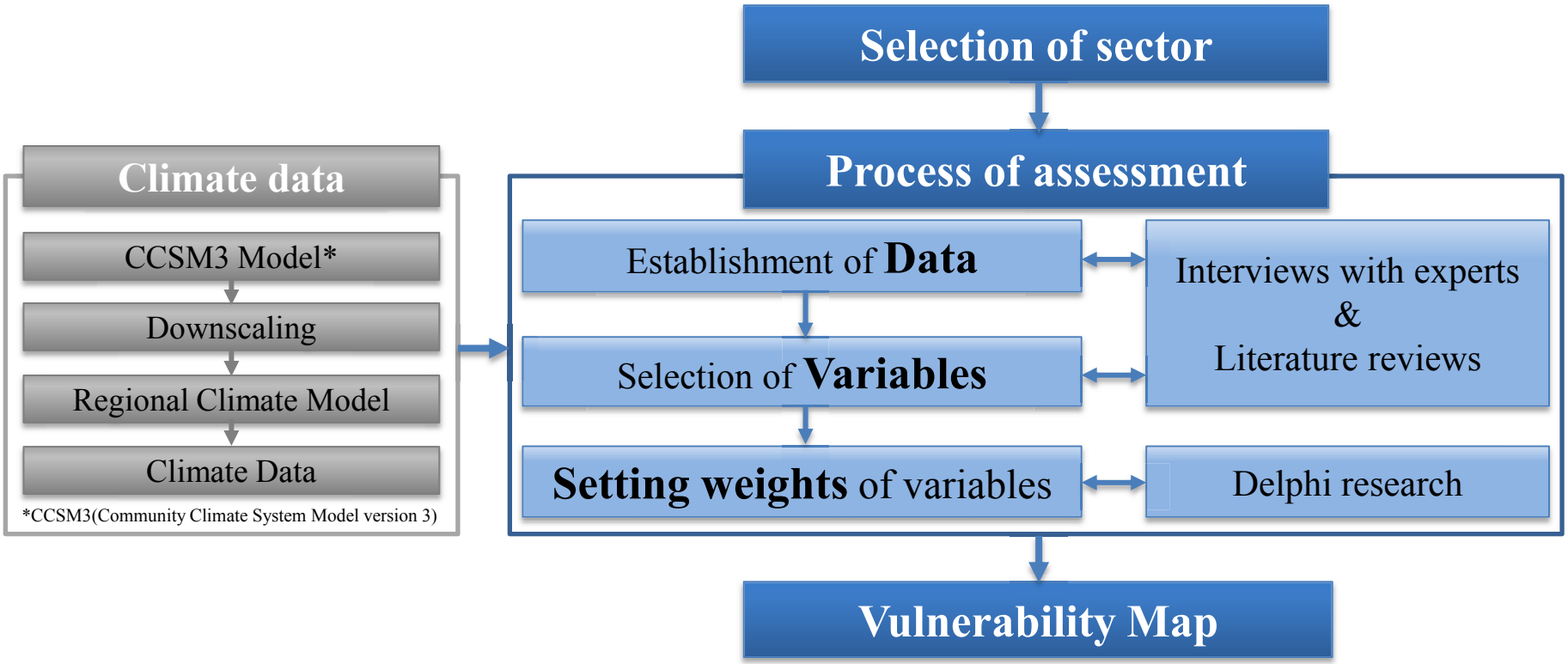
✓ Scope of study

- Spatial & Temporal scope
  - **232 local governments**(city).
  - Present : 2000 (Average of 1996~2005)
  - Future : 2020, 2050, 2100
  - Scenario : **A1B scenario** (SRES)
- Period of study
  - **April to November, 2011**
- Sector : Study consist of **7 sectors** and **32 items.**



Sector	Number of items	Name of items
Health	9	**Floods**, hurricanes, heat waves, infectious diseases…
Forests	7	**Landslide** caused by heavy rain, **forest fires**, forest vegetation due to drought…
Water	3	**Water management**(treatment, utilization)…
Ecosystem	5	**Tree growth and distribution**, insects…
Agriculture	3	**Soil erosion of cropland**, vulnerability of rice and apples…
Marine	1	Vulnerability of **fisheries**…
Disaster	4	Vulnerability of **infrastructure to sea level rise**
Total	32	

✓ Process of vulnerability assessment



✓ Vulnerability formula (UNDP, 2005)

Vulnerability = α × climate exposure + β × sensitivity - γ × adaptation ability

(α, β, γ is weight)

✓ Workshops & Meetings

- We had several **workshops** with local government officials and experts.
- Through the workshop, we got **various comments** and applied it to our research.
- Also, we had **internal meetings with researchers** to communicate each other.

