

Impact of Water Accessibility on the Carrying Capacity and Vulnerability of Pasture in Arid and Semi-arid Regions --- A Case Study in Mongolia

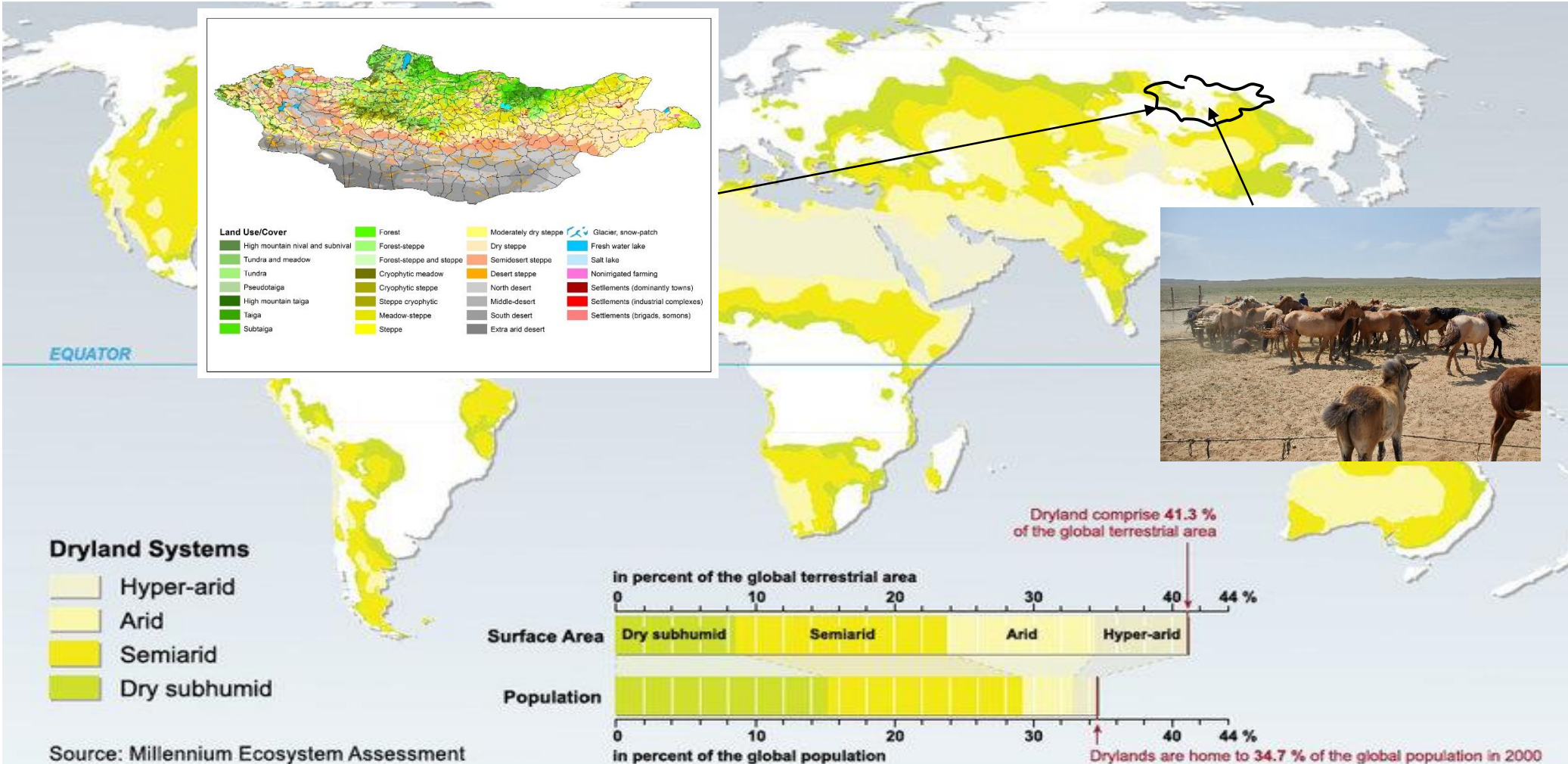
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Research Background

- Arid and semi-arid regions cover 41% of the global land area and near 2 billion people (34.7%) live there, where fragile environment is getting more vulnerable due to climate change and human activities.

