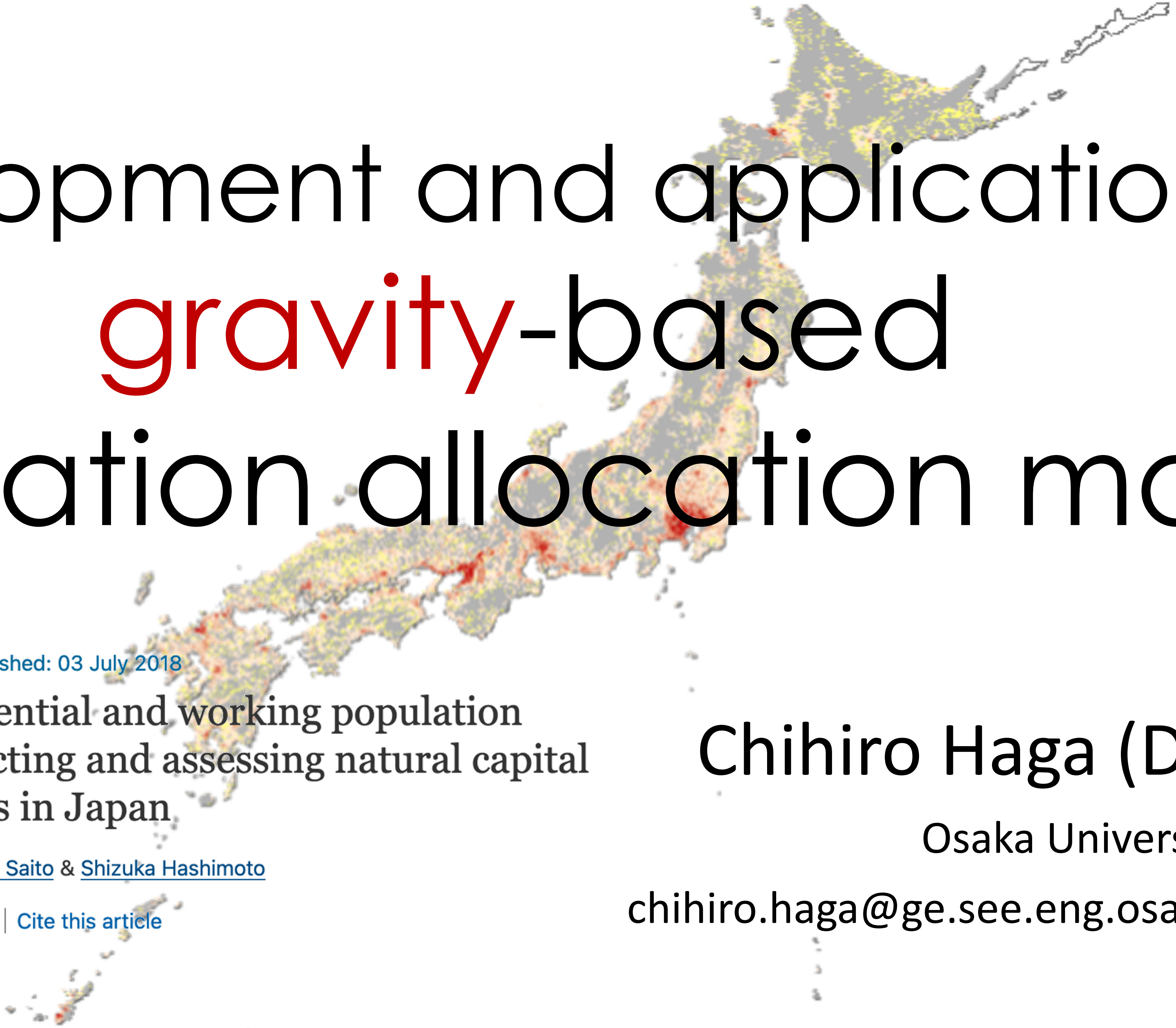
Development and application of gravity-based population allocation model