Workshop for local government officials

Internal meeting with researchers

Contents

✓ Example of results : variables and weight

- "Delphi research with 56 experts" ▶ **Weight of variables**
- An example of landslide by heavy rains.

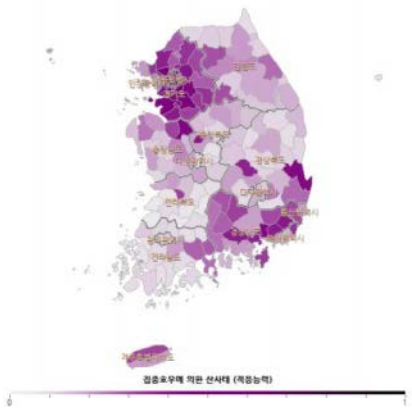
Item	Variables	Weight	Lists of variables	Weight	
Landslide by heavy rains	Climate exposure	0.40	number of dates with over 80mm of precipitation	0.24	1
			daily maximum precipitation(mm)	0.39	
			summer daily precipitation(mm)	0.21	
			5 days of maximum precipitation(mm)	0.16	
	Sensitivity	0.37	average slope of regional forest(degrees)	0.35	1
			area of coniferous forest(ha)	0.24	
			average height of regional forest(m)	0.12	
			area of planned forest(ha)	0.29	
	Adaptation ability	0.23	government officials per population	0.20	1
			rate of managed land(ha)	0.24	
			GRDP(trillion won)	0.18	
			financial independence(%)	0.38	

✓ Assessment of vulnerability(example) : vulnerability of landslide by heavy rain

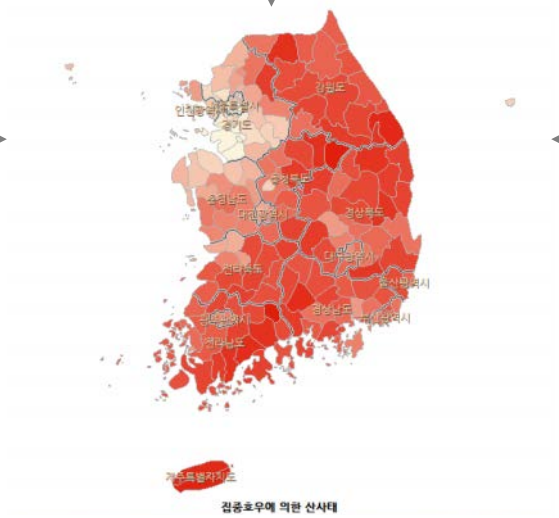
- Vulnerability is calculated by **Climate exposure, Sensitivity and Adaptation ability**.