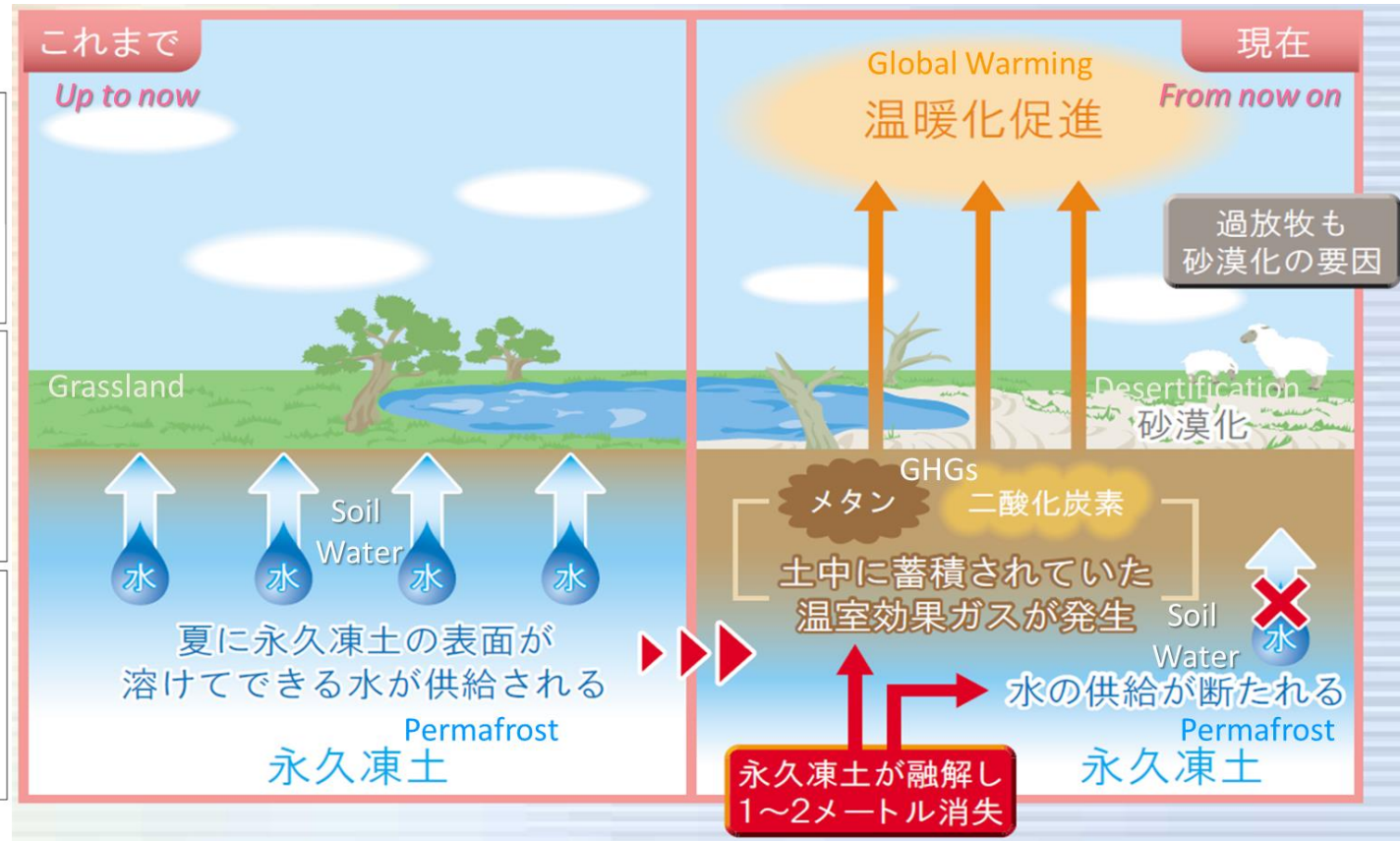
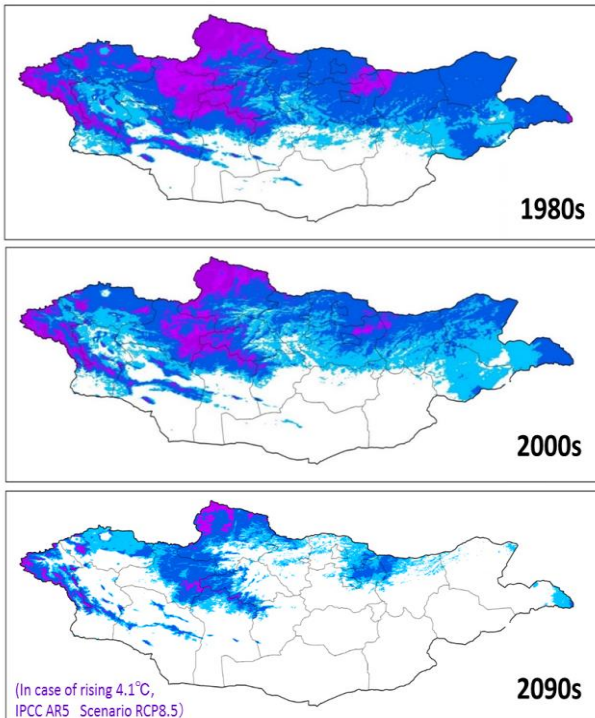


Source: Millennium Ecosystem Assessment

Impact of Climate Change

Our previous study result: **Global warming ⇒ Degradation of permafrost ⇒ Land surface water deficit & dryness ⇒ Grassland productivity ⇒ Pasture carrying capacity**

Degradation of permafrost

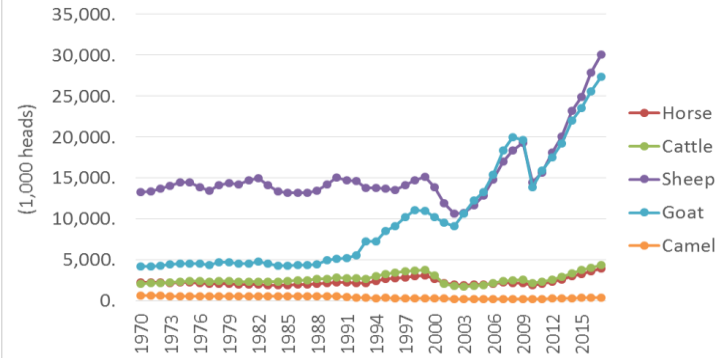


Vulnerability Assessment and Adaptation Strategies for Permafrost Regions in Mongolia

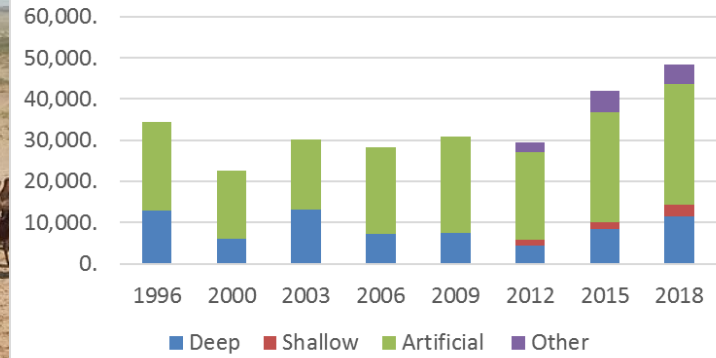
(Environment Research and Technology Development Fund (ERTDF; E-1203), Ministry of the Environment, Government of Japan 2012-2014) http://www.data.go.jp/data/dataset/env_20170508_0021

