

# The Vulnerability Assessment for Local Adaptation to Climate Change in Korea

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※ This study was supported by NIER

# **C**ontents

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**I. Introduction**

**II. Methods**

**III. Results**

**IV. Discussions & Conclusions**

- **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**.

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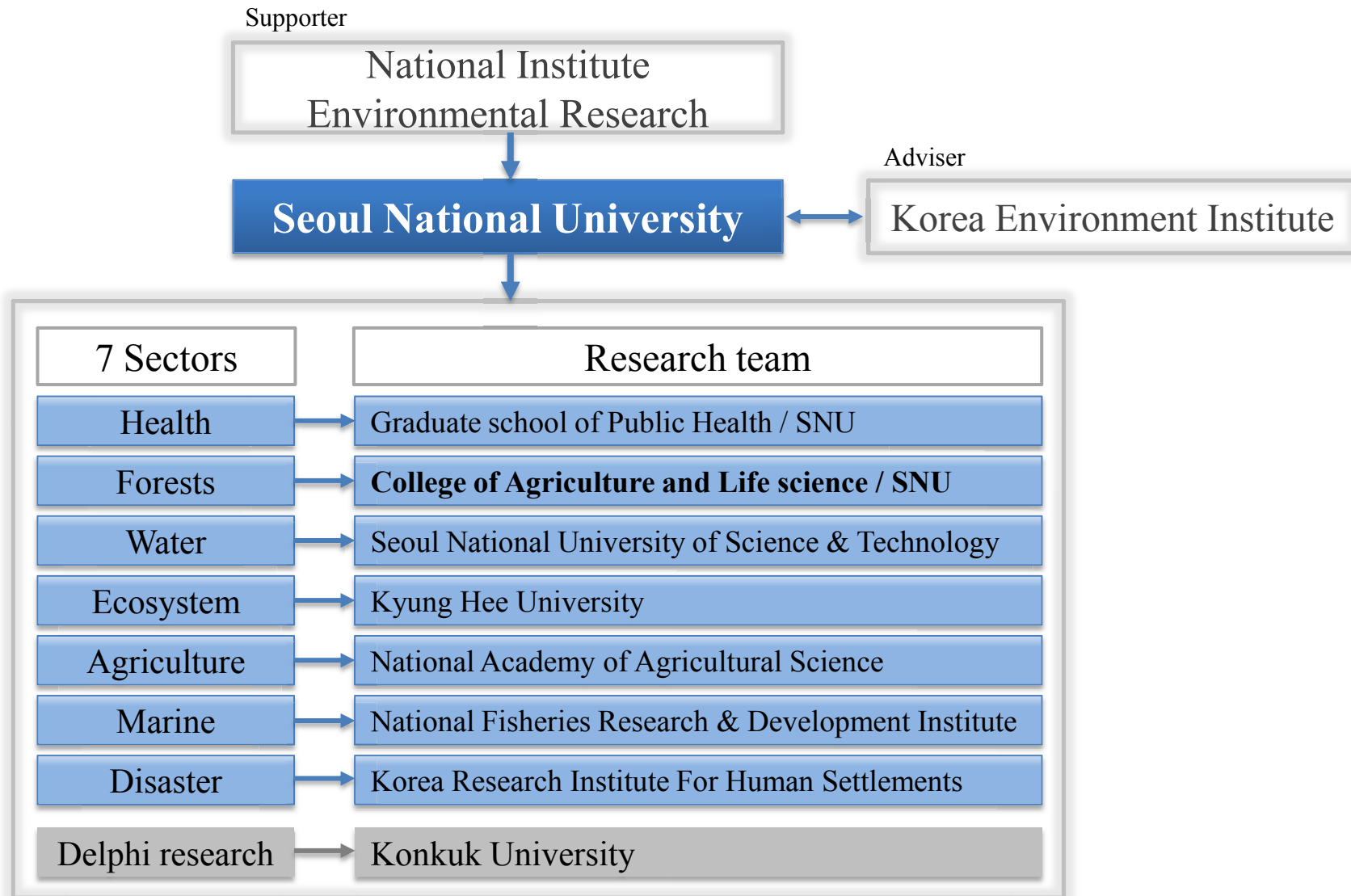
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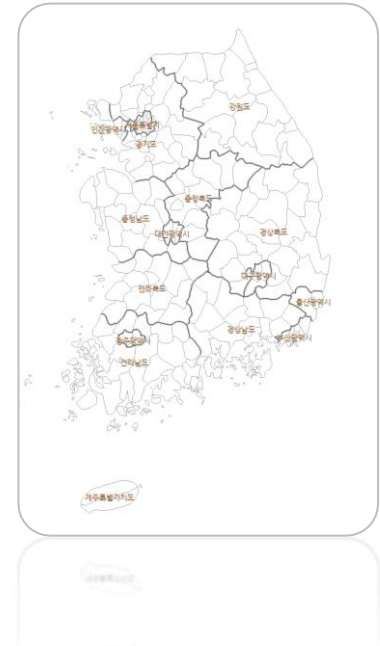
IV. Discussions & Conclusions

