PREDICTING & ASSESSING NATURAL CAPITAL & ECOSYSTEM SERVICES

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Exploring alternative futures of the social-ecological production landscapes

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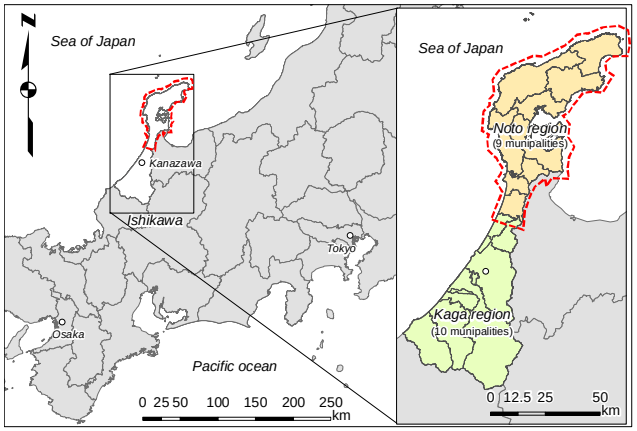
Objective of this study

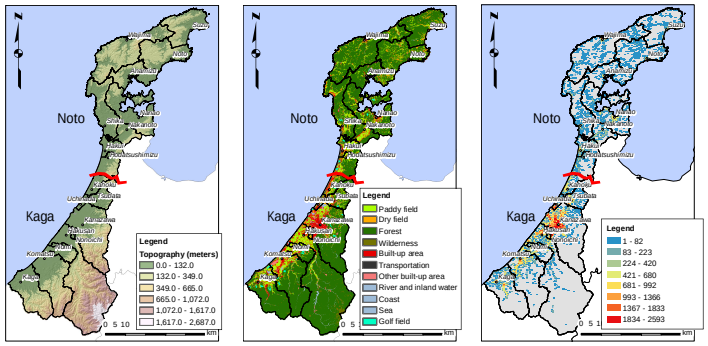
- To investigate the implications of ongoing population on the provision of ecosystem services
- To improve our understanding about how alternative development pathways could influence on the provision of ecosystem services
  e.g.
  Use/underuse of natural capital
  Population distribution

Overview of the Study area (1): Noto, Ishikawa



Location of Noto, Ishikawa

Overview of the Study area (2): Noto, Ishikawa



A) Topography

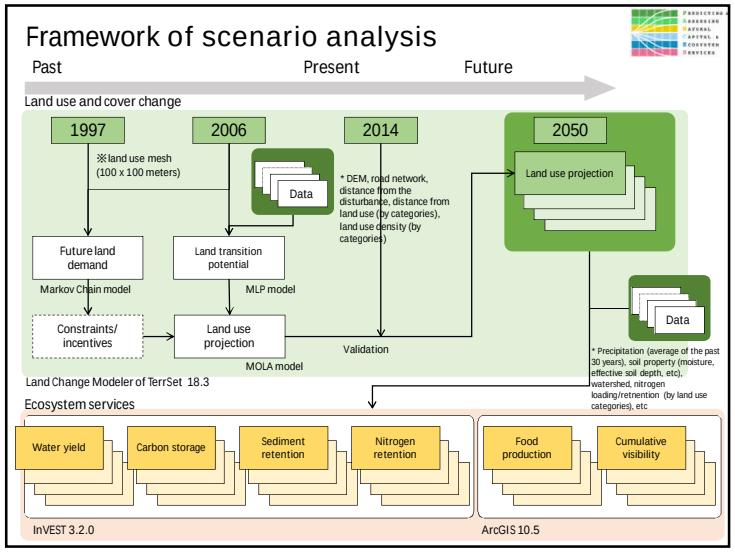
- Mostly hilly and mountainous area (limited flat area)
- Small watershed/limited availability of water resources