Climate exposure

Sensitivity



Adaptation ability



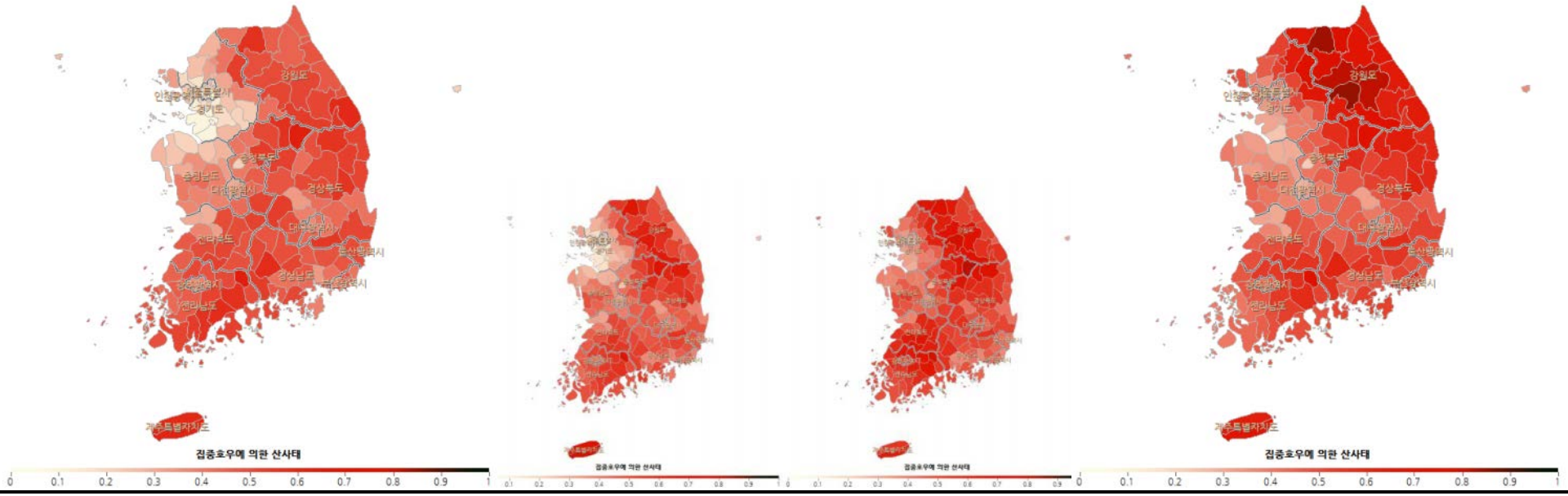
Vulnerability

Vulnerability =
α × climate exposure
+ β × sensitivity
- γ × adaptation ability

(α, β, γ is weight)

✓ Vulnerability map(example) : vulnerability of landslide by heavy rain

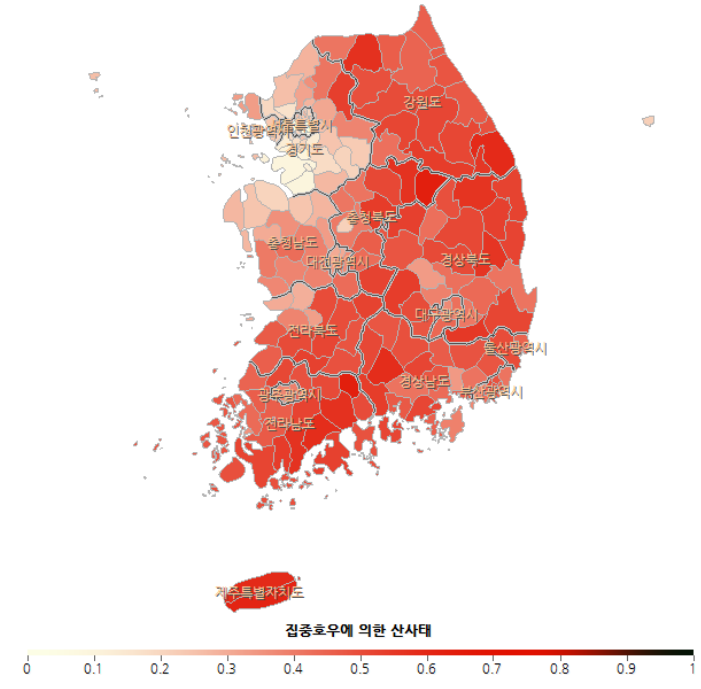
- The result of vulnerability of **landslide**. Areas of **darker red are vulnerable** to landslide.
- **Vulnerability in northeast area** of Korea is expected to increase in 2100.
- Thrugh the result, local governments can find importance of adaptation plans.



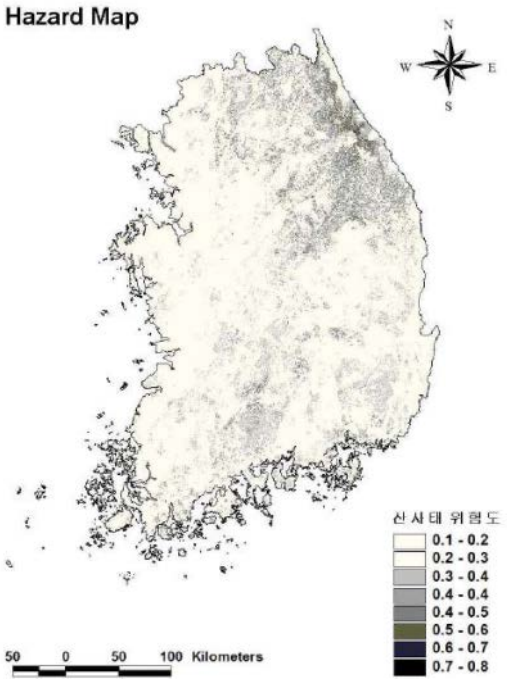
present 2020 2050 **2100**

✓ Verification of result(example) : vulnerability of landslide by heavy rain

- **Both maps** are the result of assessment for **vulnerability of landslide**.
- The right map is the result that was published on the Journal. The result is reliable.
- They show **similar trends** of vulnerability. Therefore, our result is also reliable.