Impact of Anthropogenic Disturbances

Numbers of Livestock



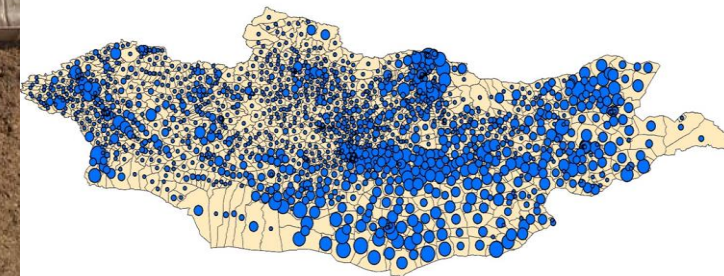
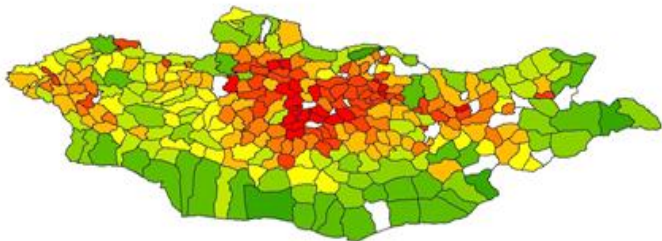
Number of wells by types



Water availability & accessibility might be one of the major factors to affect pasture carrying capacity



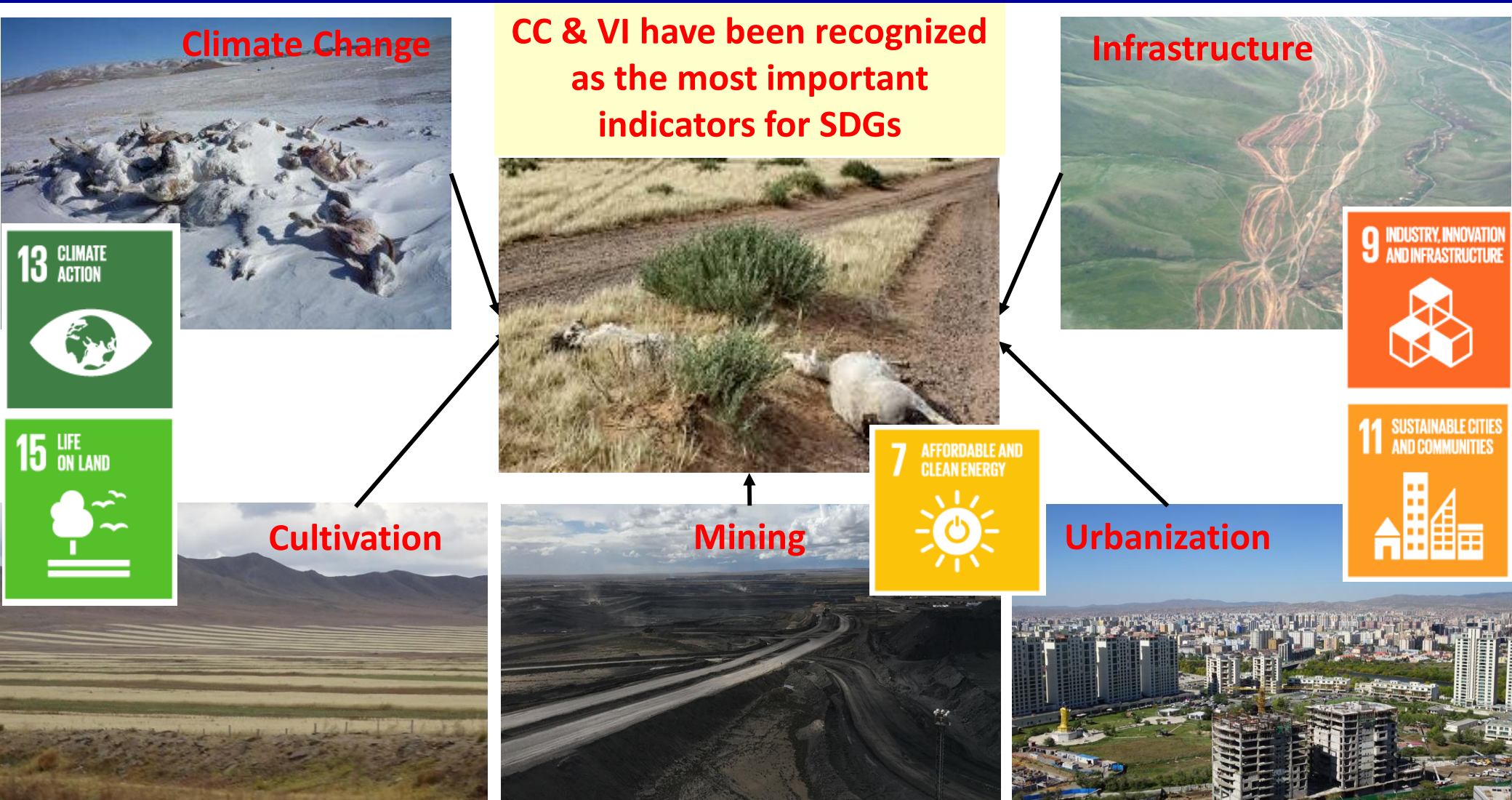
Livestock density (2010-2016)



Numbers of wells of each village (2012)

- 0 - 6
- 7 - 20
- 21 - 40
- 41 - 61
- 62 - 85
- 86 - 117
- 118 - 159
- 160 - 279

Research Objectives



- To develop an integrated model to detect the effects of water availability & accessibility on pasture carrying capacity (CC) and its vulnerability (VI) and to propose adaptation strategies for the resilience of pasture ecosystem in arid and semi-arid regions