## ✓ Organization



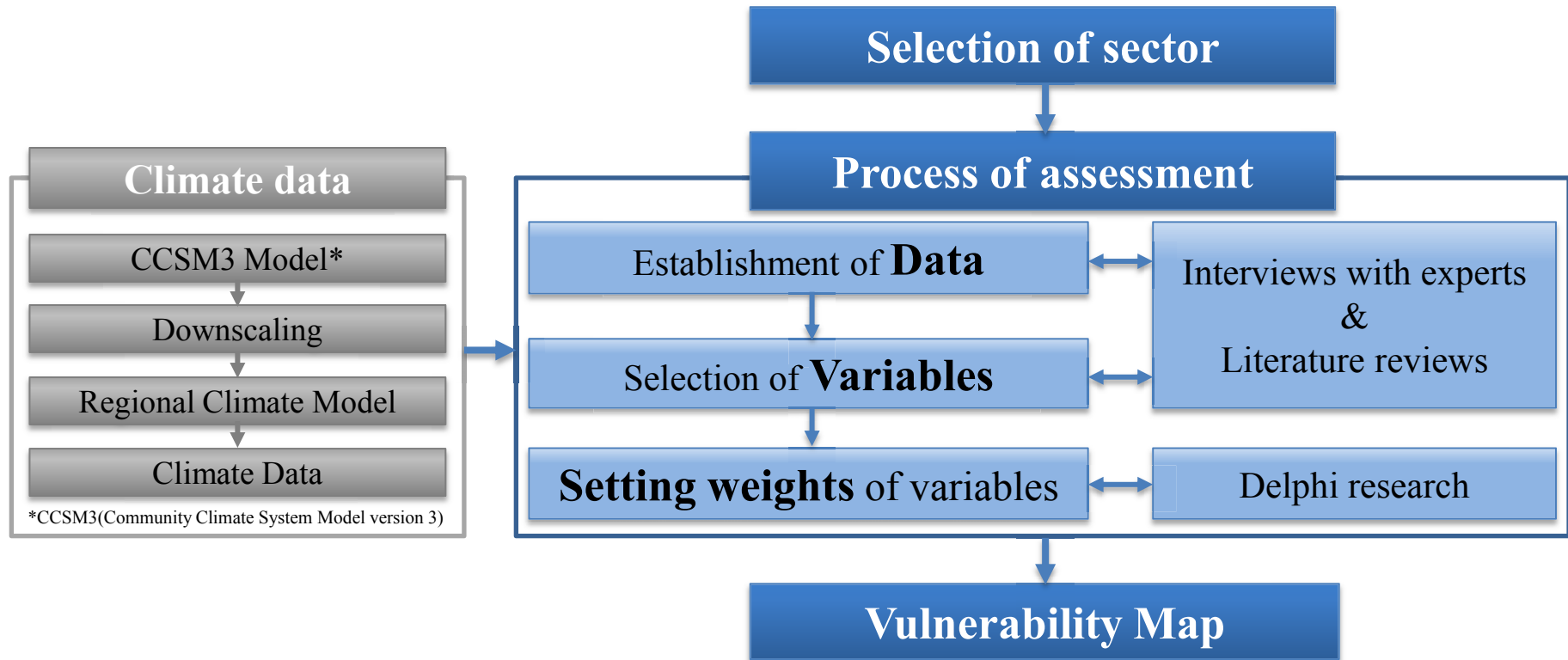
## ✓ Scope of study

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

## ✓ **Process** of vulnerability assessment



## ✓ **Vulnerability formula** (UNDP, 2005)

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

( $\alpha$ ,  $\beta$ ,  $\gamma$  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

