

# 2013 Esri International User Conference

July 8–12, 2013 | San Diego, California

## Decision-making support tool for promotion policies of abandoned mine areas

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- Methodology
- Why & How I use ArcGIS
- Result & Discussion
- Conclusion

# Background

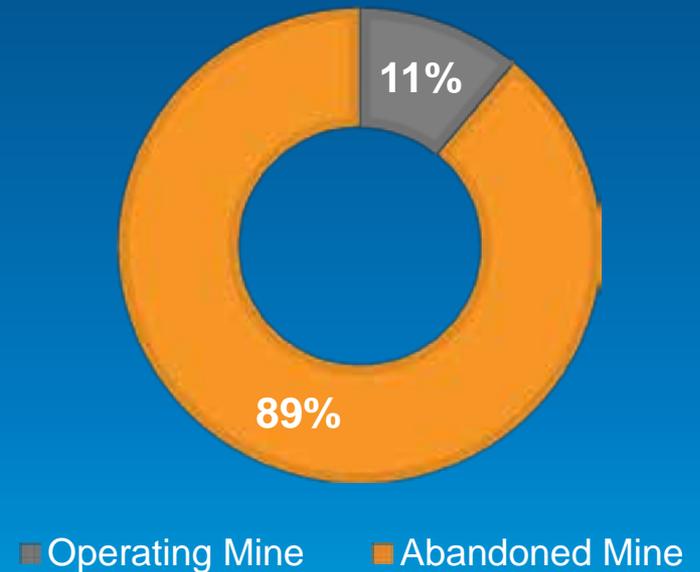
## Abandoned Mines in South Korea

- Mining Situation in South Korea (MIRECO, 2012)

Total Number of Mines



Ratio



# Background

## Promotion Policies in Abandoned Mine Sites



Baksoo (<http://blog.ohmynews.com/baksoo/105381>)

Kangwon Land (<http://kangwonland.high1.com/>)

# Background

## Promotion Policies in Abandoned Mine Sites



**Theme-Tour Development Policy  
decided by Government Authorities**

**Policy-Making based on Objective  
Multi-Criteria for Rural Resources**



# Background

## Differences from Other Sites

- Mine Hazard à Mine Reclamation  
: Abandoned mine sites need more consideration due to its environmental problems

Land Subsidence



Acid Mine Drainage



Deforestation



Wikipedia: Elura (<http://en.wikipedia.org/wiki/Image:Elura.png>)

Toxic Substances Hydrology Program, USGS ([http://toxics.usgs.gov/highlights/amd\\_tools.html](http://toxics.usgs.gov/highlights/amd_tools.html))

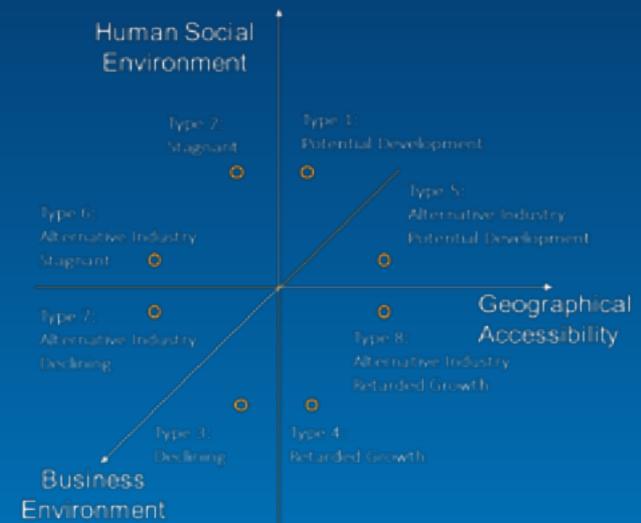
# Background

## Scheme of Mine Site Promotion Policy (Esteves, 2008)

Access to Land	Minimised Risk	Human Capital
<ul style="list-style-type: none"><li>• Positive relationship with local communities, based on acceptance and trust</li><li>• Positive relationship with key regional, State or national stakeholders</li><li>• Access to land for mineral and water resources</li></ul>	<ul style="list-style-type: none"><li>• Absence of interruptions to operations</li><li>• Stable social environment</li><li>• Effective community projects</li></ul>	<ul style="list-style-type: none"><li>• Attraction and retention of highly trained specialist labour</li><li>• Access to a pool of local labour</li><li>• Retention of non-specialist local labour</li><li>• Access to a pool of non-core contractors</li><li>• Access to a mobile pool of employees within the region</li><li>• An ethical corporate culture, through building employees' social awareness</li><li>• A culture of innovation and leadership</li></ul>
Cost Reduction	Brand value & Reputation	
<ul style="list-style-type: none"><li>• Access to local suppliers</li><li>• Reduced costs of closure and post-closure</li><li>• Reduced costs associated with environmental remediation mitigation</li></ul>	<ul style="list-style-type: none"><li>• Strengthen company brand and reputation</li></ul>	