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Spatially explicit residential and working population assumptions for projecting and assessing natural capital and ecosystem services in Japan

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Data requirement
for our gravity-based population allocation model

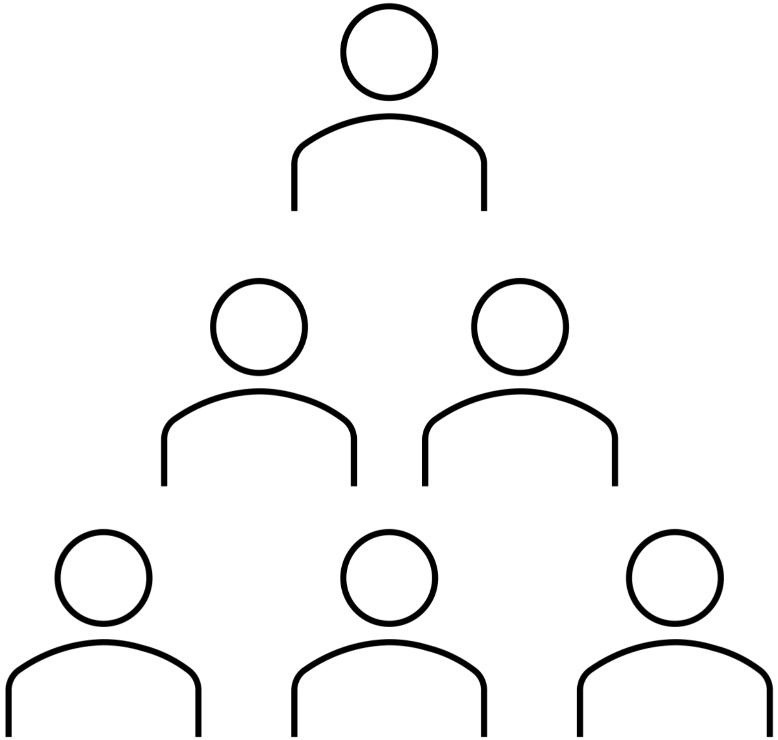
Gridded population data

- Current
- Future (Business as Usual)

  <- Ask your government or SSP scenario researchers!

Population scenario narratives

Gravity-based population allocation?

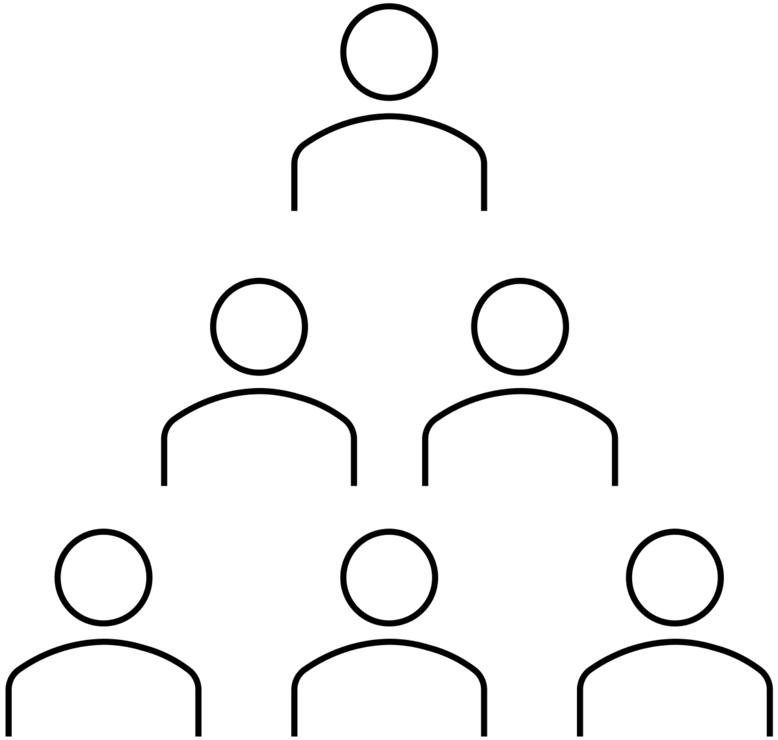


6 people will be allocated

20	10
0	30

Four grids with different population

Gravity-based population allocation?