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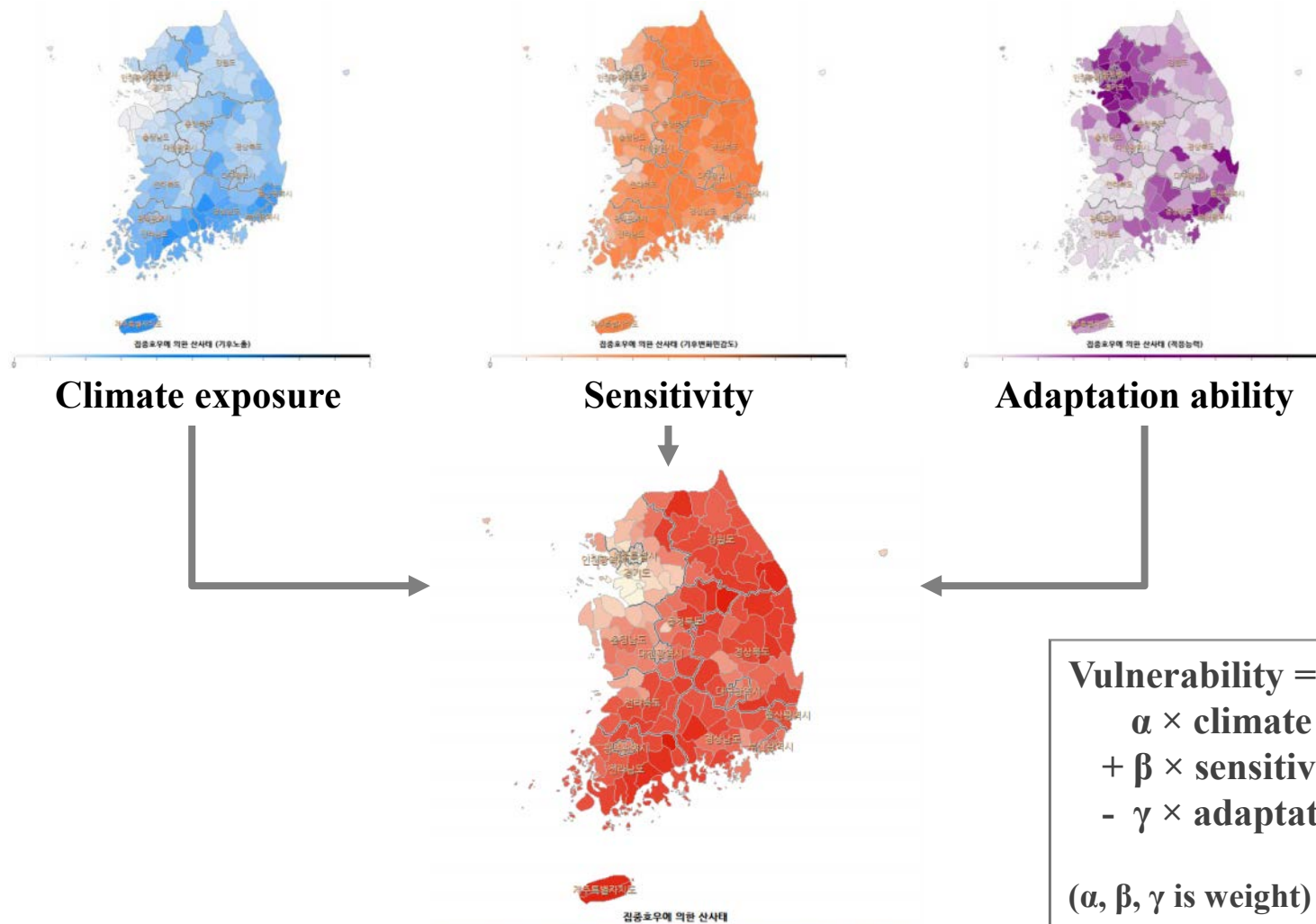
## ✓ Example of results : variables and weight

- “Delphi research with 56 experts” ► **Weight of variables**
- An example of landslide by heavy rains.

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

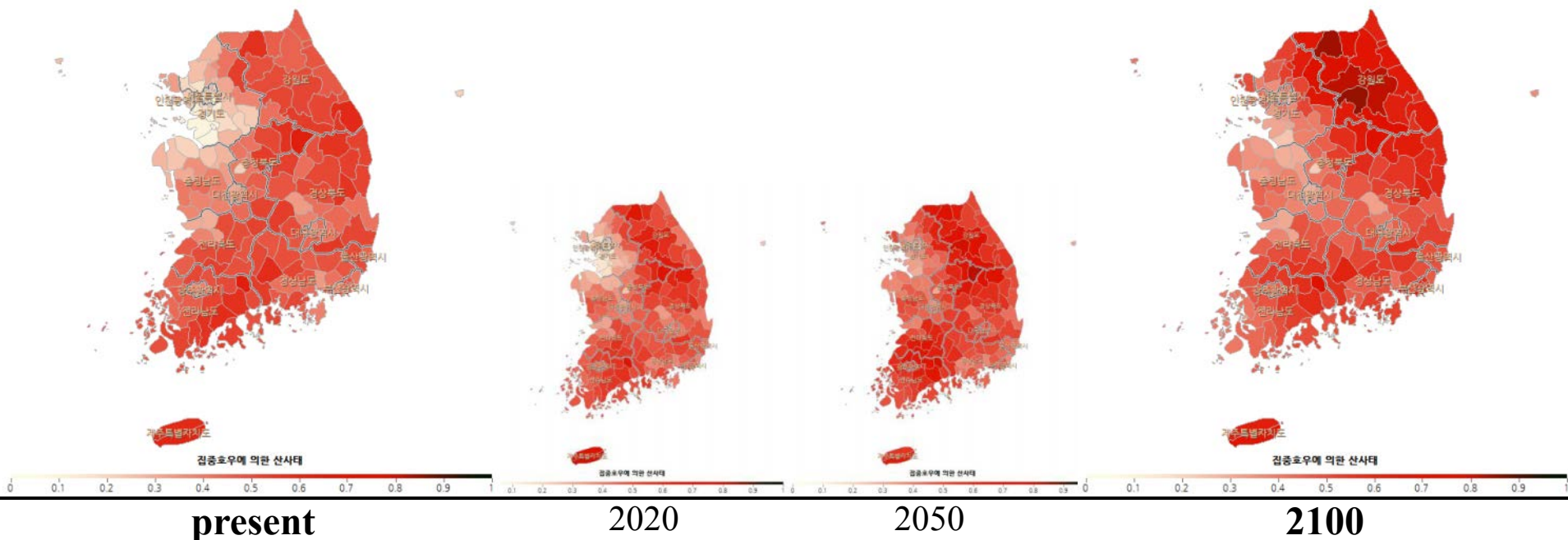
# ✓ Assessment of vulnerability(example) : vulnerability of landslide by heavy rain