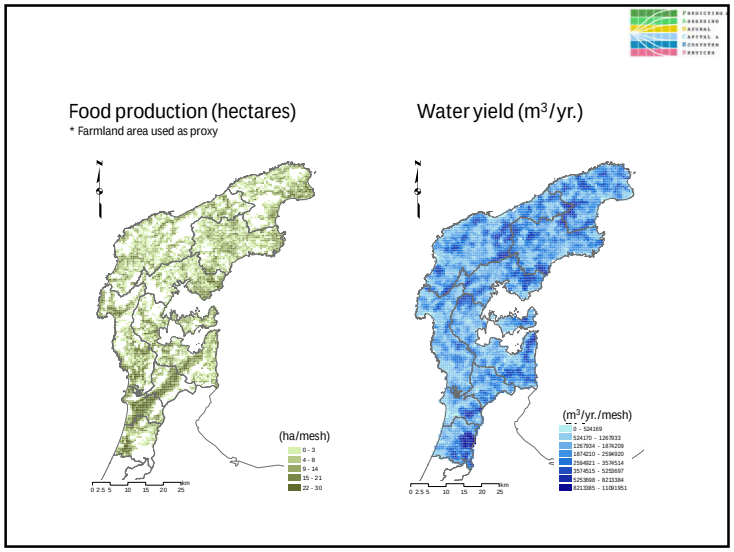
B) Land use

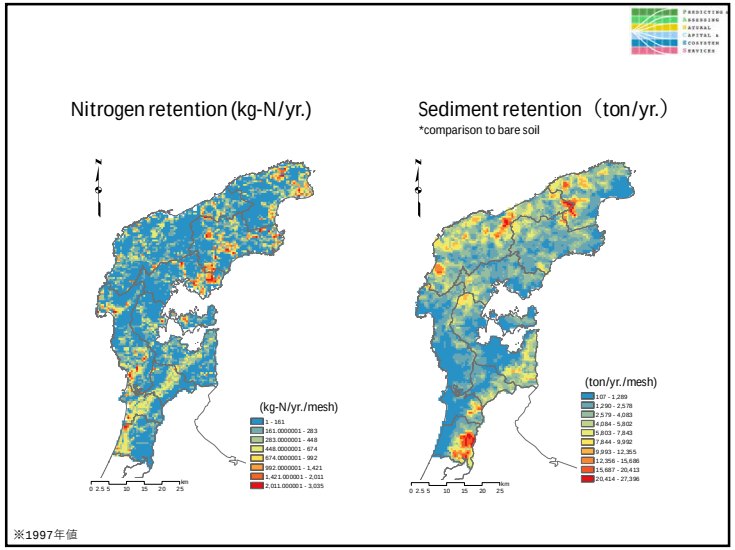
- Predominated by forests, interspersed with rice paddy fields and upland crop fields