Result of landslide vulnerability(present)



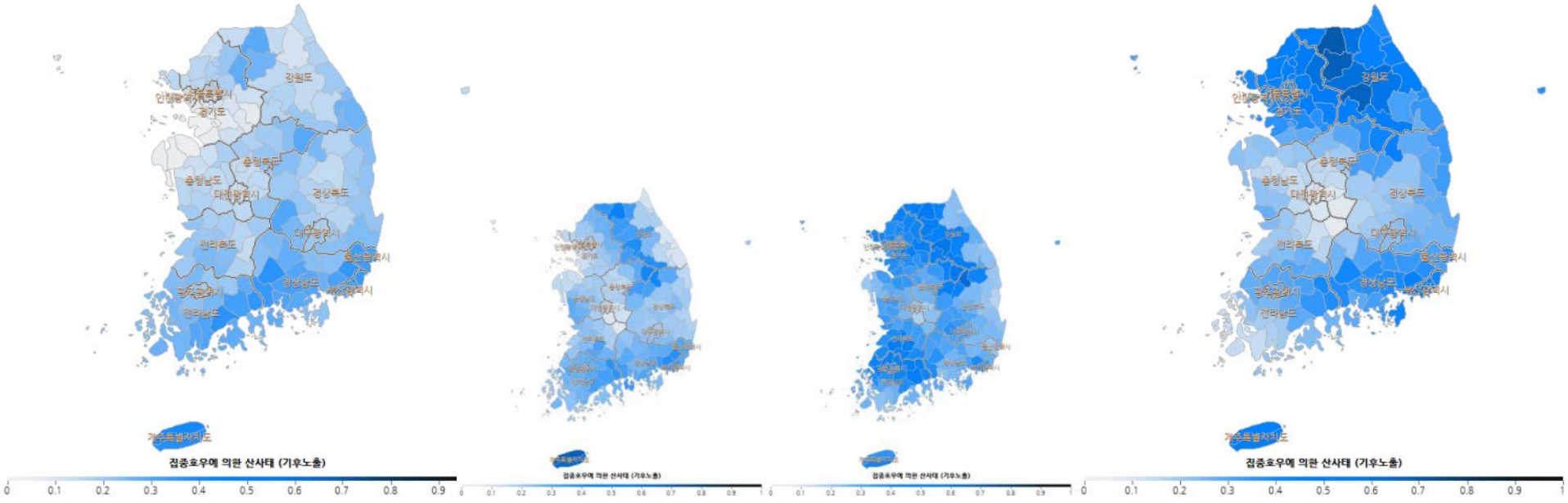
Hazard map of landslide(Yun et al., 2009)

✓ Climate exposure map(example) : vulnerability of landslide by heavy rain

- Variables of **climate exposure** consist of

  "Number of dates with over 80mm of precipitation,
  Daily maximum precipitation(mm),
  Summer daily precipitation(mm),
  5 days of maximum precipitation(mm)".

- Climate exposure is expected to increase in **northeast area**. It shows similar trend with vulnerability map.



✓ Construction of report

- The results were divided into 4 items(variables, map, statistical analysis and verification).
- Report includes **various maps** about present & future vulnerability.