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



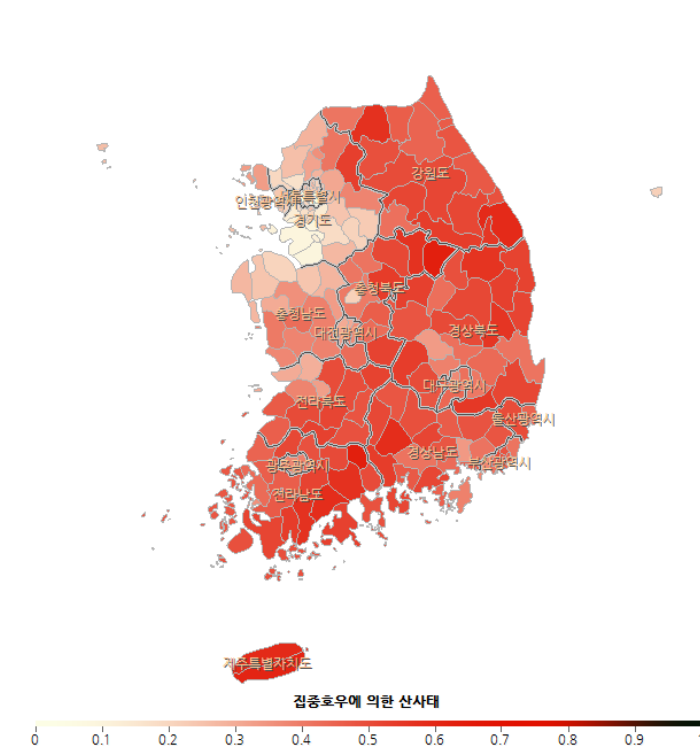
## ✓ Vulnerability map(example) : vulnerability of landslide by heavy rain

- 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.
- Through the result, local governments can find importance of adaptation plans.

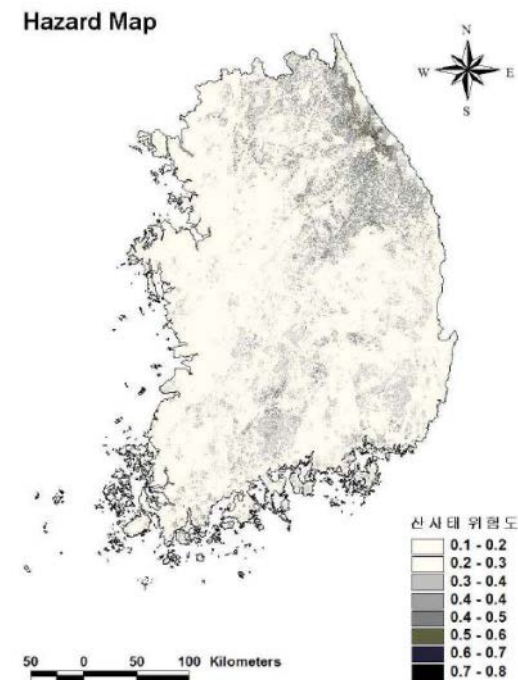


## ✓ Verification of result(example) : vulnerability of landslide by heavy rain

- **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)

