MONGOLIAN ACADEMY OF SCIENCES

SUSTAINABLE DEVELOPMENT INSTITUTE FOR WESTERN REGION OF MONGOLIA

Keio University

Northwest Institute of Eco-Environment and Resources

ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

1ST discussion workshop on Ecological Vulnerability Assessment

BOOKLET

Tongliao, Inner Mongolia, China,
5-8 July 2018

WORKSHOP ORGANIZER

- **International Organizer:** Sustainable development institute for western region of Mongolia, and Mongolian Academy of Sciences
- **Local Organizer:** Green Network NGO, Japan and Northwest Institute of Eco-environment and Resource, CAS

- **Project title:** “Ecological vulnerability assessment for adaptation strategy formulation at different spatial scales in western Mongolia and China”
- **Reference Number:** CRRP2017-04MY-Balt
- **Project Supporter:** APN

WORKSHOP SCOPE

- The aim of the workshop is to discuss the progress and situation of the project, a preliminary outputs of the assessment in each selected research area, next steps of the project, and exchange an experiences of the all research collaborators in one point.
- The workshop will focus on the indicators of ecological vulnerability assessment including pasture degradation, agriculture, water resource shortage and climate change related extreme impacts in Mongolia and China.

Workshop program

5 July 2018 (Thursday)		
8:30-23:00	**Arrival**	**At Horqin** all delegates arrival **Bo Wang Hotel, Tongliao, Inner Mongolia**
6 July 2018 (Friday)		
08:50-09:00	**Registration**	At lobby of hotel
09:00-12:00	**Field visit Tour**	Visit to Replanting area of Green Network
12:00-14:00	**On site**	Lunch with local farmers at local restaurant
14:00-18:00	**Field visit Tour**	Visit to different management (individuals, local government and community groups) of Replanting area
18:00-20:00	**Dinner**	Welcoming dinner at Hotel restaurant

Workshop program

7 July 2018 (Saturday)		
08:30-08:55	**Registration**	➢ All participants
09:00-09:05	**Opening Remarks**	➢ Altanbagana.M PhD, Head of social economic division, IGG, MAS ➢ Prof. Wanglin YAN, Director of Research center for Climate Change Adaptation, Keio University, Japan
09:05-09:15	**Introduction**	Dr. B.Suvdantsetseg **Project introduction:** "Ecological Vulnerability Assessment for Adaptation Strategy Formulation at Different Spatial Scales in Western Mongolia and China"
09:15-9:40	**Invited lecture**	Prof. Wanglin YAN, Director of Research center for Climate Change Adaptation, Keio University, Japan **Using Machine Learning to Assess and Predict the Risk of Livestock Disaster**
09:40-10:00	**Invited lecture**	Prof. Xueyong Zhao Northwest Institute of Eco-environment and Resource, CAS **Growing vulnerability of desertification reversion in Horsing Sandy Land of China**
10:00-10:20	**Discussion**	
10:20-10:35	**Group photo and Coffee break**	

Workshop program

Session chair: T. Miyasaka (PhD)		
10:35-11:00	**Speaker**	Prof. Li Yuqiang, Northwest Institute of Eco-environment and Resource, CAS **“Carbon sequestration in the plant-soil system following grazing exclusion and afforestation in dessertified area of Horsing Sandy Land”**
11:00-11:25	**Speaker**	McS. Kherlenbayar.B, Sustainable development Institute for western region of Mongolia **“Ecological vulnerability assessment of Khovd and Gobi-Altai provinces, Mongolia”**
11:25-11:45	**Speaker**	McS. Wu Nitu, Grassland survey and planning institute of Inner Mongolia, China **“Grassland degradation and monitoring system in Case study of Tongliao province, China”**
11:45-12:05	**Speaker**	McS. B.Gantuya, institute of General and experimental Biology, MAS, Mongolia **“Botanical and Grassland degradation monitoring experiences”**
12:05-12:30	**Discussion**	
12:30-13:30	**Lunch**	