International Cooperation



MEMORANDUM OF UNDERSTANDING
 BETWEEN
 NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES, JAPAN
 AND
 THE INSTITUTE OF GEOGRAPHY AND GEOECOLOGY,
 MONGOLIAN ACADEMY OF SCIENCES, MONGOLIA
 FOR
 JOINT RESEARCH ON ENVIRONMENT VULNERABILITY AND ITS
 ADAPTATION STRATEGIES IN ARID AND SEMI-ARID REGIONS

Evaluation of
 Carrying
 Capacity and its
 Vulnerability in
 Arid and Semi-
 arid Regions



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 NATIONAL INSTITUTE FOR ENVIRONMENTAL STUDIES, JAPAN
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Jan. 16, 2019, Tsukuba



Aug. 6, 2019, UB

Chiho Watanabe

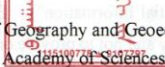
WATANABE, Chiho, Ph. D.
 President
 National Institute for Environmental Studies,
 Japan



Date: *July 4, 2018*

Batbogtokh Dorjgotov

BATTOGTOKH, Dorjgotov
 Director
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 Mongolian Academy of Sciences
 Mongolia



Date: *July. 04. 2018*

Chiho Watanabe

WATANABE, Chiho, Ph.D.
 President
 National Institute for Environmental Studies,
 Japan



Date: *July 4, 2018*

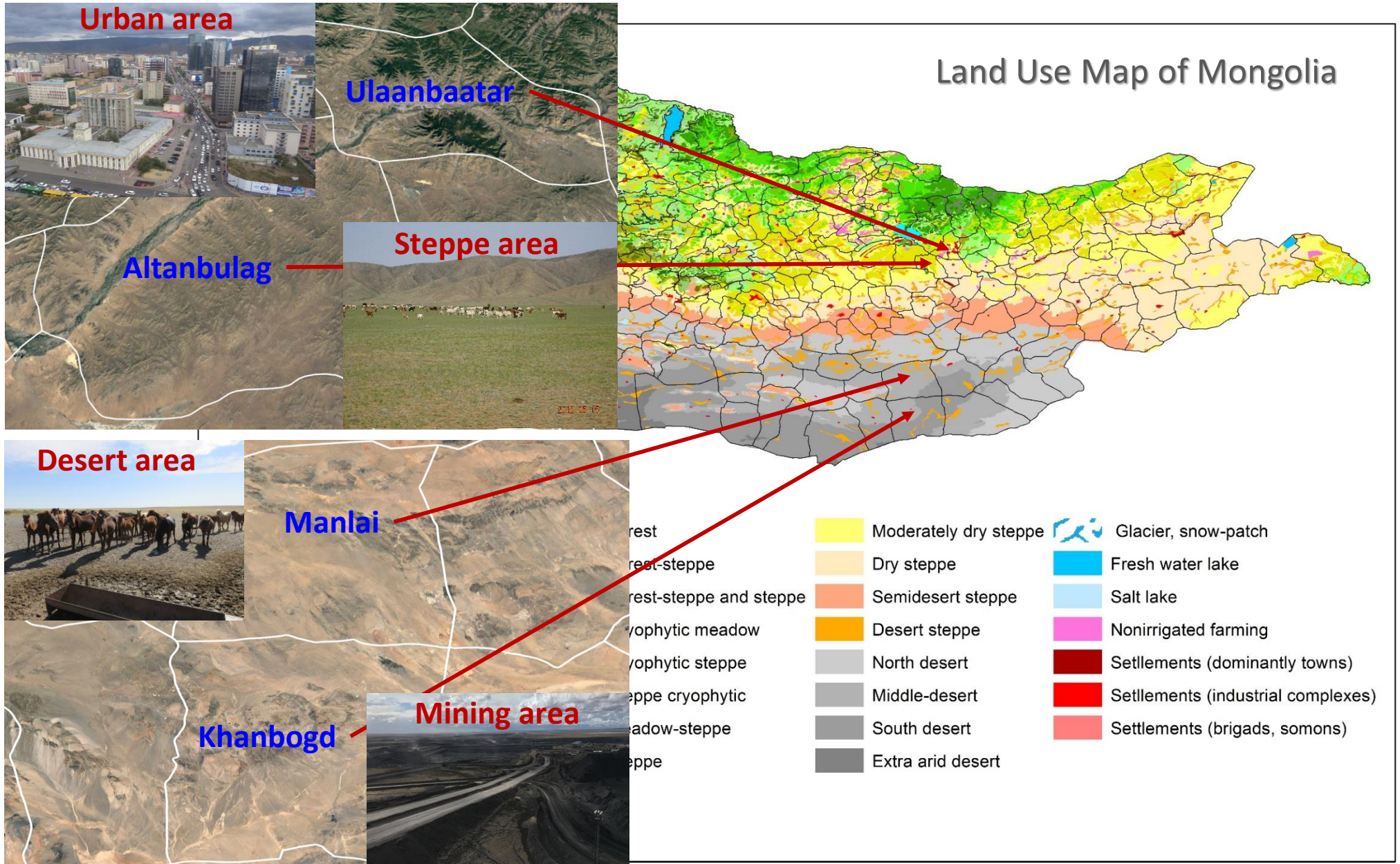
Bayartogtokh Badamdorj

Bayartogtokh, Badamdorj
 Dean of School of Arts and Sciences
 National University of Mongolia
 Mongolia