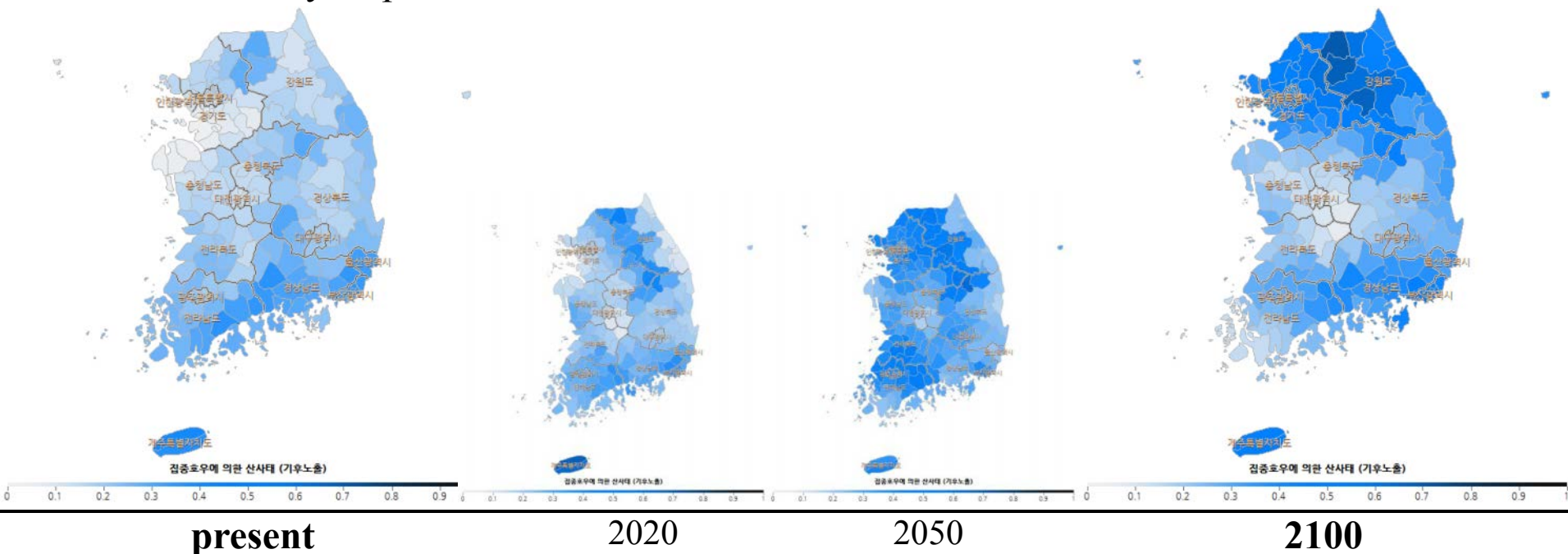


Hazard map of landslide(Yun et al., 2009)



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



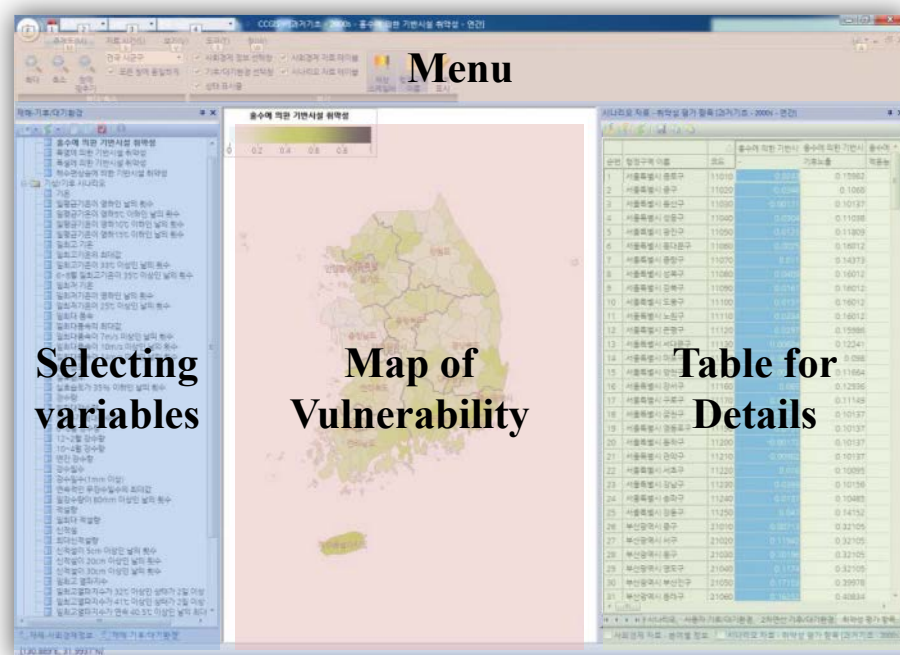
## ✓ Final report

- 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/](http://www.snu.ac.kr/ccgis/)