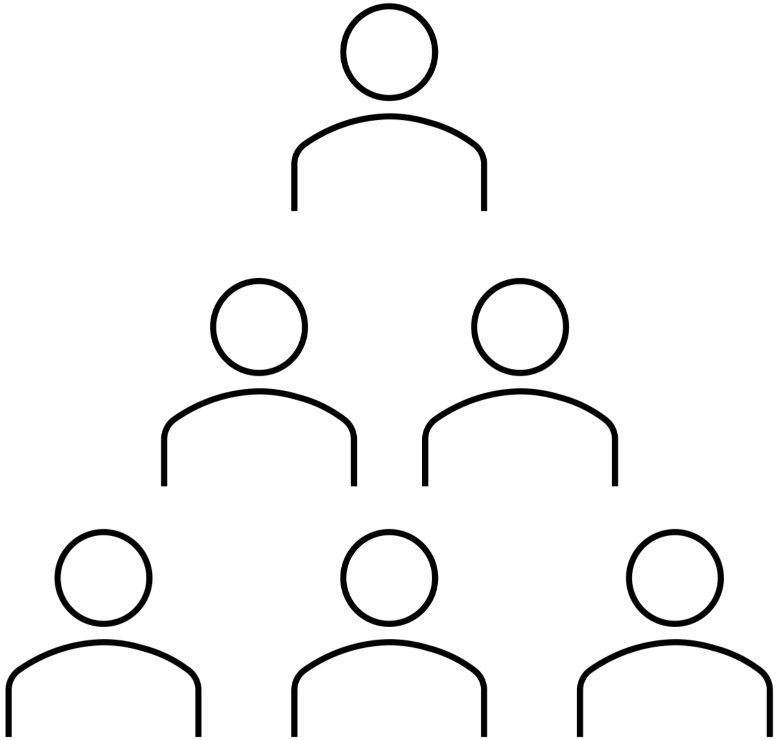


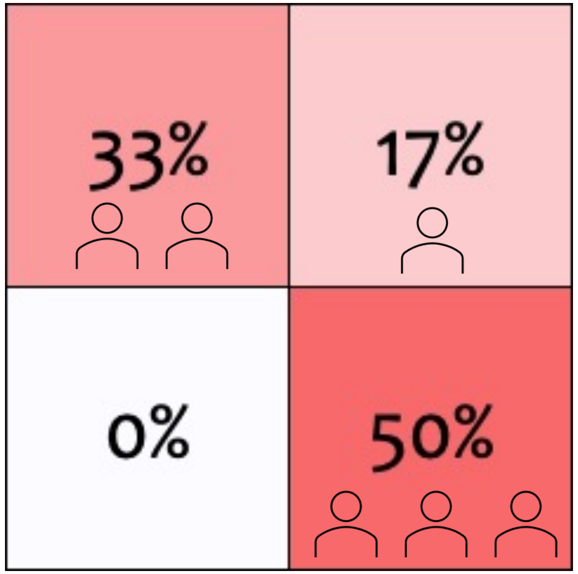
6 people will be allocated

Step 1

Compute proportion for each grid == gravity

Gravity-based population allocation?