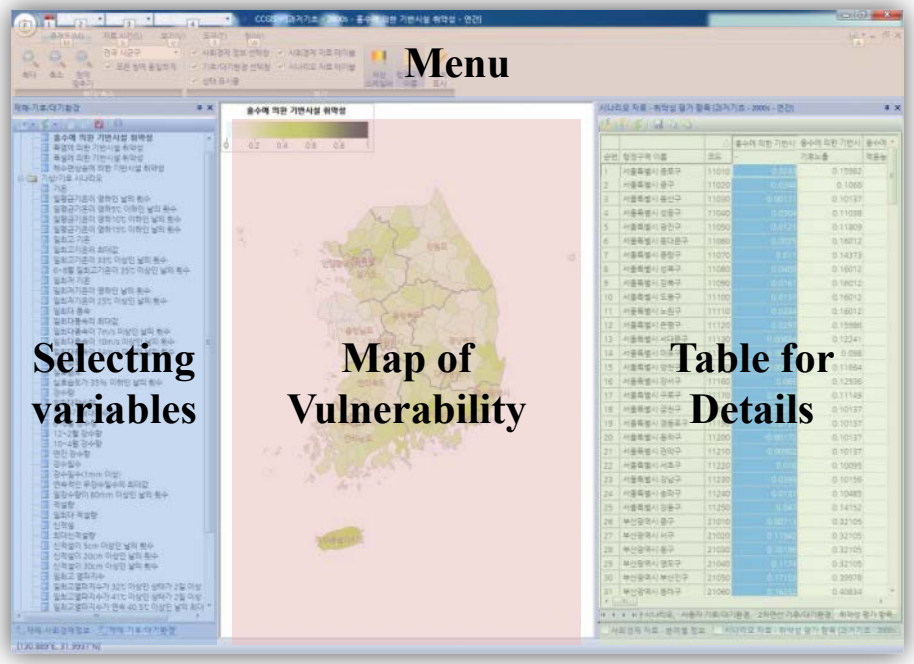
Classification	Contents	
1. Table of surrogate variables	Variables lists and Weights	
2. Map	**Present**	**Climate exposure**
		Sensitivity
		Adaptation ability
		Vulnerability
	Future	**Vulnerability**
		Climate exposure + Sensitivity
3. Statistical analysis	Rank of local governments vulnerability	
	Contribution analysis	
4. Verification of result	Comparing results with other study	

✓ Final report

- The report consists of 5 volumes.
- NIER distributed reports to local governments.

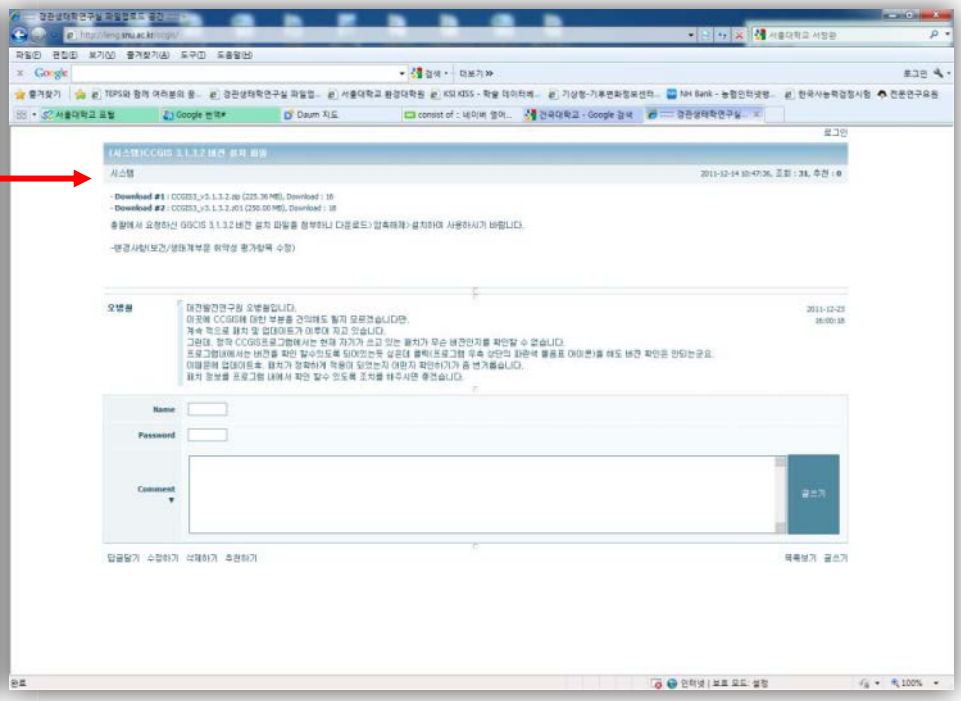
✓ CCGIS program

- CCGIS(Climate Change adaptation toolkit based on GIS) program was distributed.
- This program used to mapping vulnerability.