click

번호	제목	작성자	작성일	조회
111	[시스템]XCCGS 3.1.3.2 버전 설치 파일. doc	시스템	2011/12/14	25
110	[시스템]XCCGS 3.1.3.2 버전 설치 파일. doc	시스템	2011/11/14	42
109	[과제명/출발] 남양지문해. doc	농업	2011/11/04	30
108	[출발] 최종으로 과학원에 제출한 최종보고서 인쇄본입니다. doc	김호갑	2011/10/24	51
107	[생태계]수질은 최종보고서 올려드립니다.	생태계_이슬기	2011/10/21	13
106	[출발] 최종보고서 올릴 문서 드립니다. doc	김호갑	2011/10/20	26
105	[농업]수질문	농업	2011/10/18	13
104	농업_수질문	농업	2011/10/18	10
103	[생태계] 최종수질문 올려드립니다.	생태계_이슬기	2011/10/18	11
102	[과제명]최종보고서 인쇄본 수정요청드립니다.	과학원	2011/10/18	25
101	[수산] 수산부문 검토결과	수산	2011/10/18	6
100	[출발] 방산 학원방 보고서입니다.(보안, 생태, 재해 마히합)	김호갑	2011/10/14	11
99	[수질 및 수생태] 수정본	이건환	2011/10/14	7
98	[생물+수산] 보고서(간), 수산부문 작성	수산	2011/10/13	12
97	[농업]최종보고서	농업	2011/10/13	11
96	[출발] 출발+요약보고서 환경질 수정사항 올려드립니다.	김호갑	2011/10/13	23
95	[방관리]최종보고서	김연규	2011/10/13	9
94	[출발] 출발+요약보고서 - "결론" 주요연구결과 및 기대효과" 수정	김호갑	2011/10/12	21
93	보안분야 약대그래프 작업 역설파일	보안	2011/10/12	19
92	[출발] 보고서 양식 + 지자체별특성개성방안 관련 사항	김호갑	2011/10/12	42

목록보기 | 다음페이지 | 글쓰기

(시스템)XCCGS 3.1.3.2 버전 설치 파일

시스템

2011-12-14 10:47:30, 조회 : 31, 추천 : 0

Download #1 : CC0013\_v3.1.3.2.doc (225.36 KB), Download : 10  
 Download #2 : CC0013\_v3.1.3.2.doc (225.36 KB), Download : 10

동일에서 요청하신 CC0013 3.1.3.2 버전 설치 파일을 첨부하니 다운로드 접속해제/삭제하여 사용하시기 바랍니다.  
 -연구사(보안/생태/재해)를 위한용 용기함해 수정)

오답률

대한발견연구용 오답률입니다.  
 이항목 CC0013에 대한 부분을 건의해드 주시기 바랍니다.  
 계속적으로 위치 및 업데이트가 이루어지고 있습니다.  
 그대신, 현재 CC0013로 대체하는 현재 자료가 조금 있는 용기가 무슨 대단한지를 확인할 수 있습니다.  
 주원그림에서서는 변형을 위한 입수자료도 있지만은한 것 같습니다. 현재(주원그림) 자료 입안의 차이에 용기로 오답률에 대한 변형 확인은 가능합니다.  
 이항목에 입수자료로, 위치가 정확히 위치해 있습니다. 위치가 정확히 위치해 있습니다.  
 위치 정보를 본로그를 통해서 확인 할수 있도록 조치를 해두시면 좋겠습니다.

Name

Password

Comment

등록하기

입찰결과 수정하기 | 삭제하기 | 추천하기

목록보기 | 글쓰기

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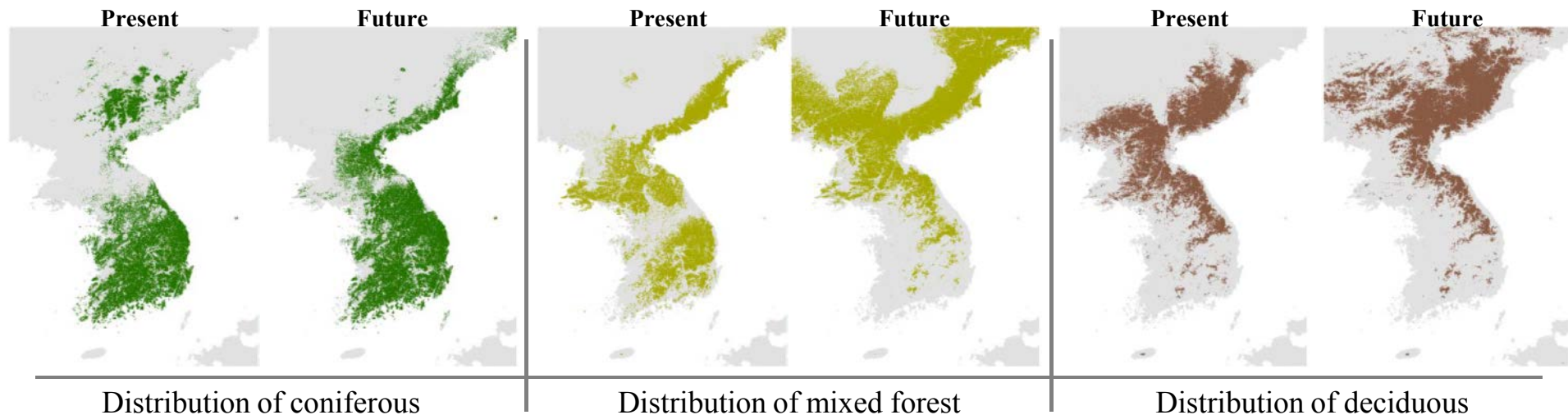
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## ✓ Results of quantitative methods : Prediction of distribution of forest types (KEI)

- **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 quantitative 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.