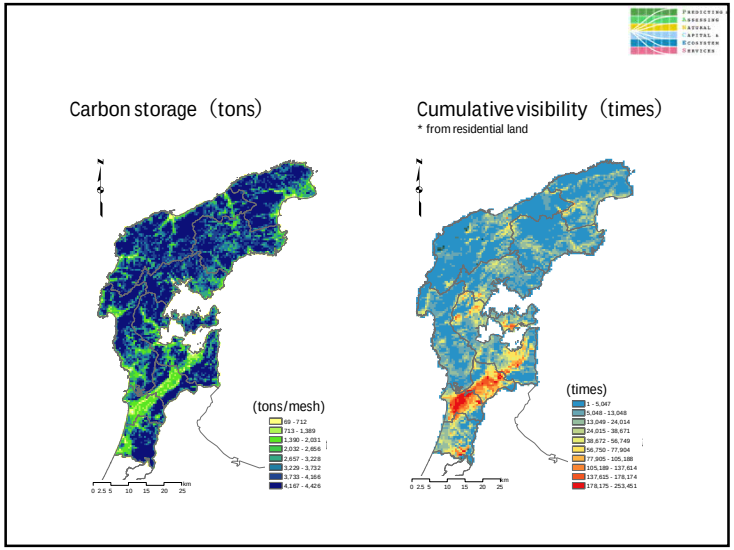
C) Population

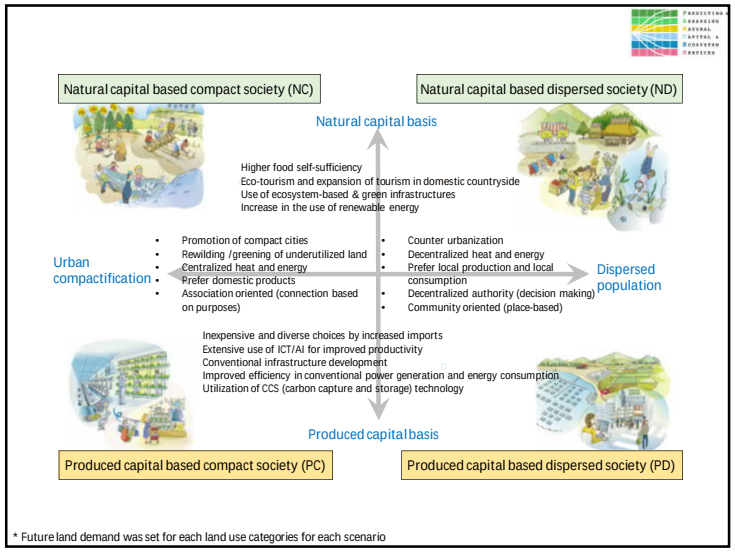
- One third of people is over 65
- Population will decrease from 196,400 (year 2015) to around 100,000 by 2050

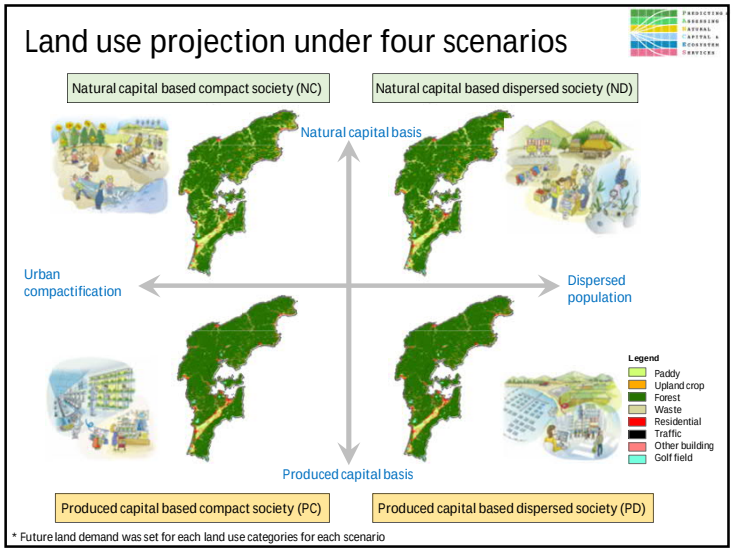

Framework of scenario analysis
Past
Present
Future
Land use and cover change
1997
2006
2014
2050
※land use mesh
(100 x 100 meters)
Data
* DEM, road network, distance from the disturbance, distance from land use (by categories), land use density (by categories)
Land use projection
Future land demand
Markov Chain model
Land transition potential
MLP model
Constraints/ incentives
Land use projection
MOLA model
Validation
Data
* Precipitation (average of the past 30 years), soil property (moisture, effective soil depth, etc), watershed, nitrogen loading/retnention (by land use categories), etc
Land Change Modeler of TerrSet 18.3
Ecosystem services
Water yield
Carbon storage
Sediment retention
Nitrogen retention
Food production
Cumulative visibility
InVEST 3.2.0
ArcGIS 10.5

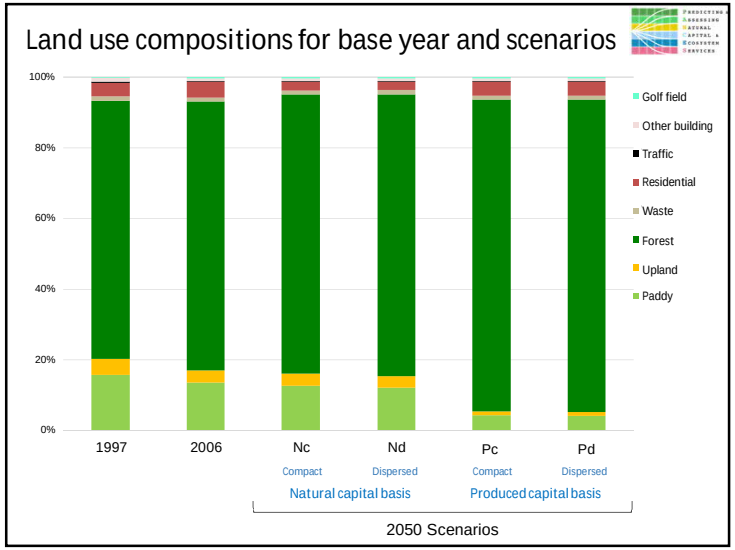

Food production (hectares)
* Farmland area used as proxy
(ha/mesh)
Water yield (m3/yr.)
(m3/yr./mesh)