✓ Website for distribution

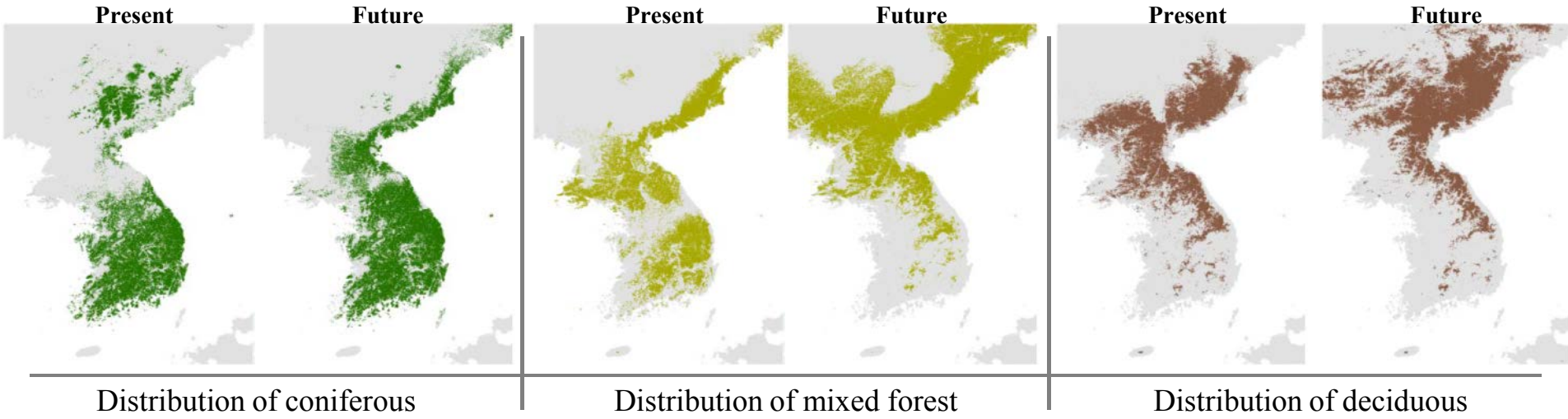
- Objective : Distribution of program and data.
- Additional effects : Sharing problems, Register of comments by local governments.
- [Website : www.snu.ac.kr/ccgis/](www.snu.ac.kr/ccgis/)



Contents

✓Results of quantitative methods : Prediction of distribution of forest types **(KEI)**

- **Examples of quantitative methods**.
- Prediction of distribution of forest types with MaxEnt model in other study.
- **More specific spatial data** and **absolute value of vulnerability** can be achieved.



- **Therefore,**

▶ Consideration about quantative methods.

▸ Establishment of database related to climate change.

※ MaxEnt Model : One of the most commonly used methods for inferring species distributions from occurrence data.

❖ Significance of study

- First attempt
  - ✓Assess vulnerability with the entire land of Korea.
  - ✓Assess 7 sectors which is important to respond to climate change.

- Supporting local governments
  - ✓Local governments can utilize the results to decide the priority of vulnerable sector and distribute financial assistance.

- Reflection of local features
  - ✓ This study used descriptive methods which is utilizing surrogate variables. Thus, local governments can modify the data which is used to vulnerability assessment.

❖ Future study

- Higher resolution : the unit of assessment is city and county. For that reason we achieved the result of a low-resolution. Thus, we need to assess more specific area.

- Establishment of data : we don't have enough data about entire land of republic of Korea. Therefore government of Korea should establish database related to climate change.

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Thanks for your listening

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Appendix

✓ Definition of surrogate variables

- To assess vulnerability, we used the surrogate variables which is classified as "**climate exposure, sensitivity** and **adaptation ability**".

- These variables are defined like below.