**Thanks for your listening**

**The Vulnerability Assessment for Local Adaptation to  
Climate Change in Korea**

**Dongkun Lee<sup>1</sup>, Hogul Kim<sup>1</sup>, Changkeun Song<sup>2</sup> and Jeong A Yu<sup>2</sup>**

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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

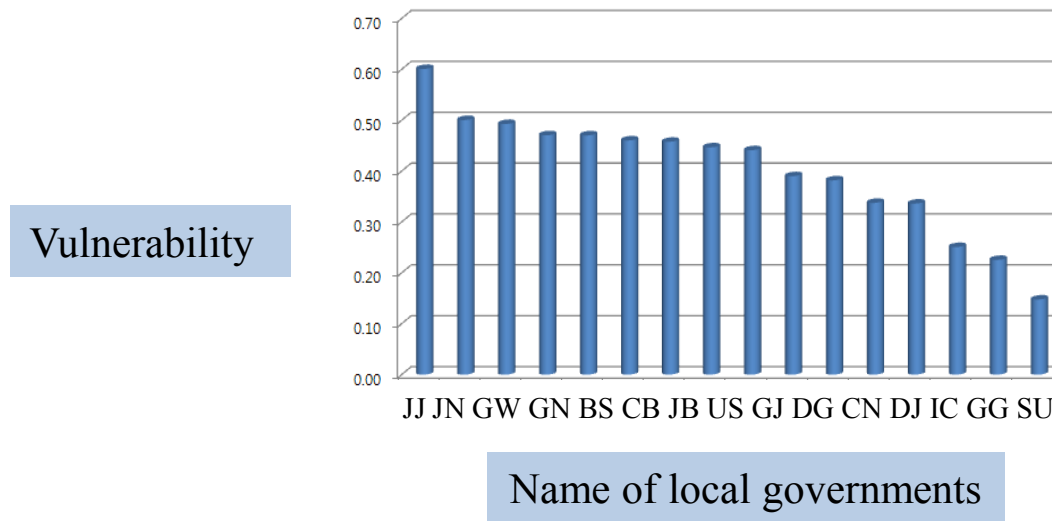
- We used this formula to calculate vulnerability.
- The formula refers to UNDP(2005).

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

( $\alpha, \beta, \gamma$  is weight)



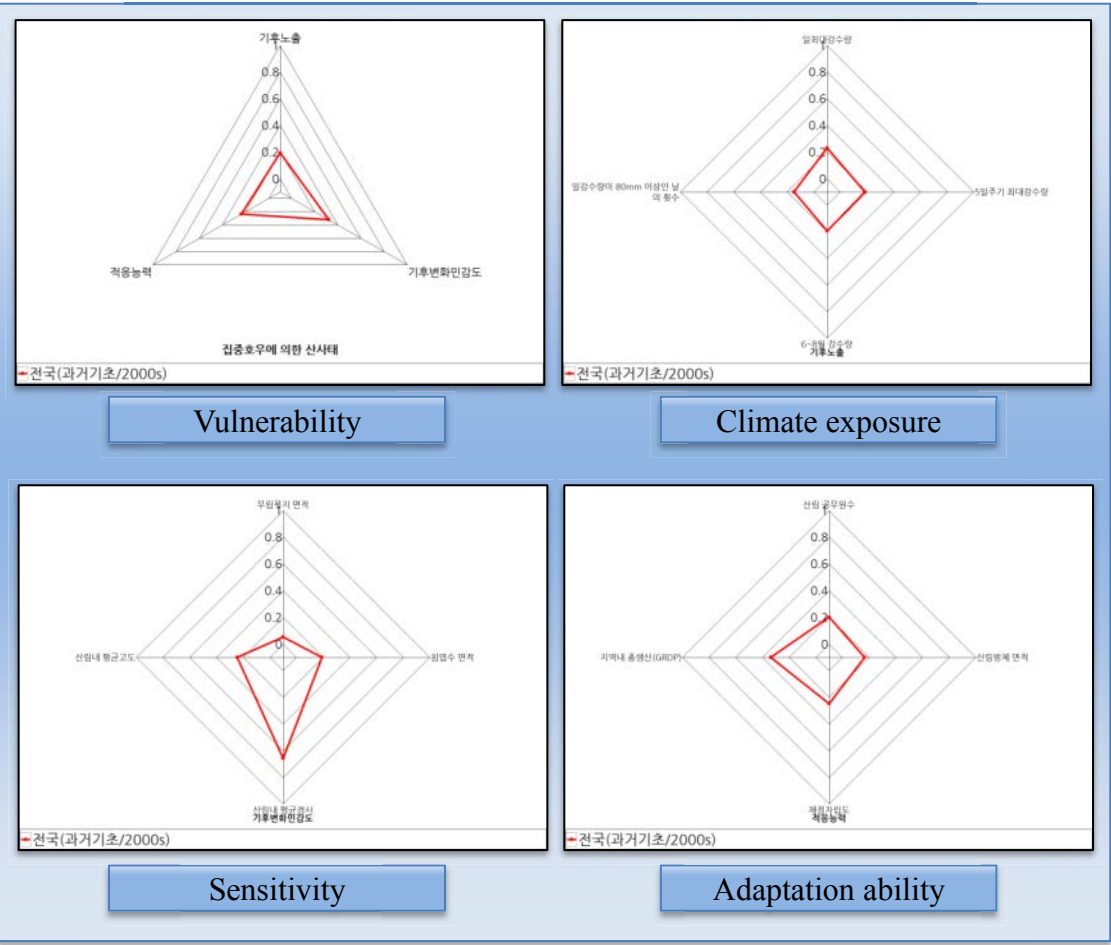
✓ Statistical analysis(example) : vulnerability of landslide by heavy rain