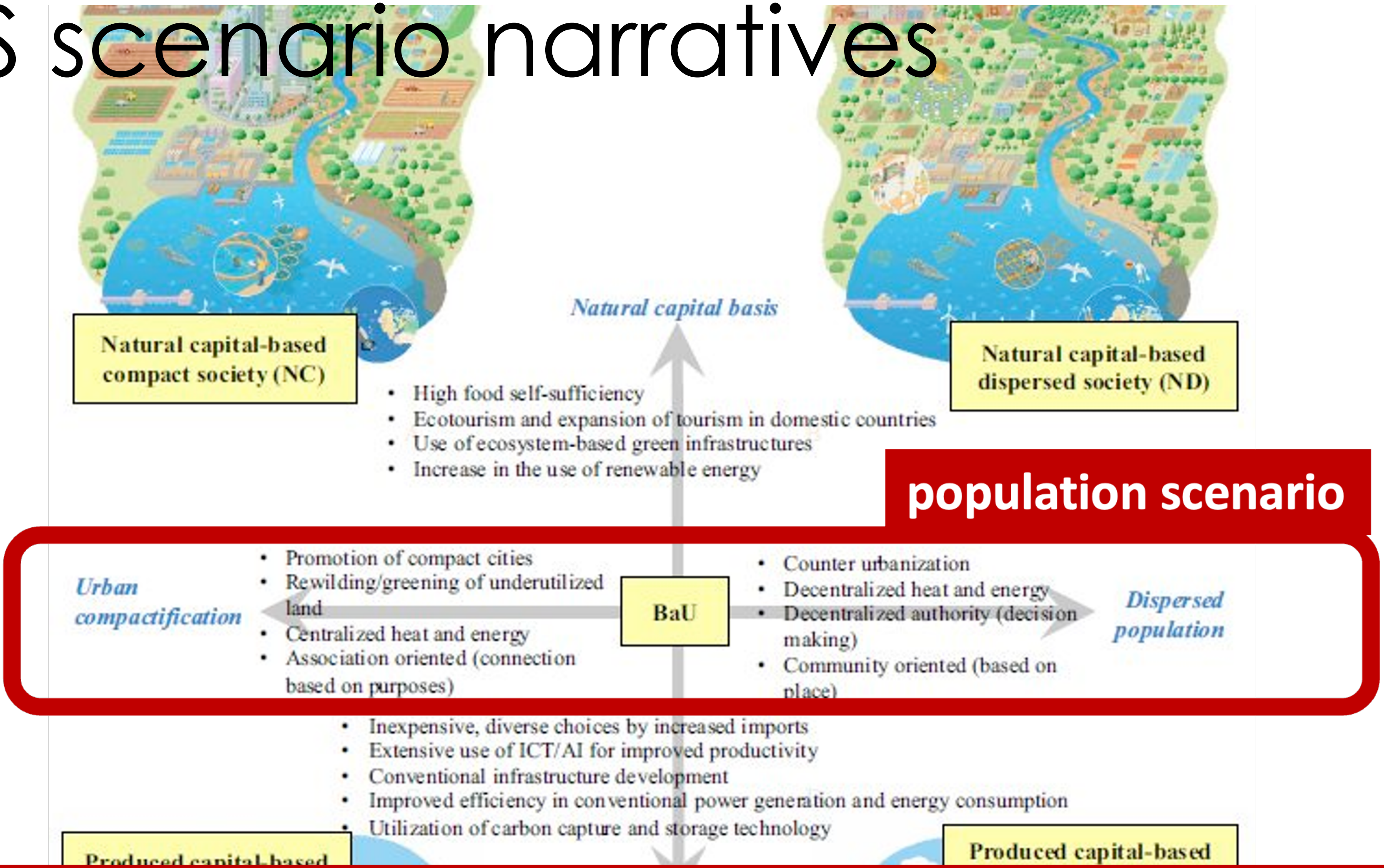




Step 2

6 people are allocated according to the percentage

PANCES scenario narratives



Assumption of our gravity-based population allocation model

- Total population sizes are the same
- Population distributions are different in response to each storylines
- Consider migration only within each administrative boundary

Algorithm 1. Urban Compactification

People are assumed to abandon rural areas and move to the centers of cities

Total = **54**
Zero pop grids = **8**

1	1	0	0	1
1	3	7	7	1
0	1	8	10	1
0	2	4	4	0
1	1	0	0	0

BaU
in 2050

1	1	0	0	1
1	3	7	7	1
0	1	8	10	1
0	2	4	4	0
1	1	0	0	0

Select grids to be 0

See our technical paper!!