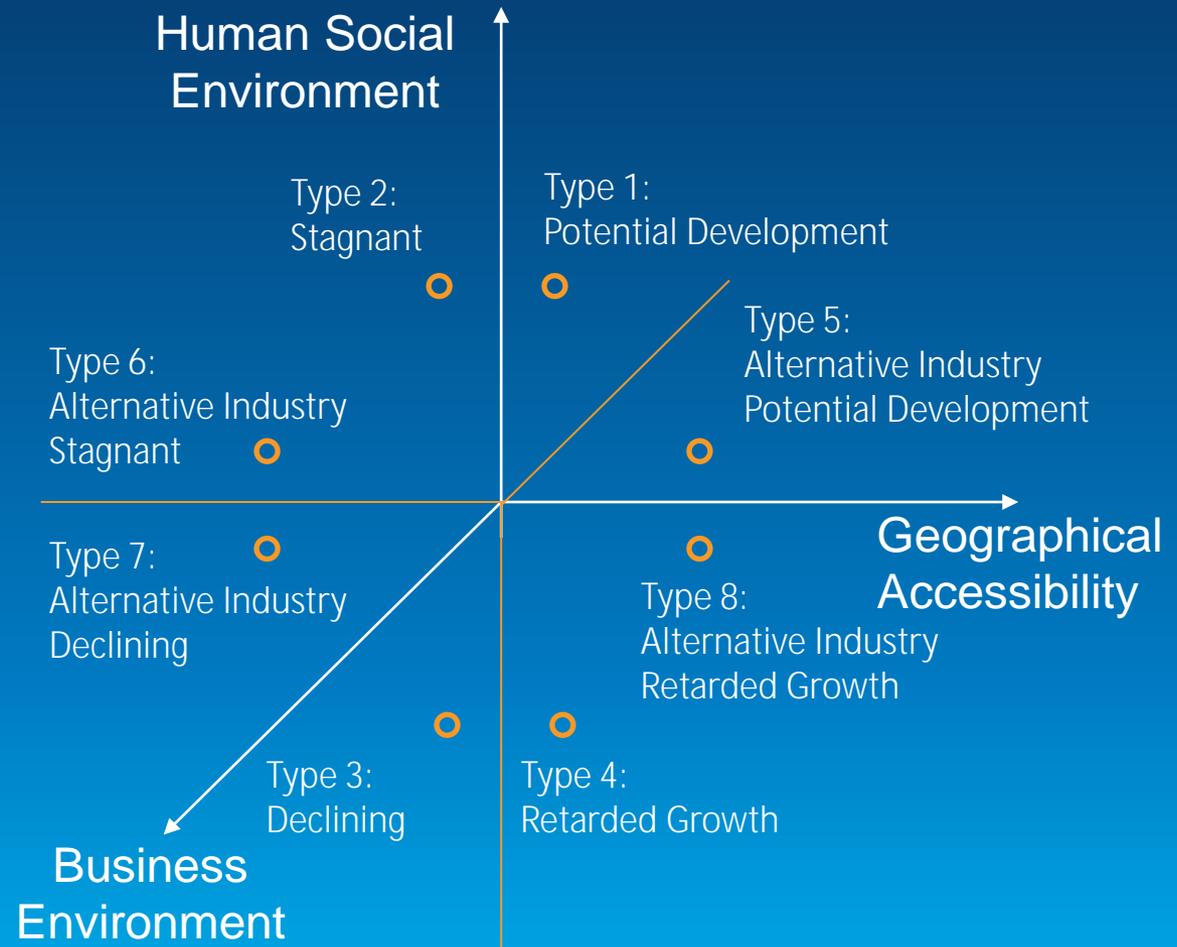
# Background

## Scheme of Mine Site Promotion Policy (Choi and Kim, 2013)



# Background

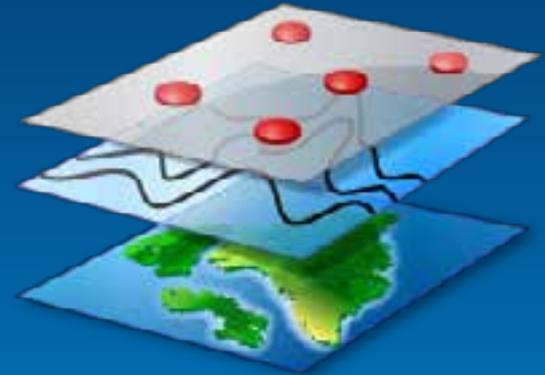
## Scheme of Mine Site Promotion Policy (Choi and Kim, 2013)



# Background

## GIS for Multi-Criteria Decision Analysis

- With ArcGIS
  - Data Collection & Management
  - Network / Spatial Analysis
  - Multi-Criteria Decision Analysis



**Decision-making support tool for  
promotion policies of abandoned mine areas**

# Methodology

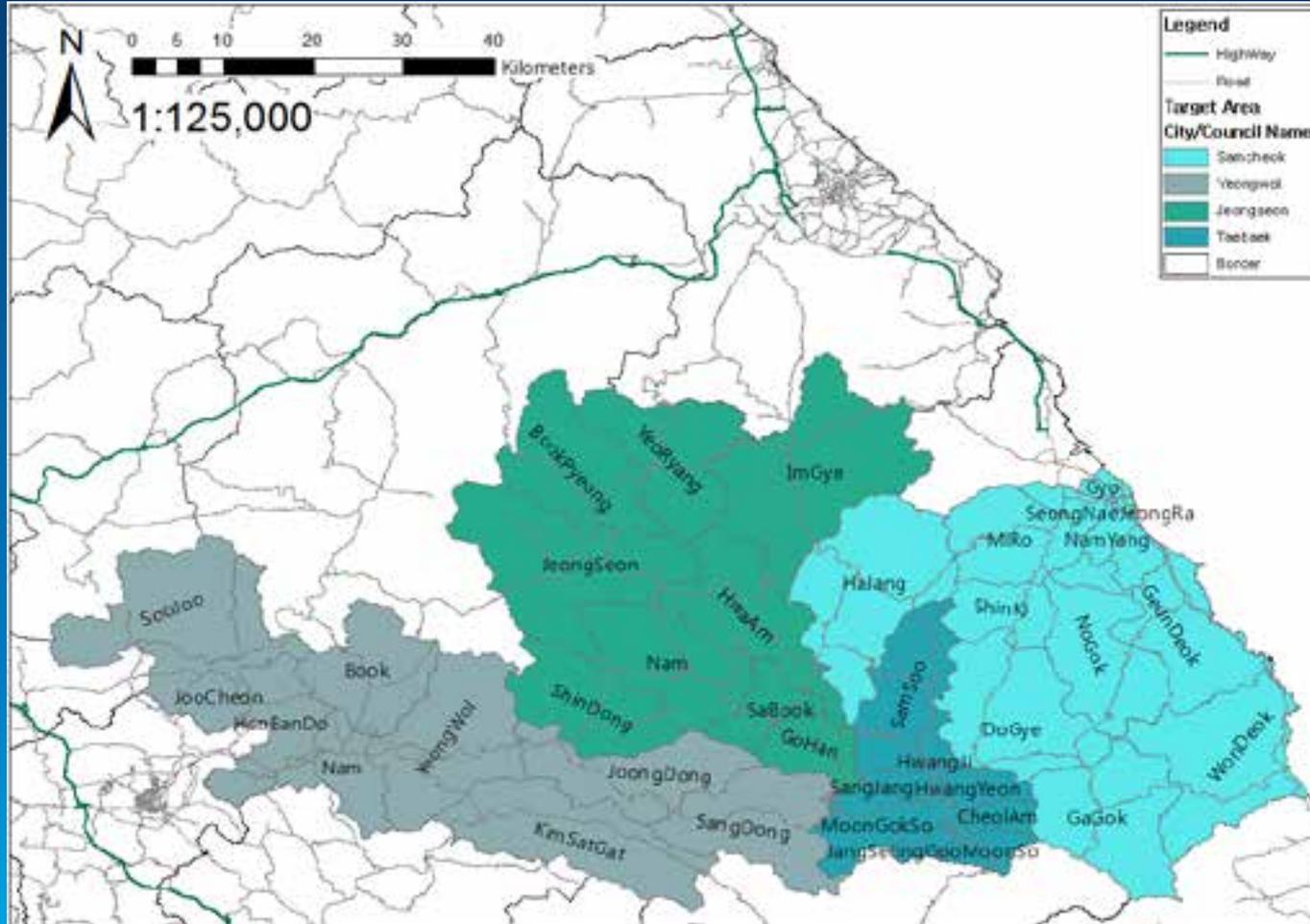
## Study Area



- Target Area:
  - Jeongseon, Taebaek, Yeongwol, Samcheok
  - Gangwon Province
    - c. 200km Far From Seoul
  - Mountainous Area
  - Industries:
    - 1960-80s: Mine Activities
    - Sports / Entertainment
    - 2018 Pyeongchang Olympic
  - 200 M\$ Investment Planned for Abandoned Mine Sites