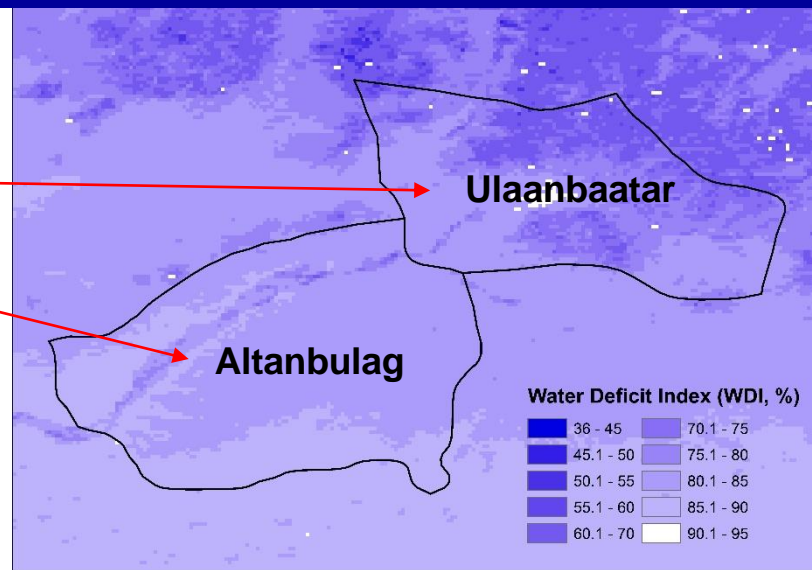
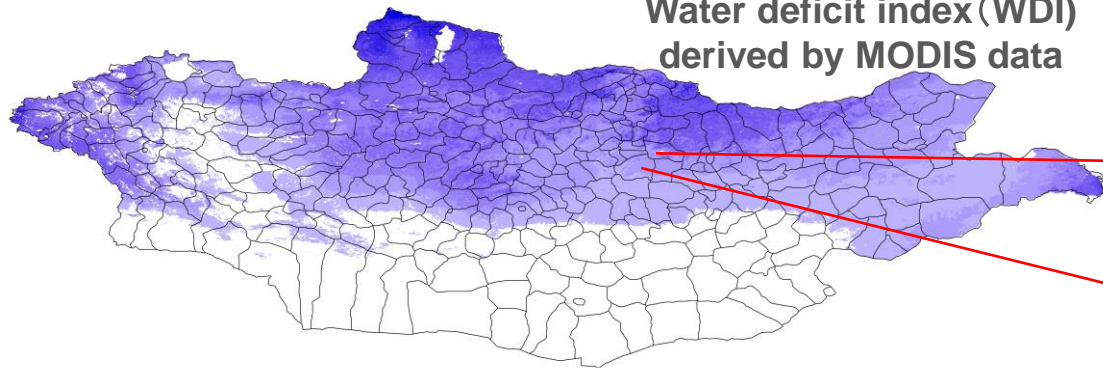
Date: *July 23, 2018*

Case Study Areas

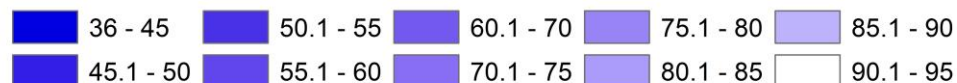


Input Data

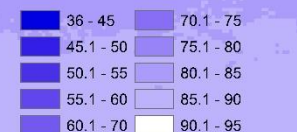
Water deficit index (WDI)
derived by MODIS data



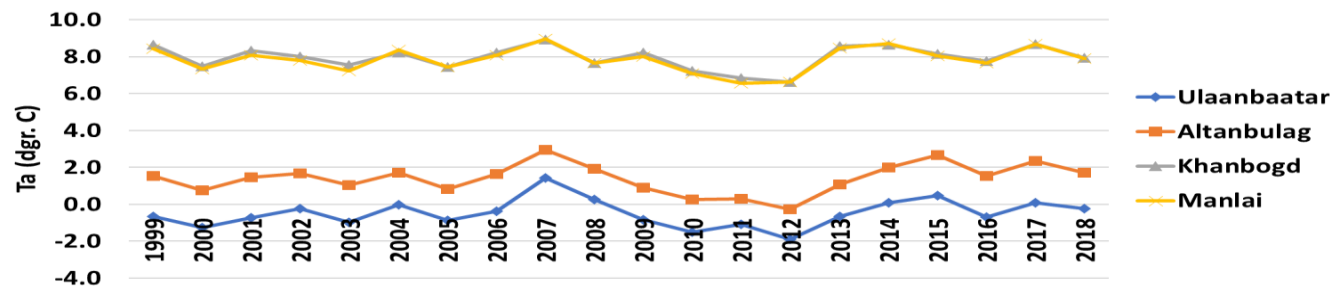
Water Deficit Index (WDI, %)



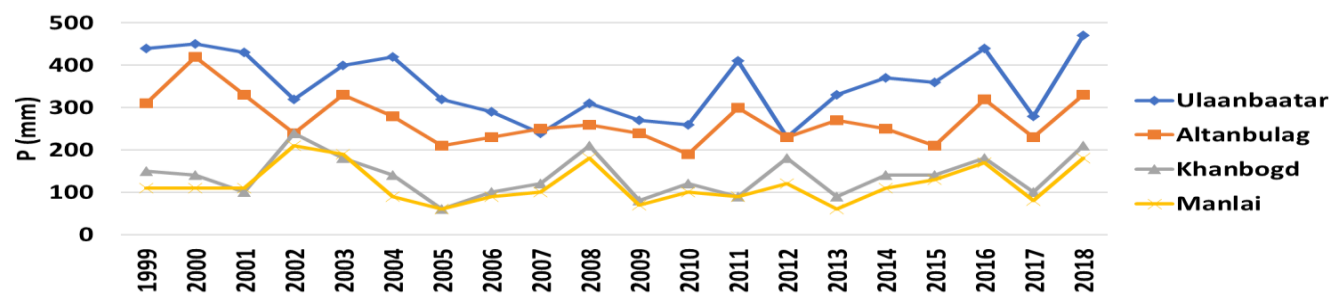
Water Deficit Index (WDI, %)



Annual change of air temperature (Ta) (2000-2017)