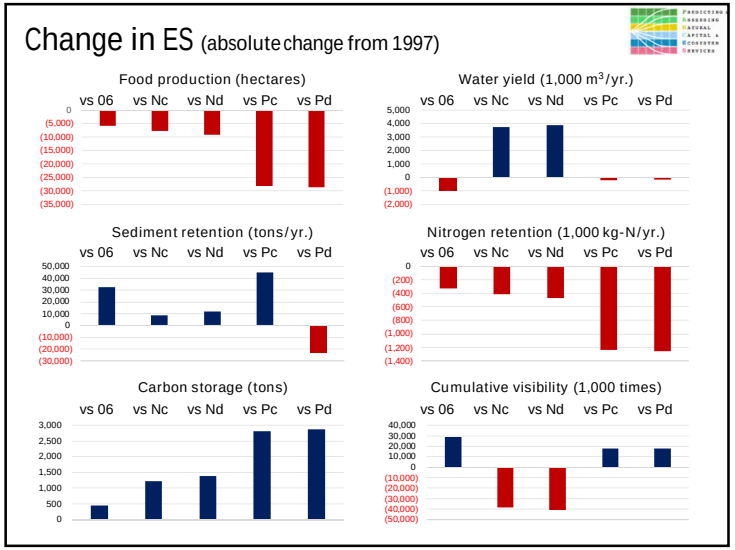

Nitrogen retention (kg-N/yr.)
(kg-N/yr./mesh)
Sediment retention（ton/yr.）
*comparison to bare soil
(ton/yr./mesh)
※1997年値


Carbon storage（tons）
(tons/mesh)
Cumulative visibility（times）
* from residential land
(times)


Natural capital based compact society (NC)
Natural capital based dispersed society (ND)
Natural capital basis
Higher food self-sufficiency
Eco-tourism and expansion of tourism in domestic countryside
Use of ecosystem-based & green infrastructures
Increase in the use of renewable energy
Urban compactification
Promotion of compact cities
Rewilding /greening of underutilized land
Centralized heat and energy
Prefer domestic products
Association oriented (connection based on purposes)
Counter urbanization
Decentralized heat and energy
Prefer local production and local consumption
Decentralized authority (decision making)
Community oriented (place-based)
Dispersed population
Inexpensive and diverse choices by increased imports
Extensive use of ICT/AI for improved productivity
Conventional infrastructure development
Improved efficiency in conventional power generation and energy consumption
Utilization of CCS (carbon capture and storage) technology
Produced capital basis
Produced capital based compact society (PC)
Produced capital based dispersed society (PD)
* Future land demand was set for each land use categories for each scenario


Land use projection under four scenarios
Natural capital based compact society (NC)
Natural capital based dispersed society (ND)
Natural capital basis
Urban compactification
Dispersed population
Produced capital basis
Produced capital based compact society (PC)
Produced capital based dispersed society (PD)
Legend
Paddy
Upland crop
Forest
Waste
Residential
Traffic
Other building
Golf field
* Future land demand was set for each land use categories for each scenario


Land use compositions for base year and scenarios
100%
80%
60%
40%
20%
0%
1997
2006
Nc
Nd
Pc
Pd
Compact
Dispersed
Compact
Dispersed
Natural capital basis
Produced capital basis
2050 Scenarios
Golf field
Other building
Traffic
Residential
Waste
Forest
Upland
Paddy


Change in ES (absolute change from 1997)
Food production (hectares)
Water yield (1,000 m3/yr.)
Sediment retention (tons/yr.)
Nitrogen retention (1,000 kg-N/yr.)
Carbon storage (tons)
Cumulative visibility (1,000 times)
vs 06
vs Nc
vs Nd
vs Pc
vs Pd

Conclusion

- For all the four scenarios, food provision, nitrogen retention decreased while carbon storage increased in exchange
  - Due to the loss of farmland and the expansion of forest
- Water yield and sediment retention increased slightly under natural capital scenarios while cumulative visibilities increased under produced capital scenarios
- Population distribution did not exhibit significant differences in the provision of ecosystem services in our analyses

- Future work
  - Detailed municipal and mesh-scale analysis of changes in ES
  - Expansion of ecosystem service categories for scenario analysis such as recreation
  - Analysis of the implication on biodiversity