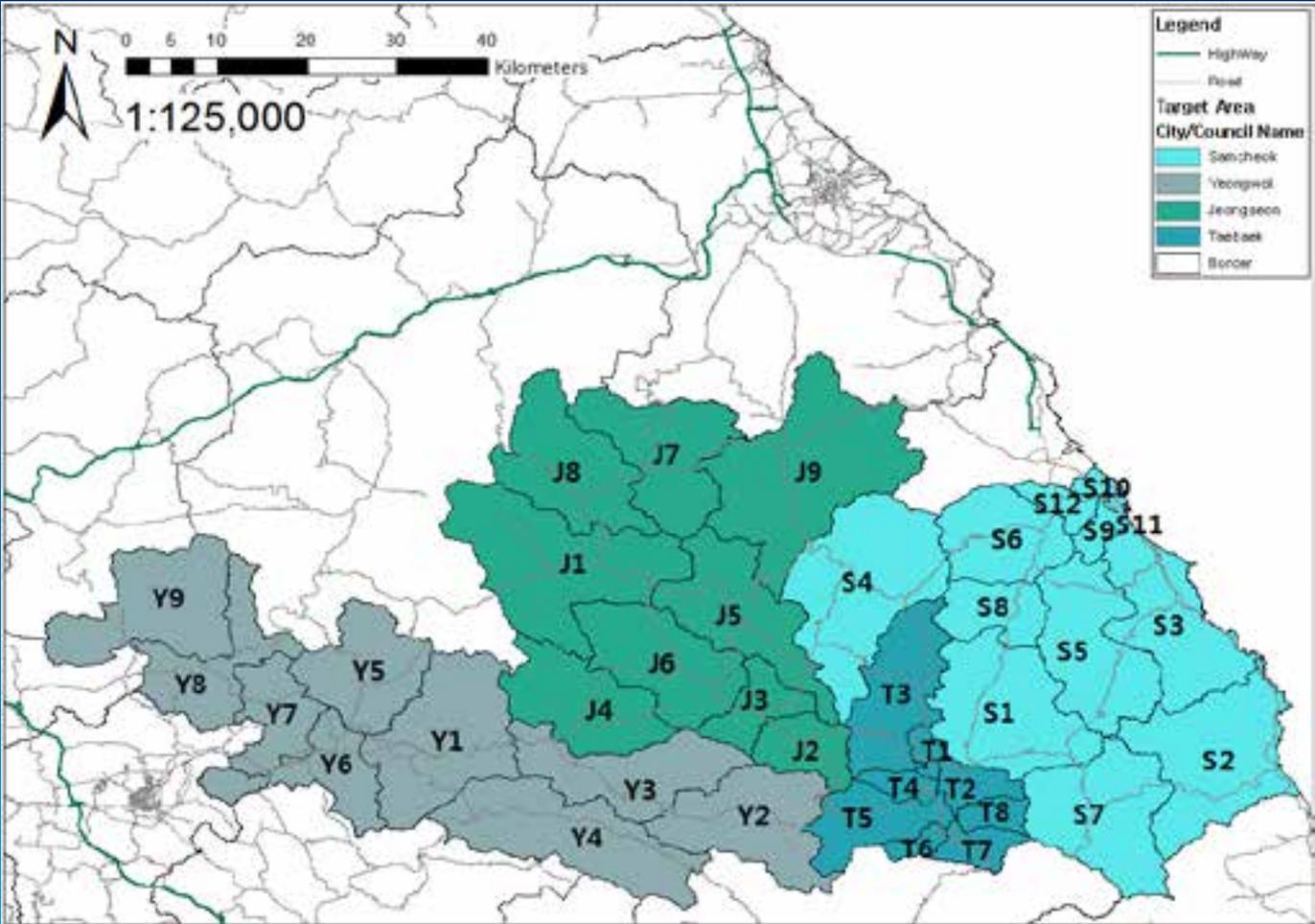
# Methodology

## Study Area



# Methodology

## Study Area



# Methodology

## Analysis Model: Database Utility

### Human Social Environment

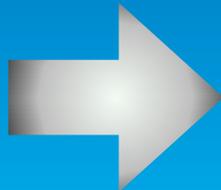
- Whole Population
- Elderly Population Ratio

### Geographical Accessibility

- Highway Accessibility based on Road Network

### Business Environment

- Resource Database in Agriculture Site
- Public Rural Resource Database
- Mine Hazards Survey Report