0	0	0	0	0
0	1	1	1	0
0	0	1	2	0
0	0	1	1	0
0	0	0	0	0

Allocate eight people
to centers of cities

Total = **54**
Zero pop grids = **16**

0	0	0	0	0
0	4	8	8	0
0	1	9	12	0
0	2	5	5	0
0	0	0	0	0

Compact
in 2050

Algorithm 2. Dispersed population

People are assumed to remain in the rural area to manage natural areas

Total = **54**
Zero pop grids = **8**

1	1	0	0	1
1	3	7	7	1
0	1	8	10	1
0	2	4	4	0
1	1	0	0	0

BaU
in 2050

1	1	0	0	1
1	3	7	7	1
0	1	8	10	1
0	2	4	4	0
1	1	0	0	0

Select grids
to preserve at
the 2010 level

(in yellow grids, 13 people lived in 2010)

See our technical paper!!

0.2	0.2	0.0	0.0	0.2
0.2	0.7	1.7	1.7	0.2
0.0	0.2	1.9	2.4	0.2
0.0	0.5	1.0	1.0	0.0
0.2	0.2	0.0	0.0	0.0

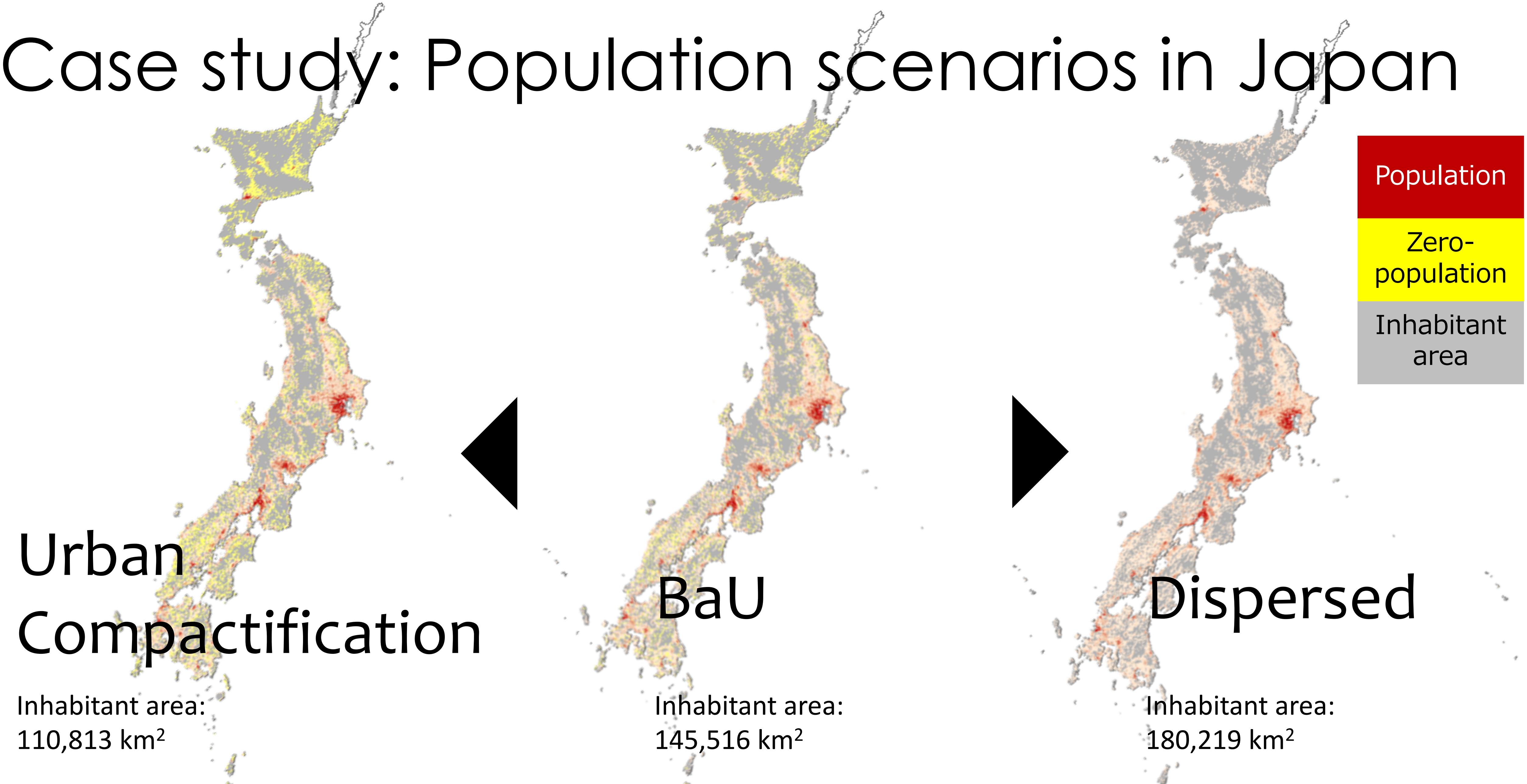
Allocate
13 people
from the surrounding grid