Surrogate Variables	Definition
climate exposure	climate change impact, such as, temperature and precipitation
sensitivity	climate change impact range or vulnerability impact, such as, slope, soil condition
adaptation ability	climate change impact reduction, such as, financial support and supporters

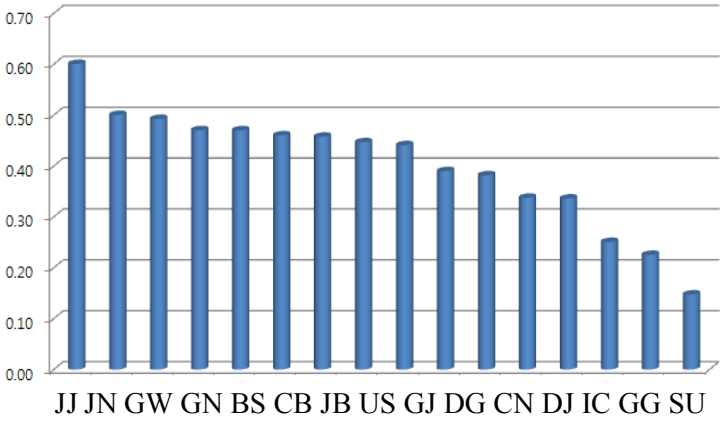
- We used this formula to calculate vulnerability.

- The formula refers to UNDP(2005).

$$\textbf{Vulnerability} = \alpha \times \textbf{climate exposure} + \beta \times \textbf{sensitivity} - \gamma \times \textbf{adaptation ability}$$

(α, β, γ is weight)

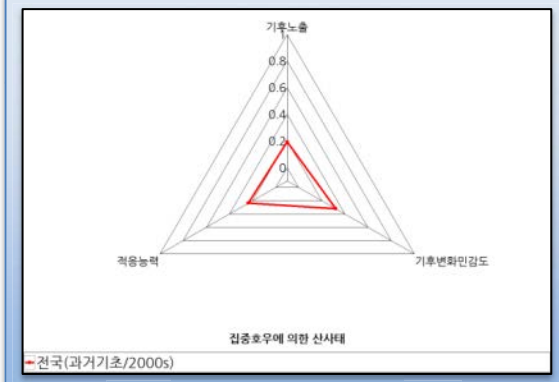
✓ Statistical analysis(example) : vulnerability of landslide by heavy rain



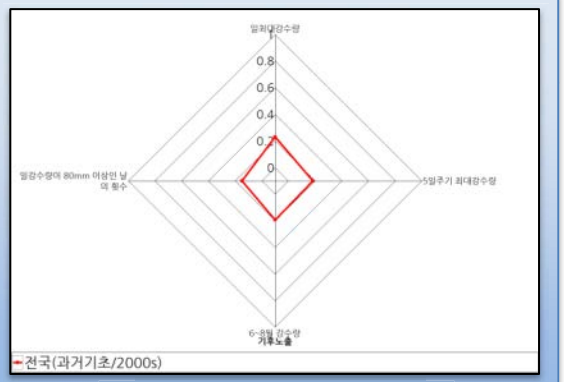
- A ranking graph was created to compare vulnerability among local governments.
- Local governments can get an information about the priority of vulnerable sector or item by getting relative vulnerability.
- Local governments can utilize this data to request and distribute budget.