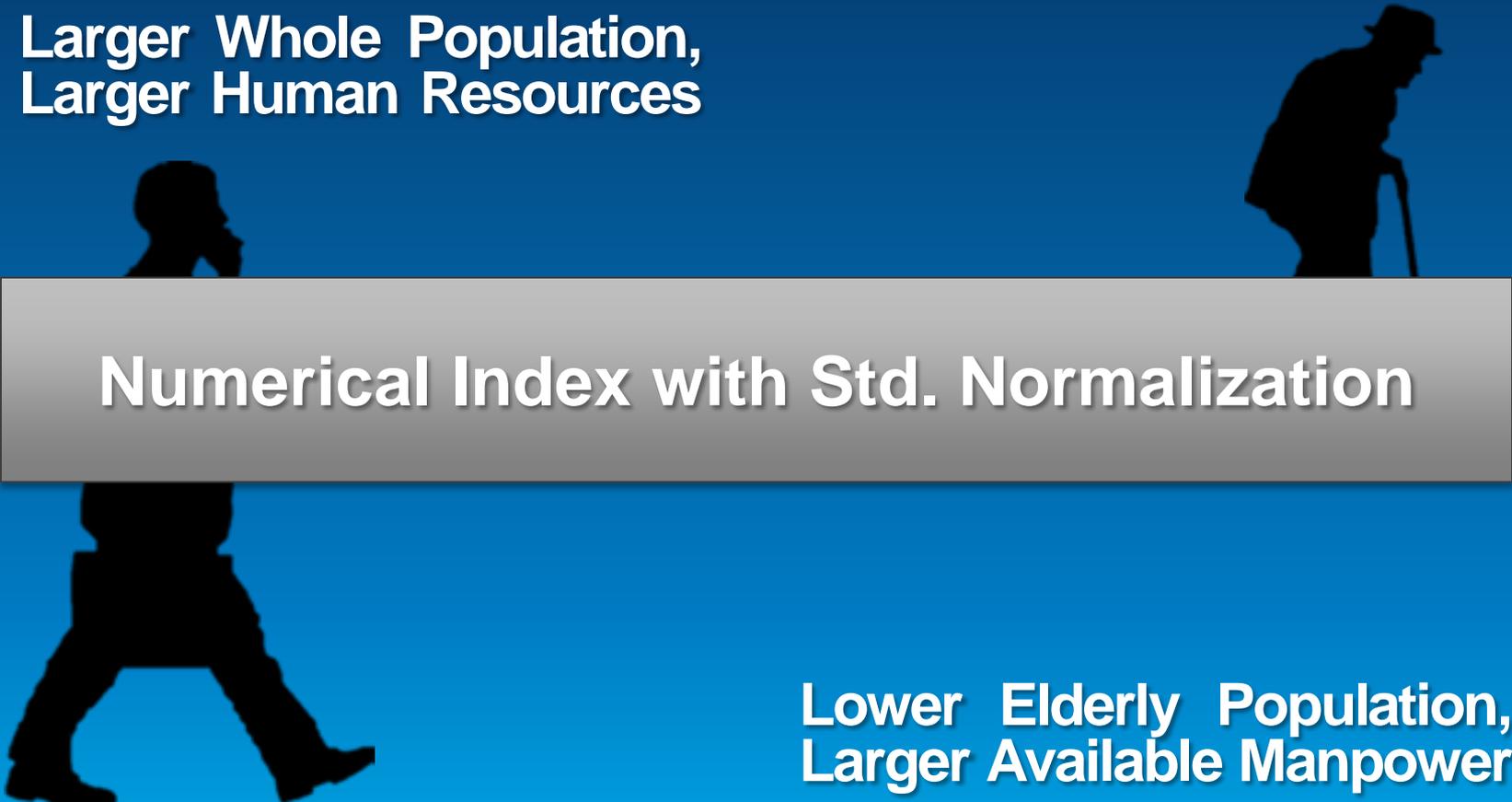


**Field Surveys are Required!**

# Methodology

Analysis Model: Human Social Environment

**Larger Whole Population,  
Larger Human Resources**

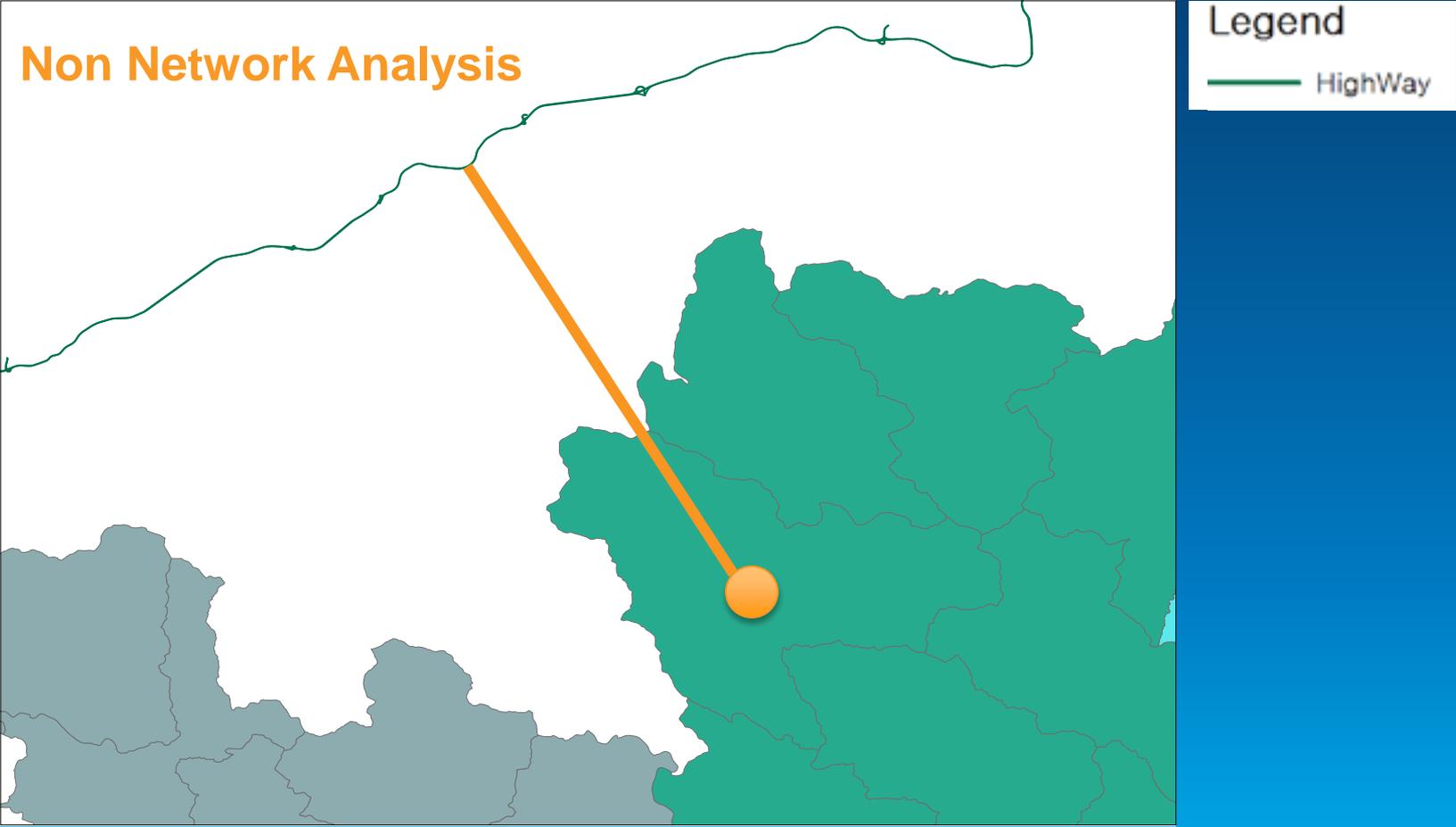


**Numerical Index with Std. Normalization**

**Lower Elderly Population,  
Larger Available Manpower**

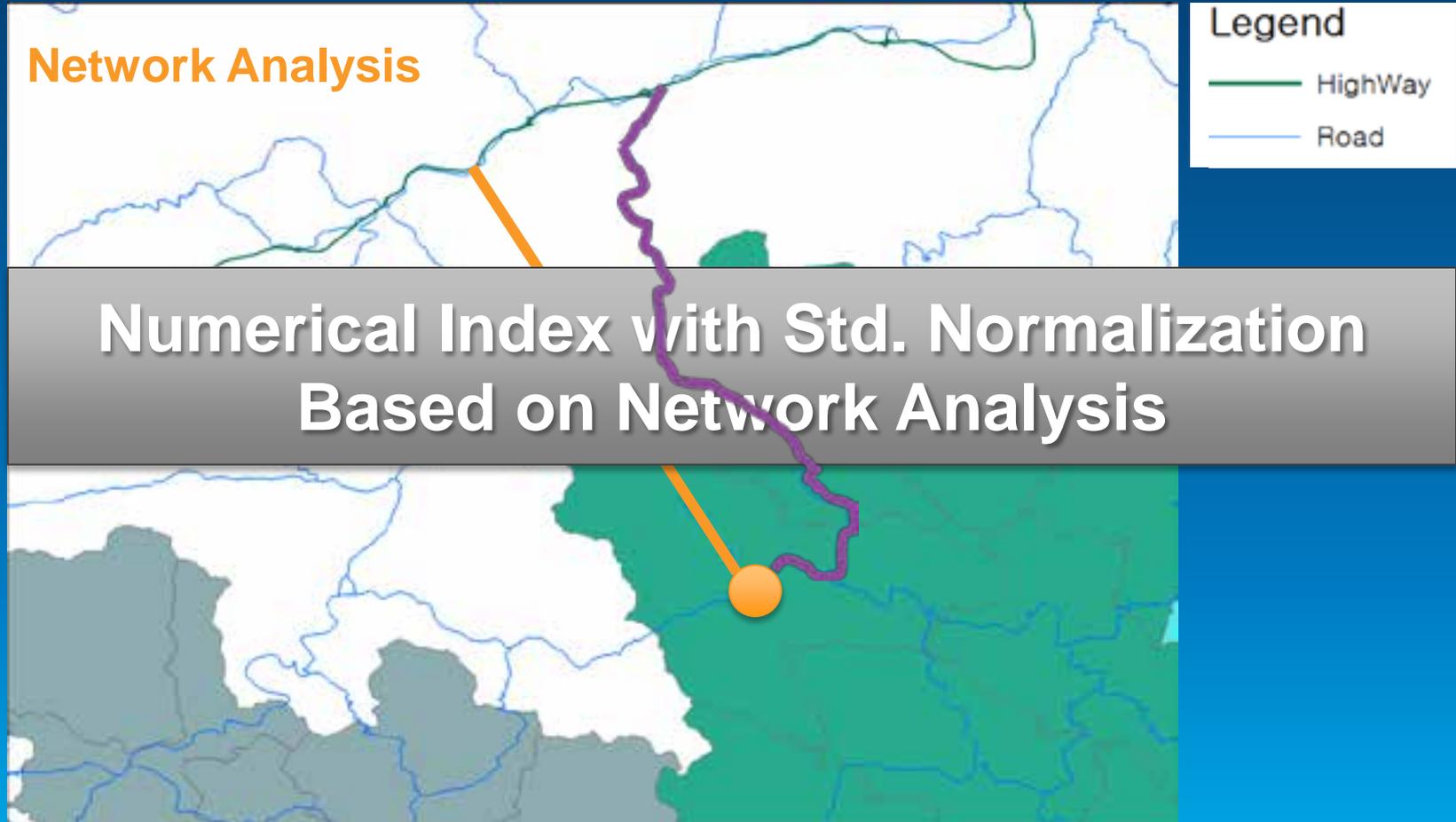
# Methodology

Analysis Model: Geographical Accessibility



# Methodology

Analysis Model: Geographical Accessibility



# Methodology

## Analysis Model: Business Environment



### Rural Resource Inventories in Agriculture Site (modified from Oh et al., 2008)

#### Nature Resource

- Water
- Geography
- Bio-ecosystem

#### Social Resource

- Infrastructure
- Economy
- Community

#### Cultural Resource

- Environment
- Tradition
- Sight-seeing

# Methodology

## Analysis Model: Business Environment



### Weighting of Rural Resources in Abandoned Mine Site with AHP Analysis

	Air Pollution	Noise	Land Subsidence	Water (AMD)	Mine Tailings	CI	GCI	CR(%)	Eigen Value( )
Environment Tour	11	13	8	20	7	0.37	0.05	1.2	5.05
Environment Residential	24	36	19	37	15	0.37	0.04	0.9	5.04
	Forest	River	Agriculture Area	Residential Area	Coastal Area	CI	GCI	CR(%)	Eigen Value( )
Sight Tour	33	35	13	21	29	0.37	0.09	2.3	5.10
Sight Residential	12	24	12	15	12	0.37	0.05	1.2	5.06

# Why & How I use GIS

## Network Analysis

### Geographical Accessibility

- Highway Accessibility based on Road Network

- With ArcGIS Network Analyst,
  - Create a network using your existing GIS data
  - Generate a matrix of network travel costs from each origin to all destinations

# Why & How I use GIS

## Field Survey: Data Collection & Management

### Business Environment

- Resource Database in Agriculture Site
  - Public Rural Resource Database
  - Mine Hazards Survey Report
- With ArcGIS for Mobile,
    - Navigate maps, collect and report data, and perform GIS analysis
    - Access and share your enterprise GIS via ArcGIS Online or ArcGIS for Server