Total = **54**
Zero pop grids = **0**

1	1	3	2	1
1	2	5	5	1
1	1	6	8	1
1	2	3	3	2
1	1	1	2	1

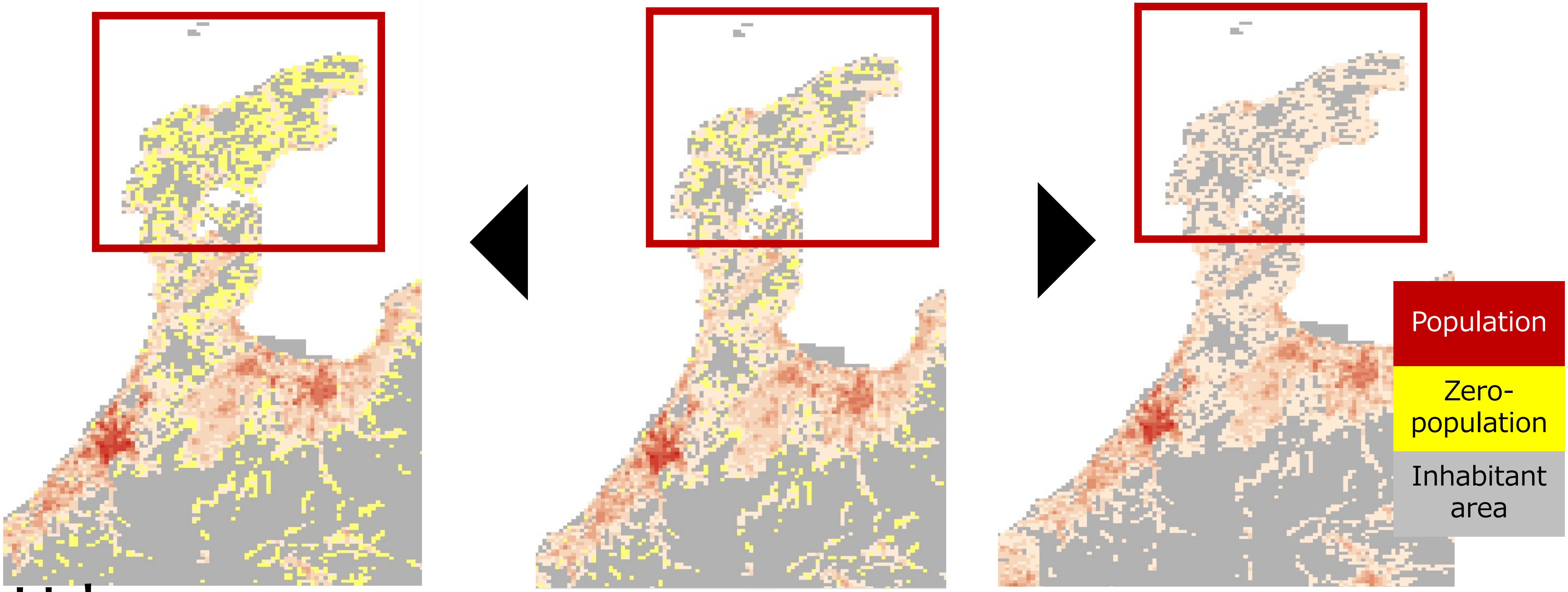
Dispersed
in 2050

Case study: Population scenarios in Japan



Residential population distribution in 2050 by scenario (n = 97,074,889 in both scenarios). The population density (person/km^2) is shown in red, the uninhabitable areas are shown in gray, and the zero population areas are shown in yellow