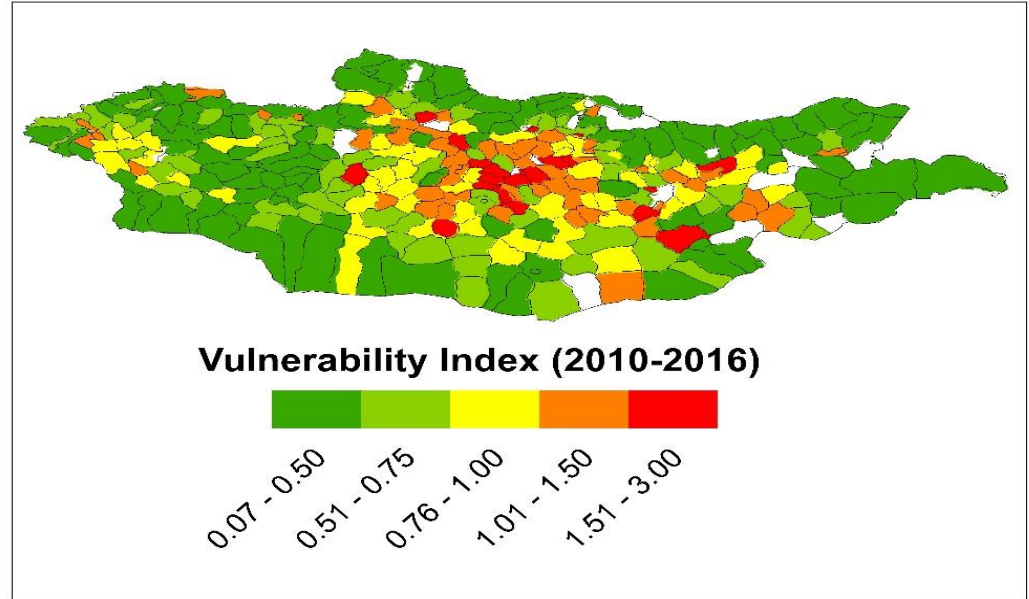
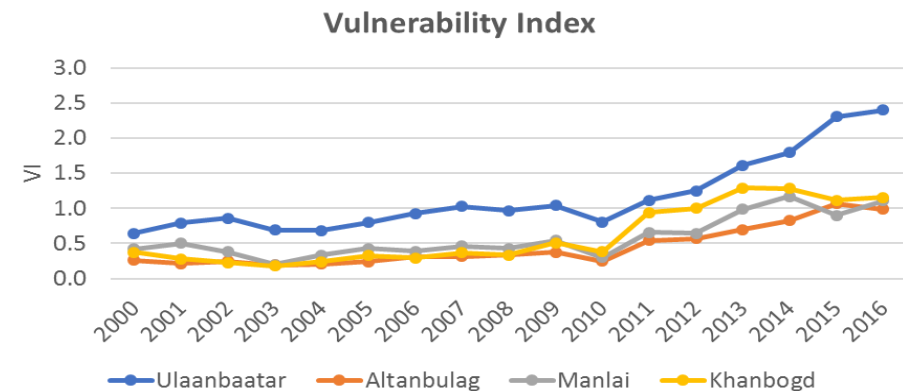
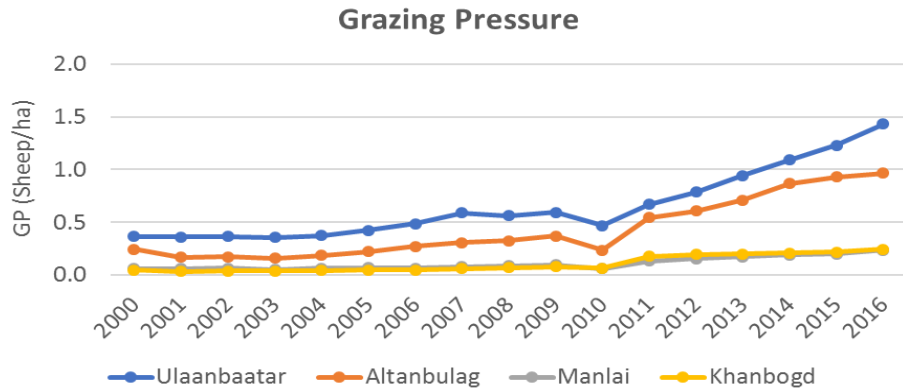
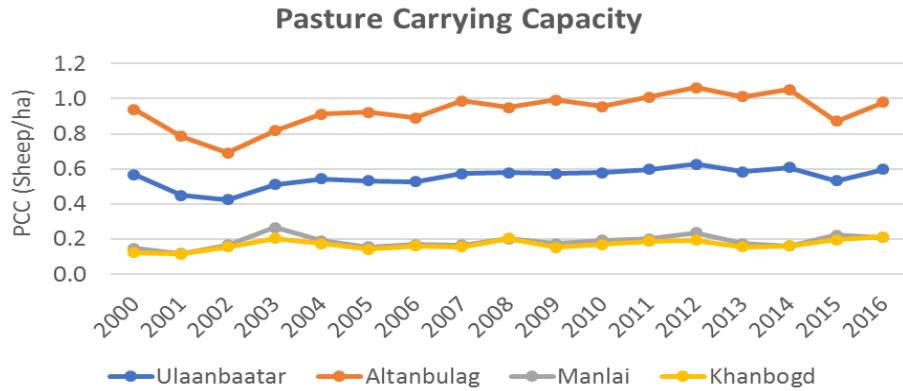


Annual change of Precipitation (P) (2000-2017)