# Why & How I use GIS

## Multi-Criteria Decision Analysis



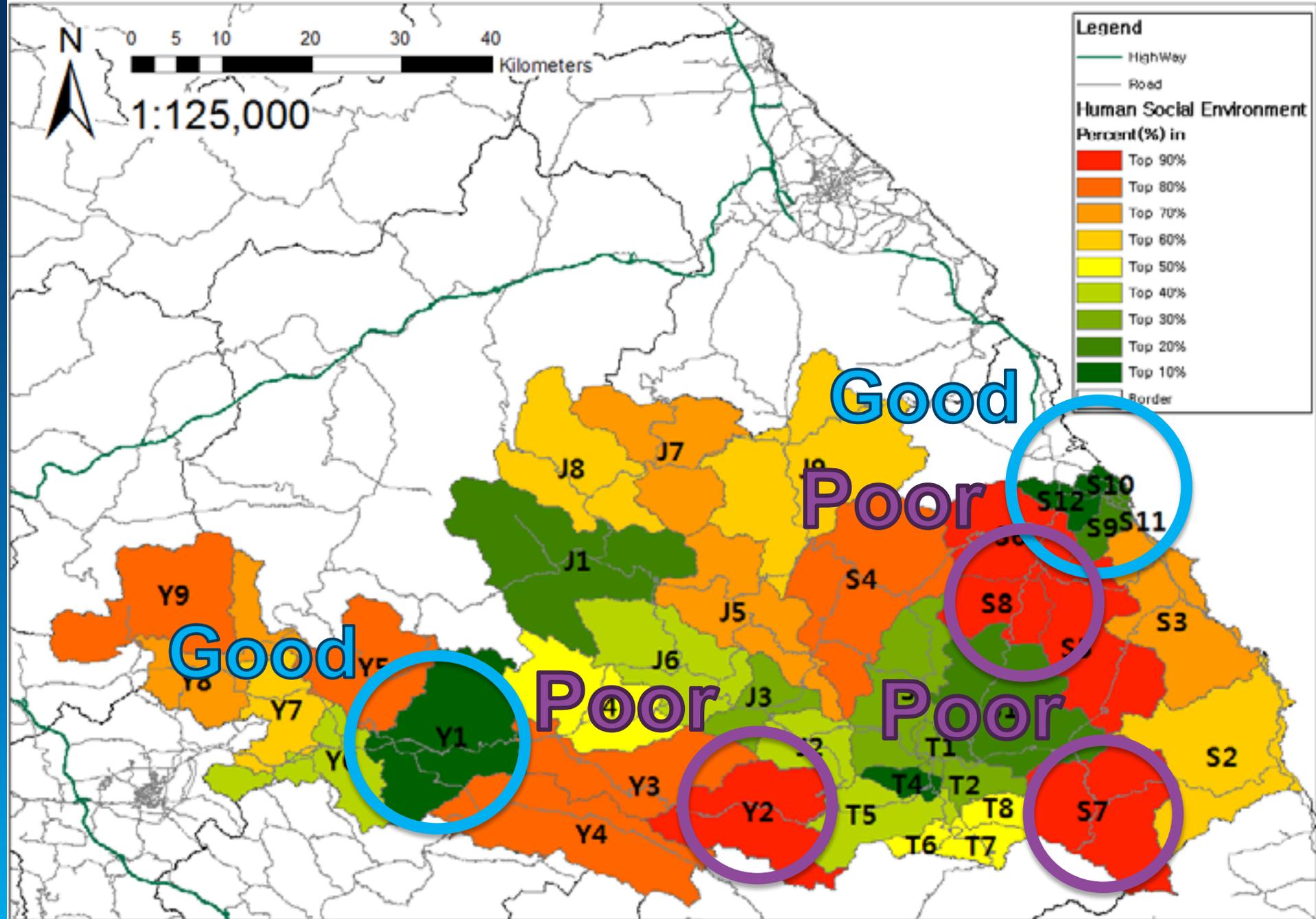
- With ArcGIS,
  - Organize abundant datasets in spatial information collected at field survey
  - Standardize each criteria, set the suitable weightings, and figure the quantitative indices