Case study: Population scenarios in Japan



Urban Compactification

BaU

Dispersed

Application: Population vs. Natural Capital

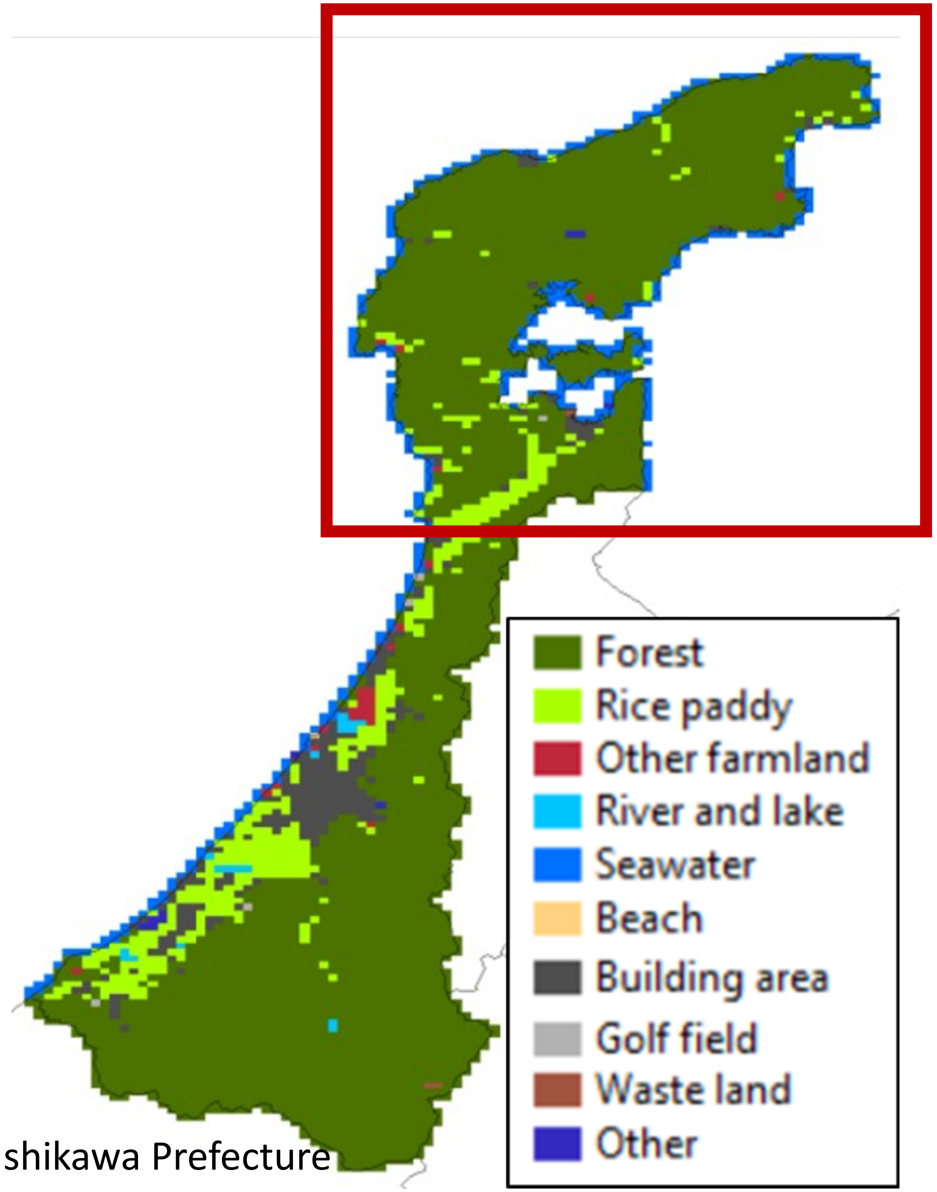


Fig 8
LULC of Ishikawa Prefecture

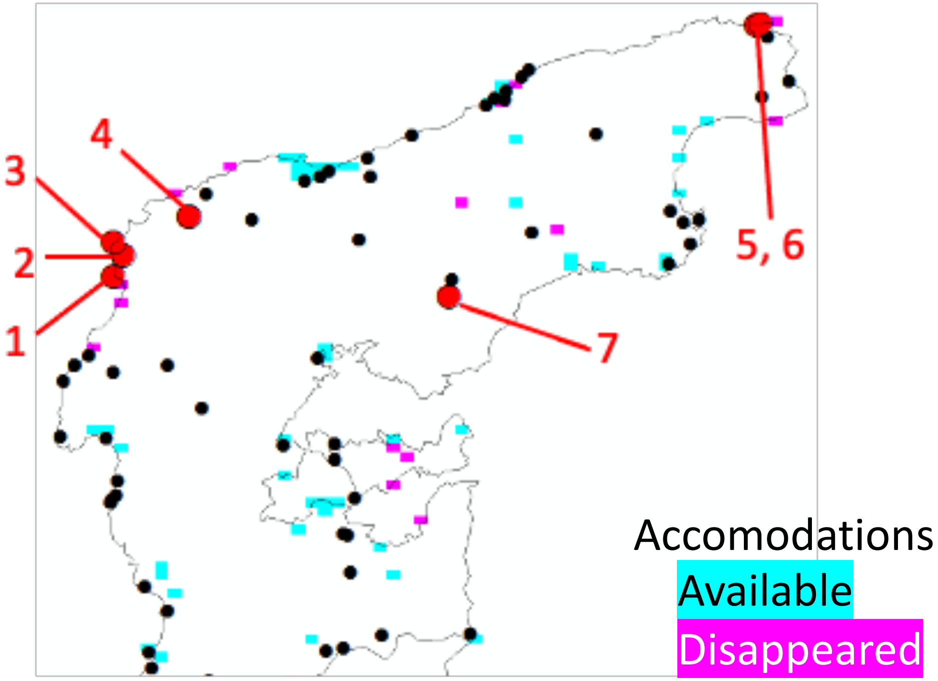


Fig 10 b
Distribution of poorly accessible natural landscape resources in 2050 on the Noto Peninsula in the Ishikawa Prefecture. The black points indicate locations of natural landscape resources. The red points represent natural landscape resources where accommodations within a 10-km radius become difficult to maintain in 2050.

Summary:

Development and application of gravity-based population allocation model

Data requirement:

- Current & future baseline gridded population
- Population scenario narratives

For more complex modeling → Next speaker

- Consider age – sex class cohort dynamics
- Migration beyond administrative boundaries
- Strength of compactification/dispersion

Any questions or ideas?