<https://www.ecmwf.int/en/forecasts/datasets/browse-reanalysis-datasets>

Major Results



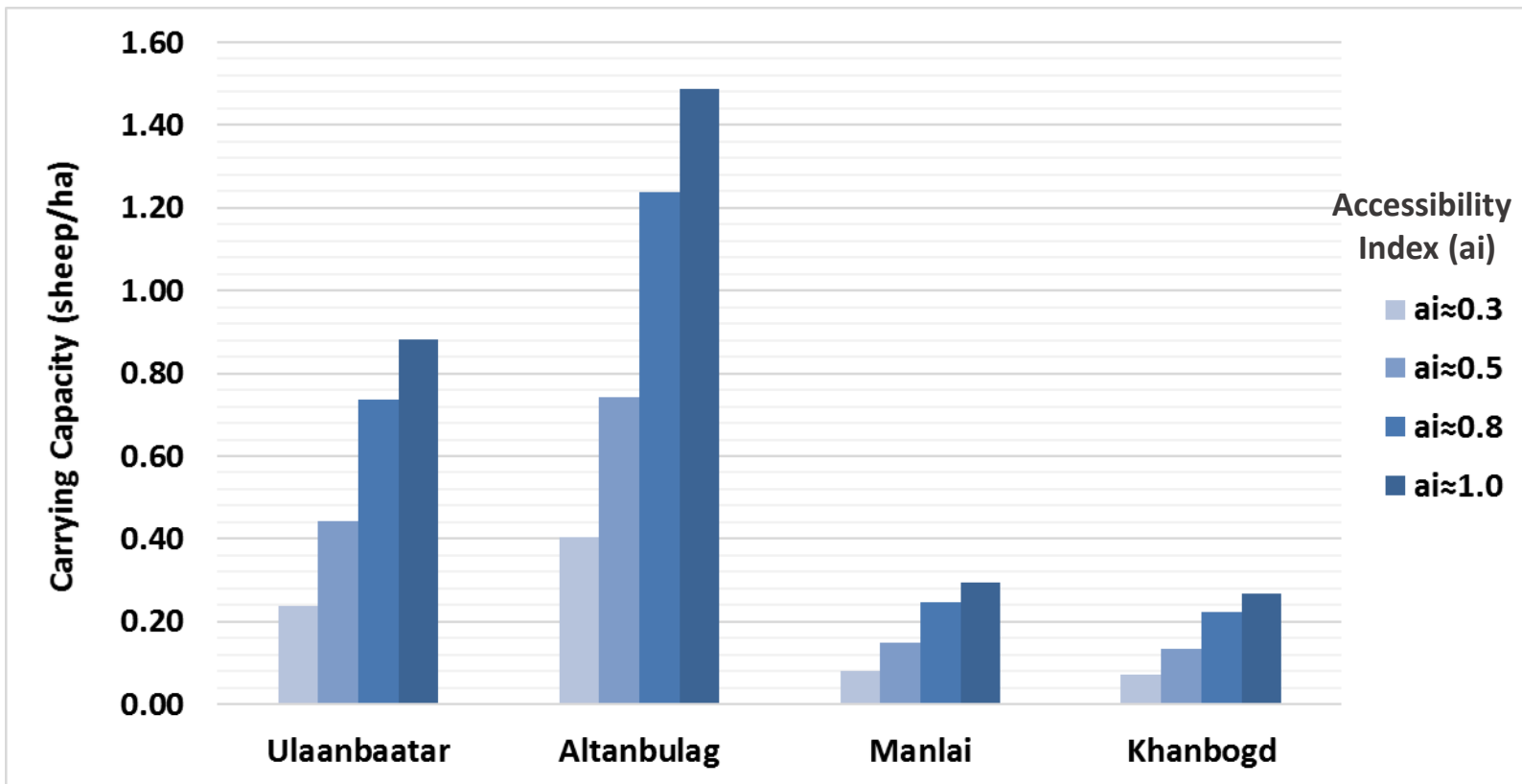
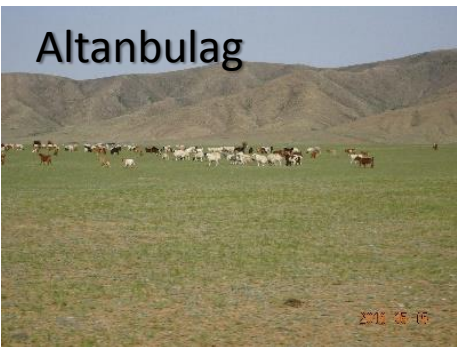
The result indicates:

CC: steppe area > urban area > desert area > mining area

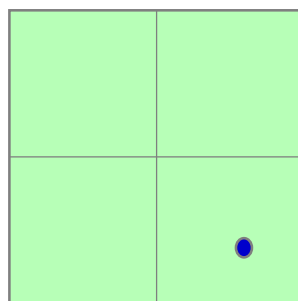
GP: urban area > steppe area > mining area > desert area

VI: urban area > mining area > desert area > steppe area

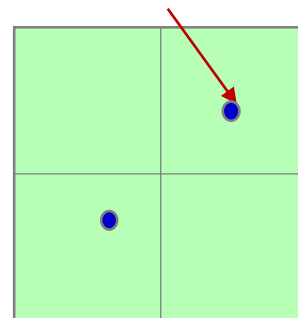
Scenarios: Impact of Water Accessibility



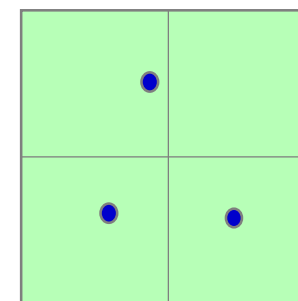
Water source point (well, spring, river, pond et.)