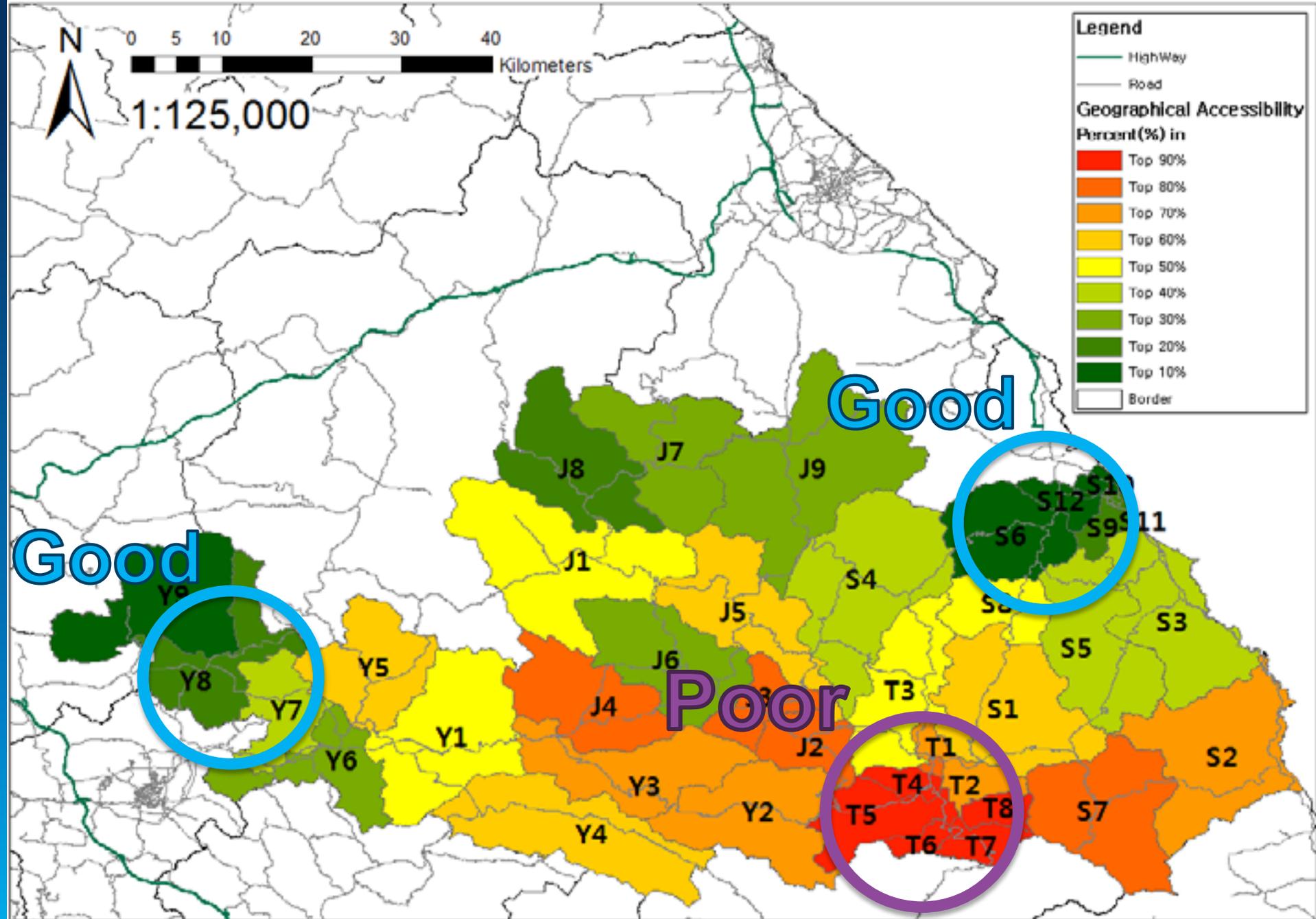
# Result & Discussion

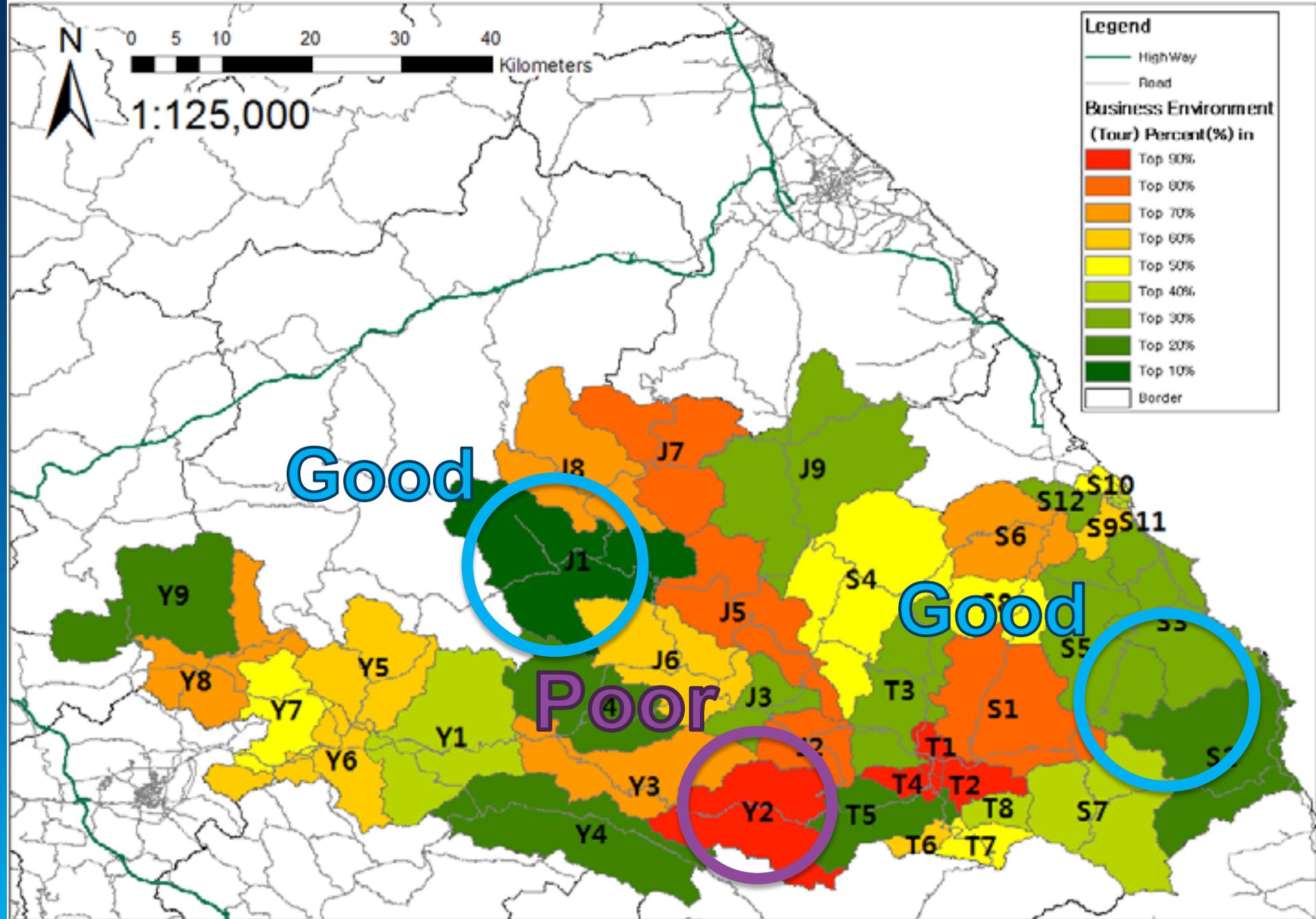
	Human Social Environment	Geographical Accessibility	Business Environment (Tour)	Business Environment (Resi.)
T1	16.71	-12.14	-14.29	-8.59
T2	12.75	-9.43	-15.31	-13.10
T3	15.87	1.59	6.50	27.05
T4	39.39	-13.46	-17.71	-14.49
T5	6.04	-14.69	15.56	12.72
T6	1.62	-17.38	-2.97	-8.52
T7	0.31	-16.90	-1.01	-13.72
T8	-1.23	-14.17	1.19	9.39
S1	22.02	0.66	-12.30	-15.11
S2	-9.32	-7.97	11.24	13.60
S3	-10.91	6.81	9.61	4.92
S4	-13.82	7.17	-0.67	1.85
S5	-33.13	6.92	8.67	-3.03
S6	-19.79	12.84	-6.35	-3.87
S7	-20.36	-9.56	2.27	2.36
S8	-23.38	4.82	-0.23	2.36
S9	17.02	10.20	-2.19	-7.35
S10	29.43	12.89	-0.16	-7.09
S11	17.84	9.83	2.48	-2.18
S12	33.12	13.75	7.41	-0.43

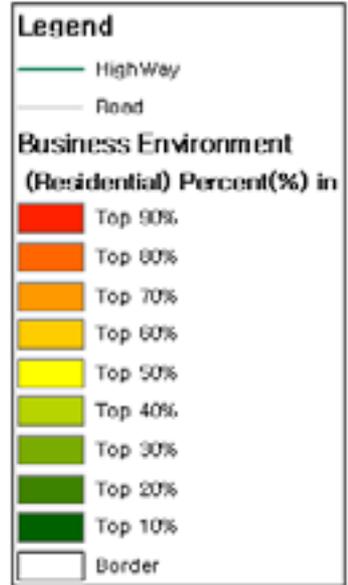
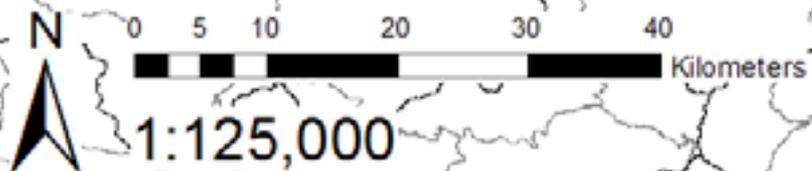
# Result & Discussion