✓ Statistical analysis(example) : vulnerability of landslide by heavy rain

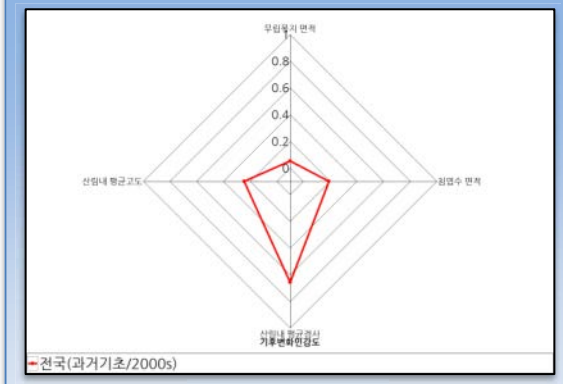
Vulnerability of 232 local governments



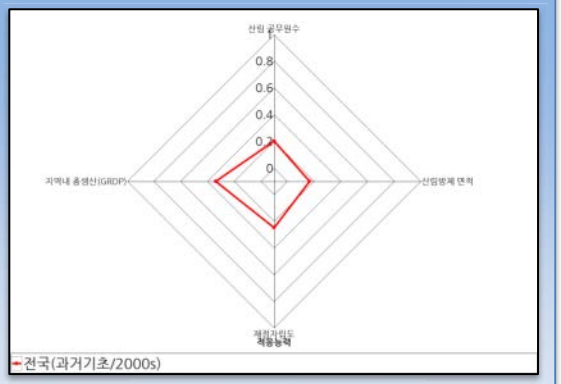
Vulnerability



Climate exposure



Sensitivity



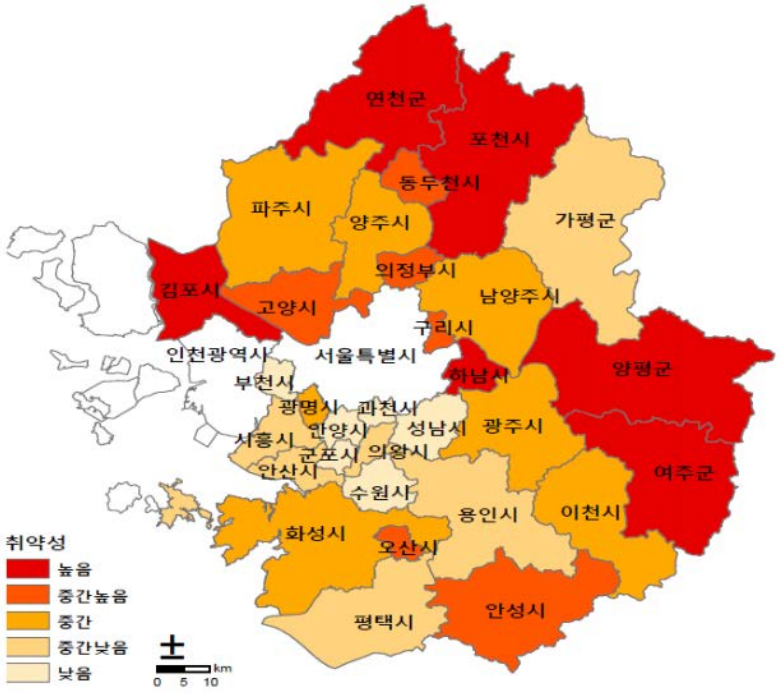
Adaptation ability

- A radial graph was created to identify the contribution of variables.
- Through the radial graph, we can get an information about contribution of certain variables.
- This graph shows average vulnerability of 232 local governments. We can also search an information about certain local government by using CCGIS.
- Local governments can find out vulnerable variables, therefore they can utilize this graph to establish adaptation plans.

✓ Comparison with **other study** : Assessment of vulnerability in Gyeonggi province

계층 1	계층 2		계층 3	
기후노출 0.163	호우	0.069	호우일수	0.009
			1일 최대강수량	0.029
			강수강도지수	0.029
	가뭄	0.044	연속적인 무강수일수 평균	0.014
			연속적인 무강수일수 최대값	0.029
	폭서	0.023	열대야일수	0.004
			일최고기온 33℃이상인 날 횟수	0.009
			열파지속지수	0.009
	해수면 상승	0.026	해수면상승정도	0.026
민감도 0.296	지리적 특성 및 토지이용	0.148	생태적 민감지역	0.020
			가뭄 취약지역	0.034
			홍수취약지역	0.068
			연안 침수 취약지역	0.034
	인구적 특성	0.074	인구밀도	0.010
			65세이상 인구 비율	0.017
			사회적 취약인구 비율	0.026
			기후민감질환자 발병률	0.020
	기반시설/산업	0.074	사회기반시설	0.040
			산업단지	0.017
			임물	0.016
적응능력 0.539	경제적 능력	0.109	GRDP	0.047
			경제성장률	0.015
			재정자립도	0.047
	물적 인프라	0.132	녹지	0.022
			하천개수율	0.019
			의료시설 확보율	0.033
			깨끗한 물에 대한 접근성	0.038
			통신	0.019
	사회적 자본	0.109	민관 파트너십	0.036
			시민의 기후변화 대응 역량	0.036
			공동체 의식	0.036
	제도적 역량	0.187	기후변화에 대한 지자체장의 관심	0.063
			재해 관련 사전예방 시스템	0.063
			적응정책 인력	0.031
			정책대응 수준	0.038

List of variables



Map of vulnerability to climate change

- Research institute in Gyeonggi province(GRI) performed vulnerability assessment in 2009.
- They didn't select specific sector and assessed overall vulnerability to climate change.
- GRI want to assess specific sector and we are supporting assessment of forest sector from last year.