- 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

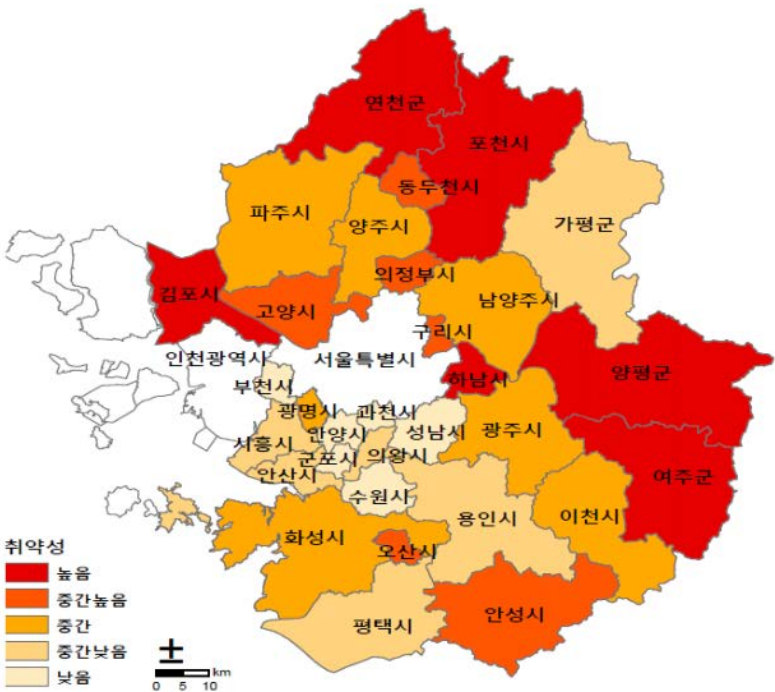


- A radial graph was created to identify the contribution of variables.
- Through the radial graph, we can get an information about contribution of certain variables.
- This graph shows average vulnerability of 232 local governments. We can also search an information about certain local government by 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

계통 1	계통 2	계통 3		
기후노출 0.163	호우	0.069	호우일수	0.009
			1일 최대강수량	0.029
	가뭄	0.044	강수량저수	0.029
			연속적인 무강수일수 평균	0.014
	폭서	0.023	연속적인 무강수일수 최대값	0.029
민감도 0.296	해수면 상승	0.026	열대야일수	0.004
			일최고기온 33℃이상인 날 횟수	0.009
	지리적 특성 및 토지이용	0.148	열파지속지수	0.009
			생태적 민감지역	0.020
			가뭄 취약지역	0.034
적응능력 0.639	인구특성 특성	0.074	홍수취약지역	0.068
			연안 침수 취약지역	0.034
			인구밀도	0.010
	기반시설/산업	0.074	65세이상 인구 비율	0.017
			사회적 취약인구 비율	0.026
제도적 역량 0.187	경제적 능력	0.109	기후민감질환자 발병률	0.020
			사화기반시설	0.040
	물적 인프라	0.132	산업단지	0.017
			건물	0.016
	적응능력 0.639	사회적 자본	0.109	GRI
경제성장률				0.016
제도적 역량		0.187	재정자립도	0.047
			녹지	0.022
적응능력 0.639		사회적 자본	0.109	화천개수율
	의료시설 확보율			0.033
	제도적 역량	0.187	깨끗한 물에 대한 접근성	0.038
			통신	0.019
	적응능력 0.639	사회적 자본	0.109	민관 파트너십
시민의 기후변화 대응 역량				0.036
제도적 역량		0.187	공동체 의식	0.036
			기후변화에 대한 지자체장의 관심	0.063
적응능력 0.639		사회적 자본	0.109	재해 관련 사전예방 시스템
	적응정책 인력			0.031
	제도적 역량	0.187	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.