	Human Social Environment	Geographical Accessibility	Business Environment (Tour)	Business Environment (Resi.)
Y1	41.58	2.10	2.34	-6.36
Y2	-18.75	-8.73	-16.19	-10.54
Y3	-16.76	-7.13	-8.21	-5.48
Y4	-16.31	0.28	12.25	-3.87
Y5	-15.58	-1.36	-3.58	-7.97
Y6	2.00	9.40	-2.19	3.24
Y7	-9.98	6.40	0.62	-1.69
Y8	-10.94	10.45	-6.72	-7.68
Y9	-15.24	13.75	13.20	9.35
J1	20.65	4.28	28.41	21.19
J2	11.76	-12.53	-11.52	4.23
J3	14.57	-11.74	8.16	-3.43
J4	-6.74	-10.09	10.86	21.81
J5	-13.35	-3.63	-12.16	-6.32
J6	2.00	9.40	-2.19	3.24
J7	-13.20	7.73	-10.30	3.53
J8	-7.71	10.31	-5.74	7.23
J9	-10.26	9.33	7.72	6.13









Good



Poor

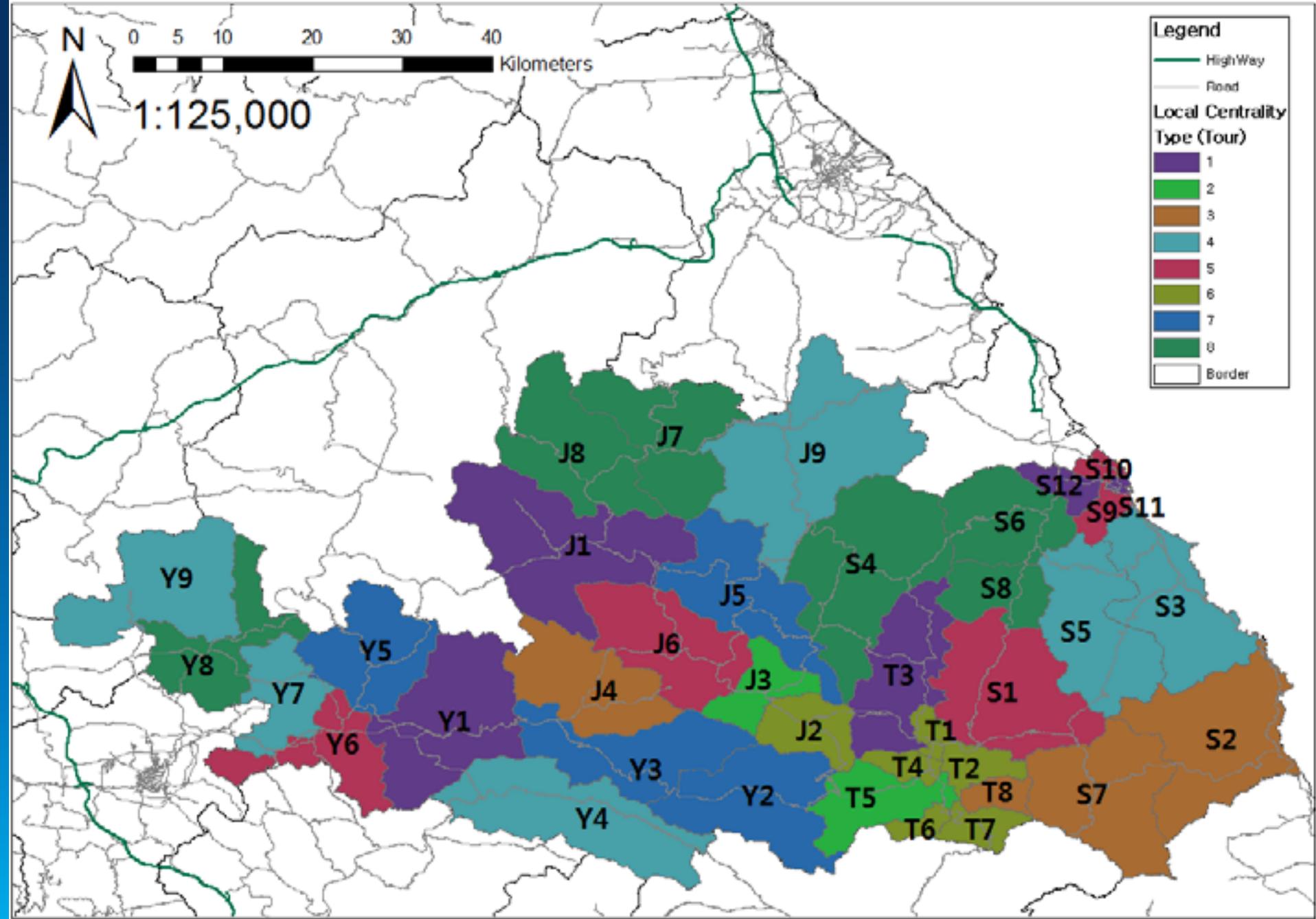
Poor



# Result & Discussion

## Classification of Abandoned Mine Areas in Korea

	Tourism	Residential
<b>Type 1:</b> Potential Development	J1, S11, S12, Y1	J1, J6
<b>Type 2:</b> Stagnant	J3, T5	J2, T5
<b>Type 3:</b> Declining	J4, T8, S2, S7	J4, T8, S2, S7
<b>Type 4:</b> Retarded Growth	S3, S5, Y4, Y6, Y7, Y9	S3, S4, S8, Y9
<b>Type 5:</b> Alternative Industry Potential Development	J6, S1, S10	S1, S9, S10, S11, S12 ,Y1
<b>Type 6:</b> Alternative Industry Stagnant	J2, T1, T2, T4, T6, T7	J3, T1, T2, T4, T6, T7
<b>Type 7:</b> Alternative Industry Declining	J5, Y2, Y3, Y5	J5, Y2, Y3, Y5
<b>Type 8:</b> Alternative Industry Retarded Growth	J7, J8, S4, S6, S8, Y8	S5, S6, Y4, Y6, Y7, Y8





# Conclusion

- GIS techniques can be applied as a support tool for policy making in abandoned mine sites
  - Network Analysis: Geographical Accessibility
  - Mobile Data Collection: Rural Resources
  - Multi-Criteria Analysis: Quantitative Assessment
- ArcGIS is great tool to set up the decision making system based on multi-platform: Mobile, Server and Desktop.

# Thank You

## Any Question?

### **Acknowledgement**

This work was supported by the Mine Reclamation Corporation funded by the Ministry of Knowledge Economy, Republic of Korea.