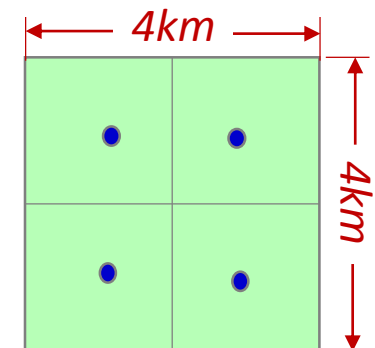
ai ≈ 0.3



ai ≈ 0.5

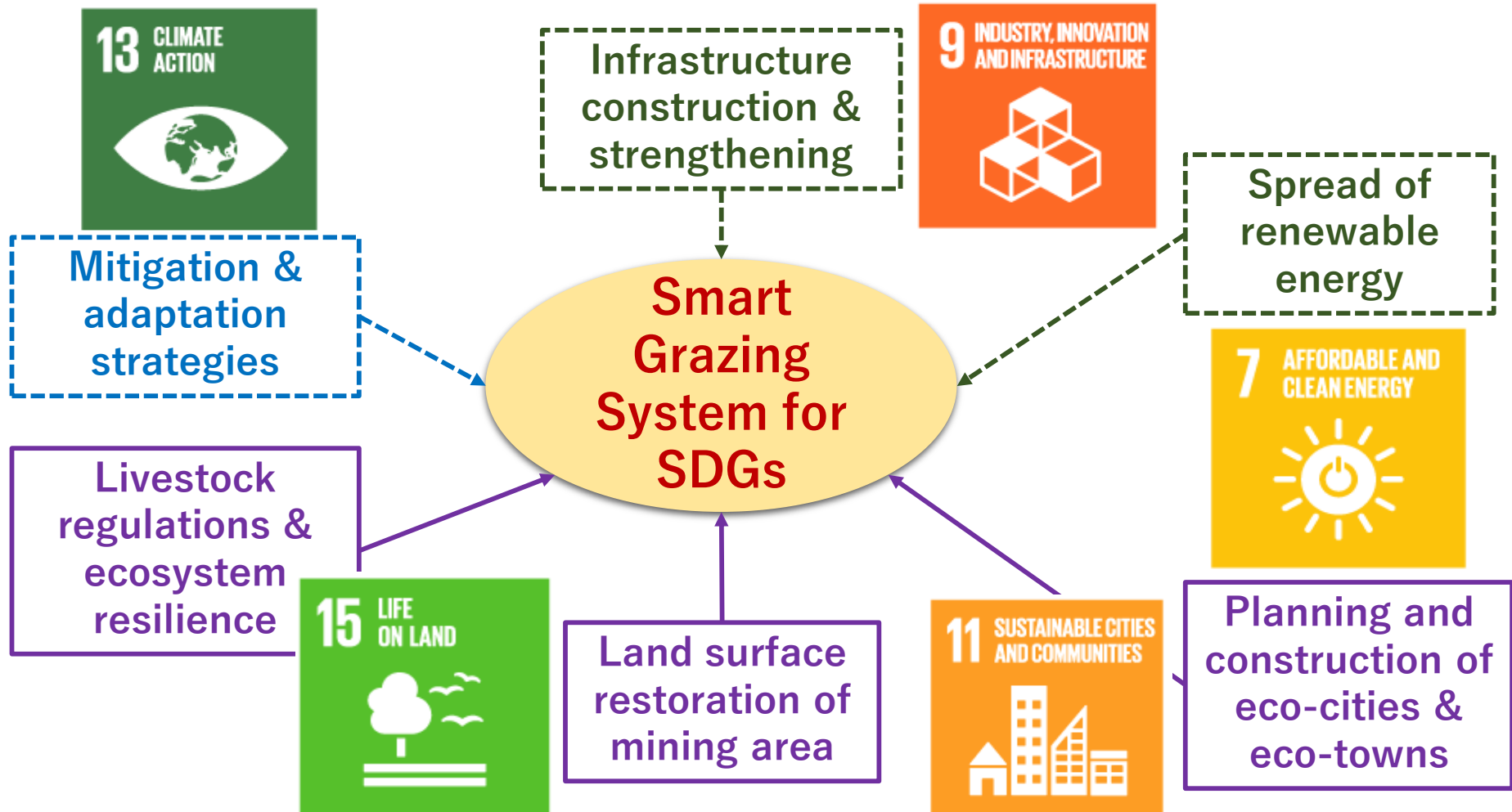


ai ≈ 0.8



ai ≈ 1.0

Proposals for Adaptation Strategies



Proposals for Adaptation Strategies

Smart Grazing System for SDGs

Collaboration with local residents and decision makers

Find the suitable area for grazing by remote sensing technologies

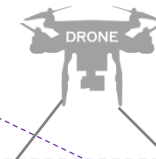
Development of low carbon technologies

Providing information by establishing an early warning system

Livestock management by using innovative technologies

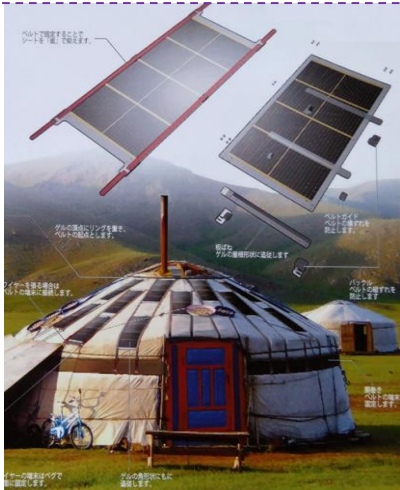
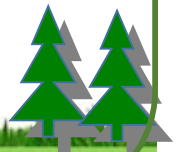
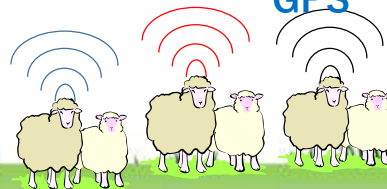
Terminal

Drone



GPS

GPS



Energy

Acknowledgments

The research was supported by the following projects:

- **Evaluation of the pasture carrying capacity and its vulnerability based on water resources in arid and semi-arid regions** (A Research Project supported by the NIES Research Funding (Type A) , 2018-2020)
https://web2.nies.go.jp/subjects/2018/24457_fy2018.html
- **Project to Implement MRV and Related Technological Improvements Contributing to the Joint Crediting Mechanism (JCM) in Mongolia** (Ministry of the Environment, Government of Japan , 2014-2019)
<http://www.ccau.jp/English/>
- **Vulnerability Assessment and Adaptation Strategies for Permafrost Regions in Mongolia** (Environment Research and Technology Development Fund (ERTDF; E-1203), Ministry of the Environment, Government of Japan 2012-2014)
http://www.data.go.jp/data/dataset/env_20170508_0021