Workshop program

Session chair: M. Altanbagana (PhD)		
13:30-13:50	**Speaker**	Dr.Takafumi Miyasaki, Nagoya university **“Social-ecological impacts of a payment for ecosystem services scheme in the Horqin Sandy Land”**
13:50-14:10	**Speaker**	Prof. Kenji Kai, department of Education, Ibaraki university **“Horqin Sandy Land as one of the sources of the Asian dust storm”**
14:10-14:30	**Speaker**	Dr. Shaokun Wang, Northwest Institute of Eco-environment and Resources, CAS **“Changes of soil microbial community along vegetation restoration in semi-arid sandy land of northern China”**
14:30-14:50	**Speaker**	Mr. Kitaura Yoshio, executive director of Green Network **Greening activity for restoration and adaptation management in Horqin case.**
14:50-15:10	**Tea Break**	
15:10-16:20	**Discussion**	
16:20-16:40	**Closing Remarks**	Dr.B.Suvdantsetseg, Director, Sustainable development institute for western region of Mongolia
19:30	**Dinner**	

Predict the Mortality Rate of the Livestock Under the Climate Change in Mongolia

A Case Study in the Gobi Desert Area of Mongolia

Wanglin Yan, Professor
Faculty of Environment and Information Studies
Graduate School of Media and Governance / Keio University
Yang Wang, Yan Lab.
Grade 2 / Master Student

Background

Introduction:

· Zud happens frequently in recent 20 years in Mongolia, caused millions of livestock loss (e.g. 1999-2002, loss of 10-12 million livestock; 2009-2010, more than 10 million livestock lost), impacted on more than one million of Mongolian herders.(Rao et al., 2015)

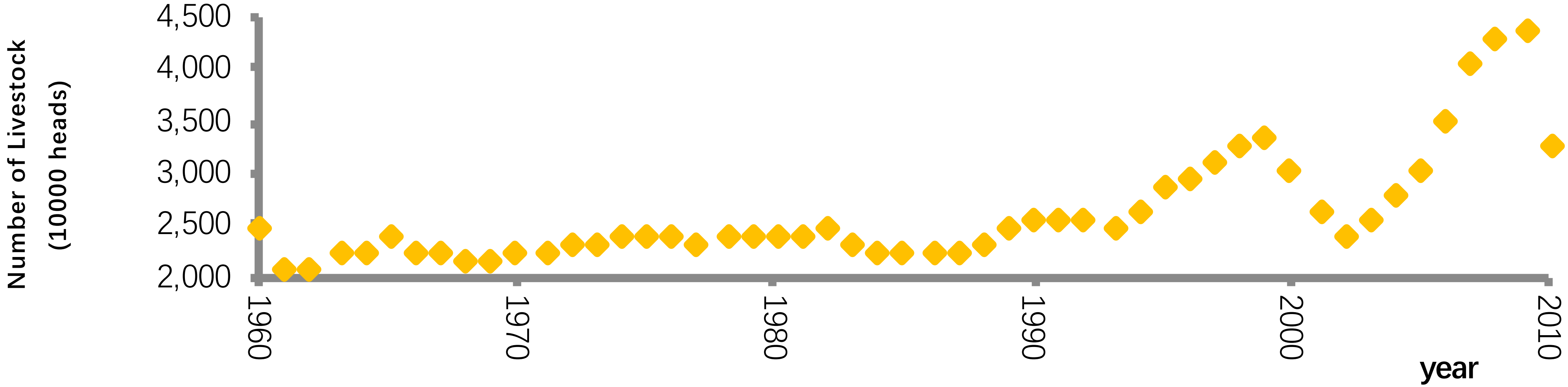
· Pre-disaster preparation is vital for helping herders to survive from serious livestock loss, especially in condition of relatively poor infrastructure and weak government.

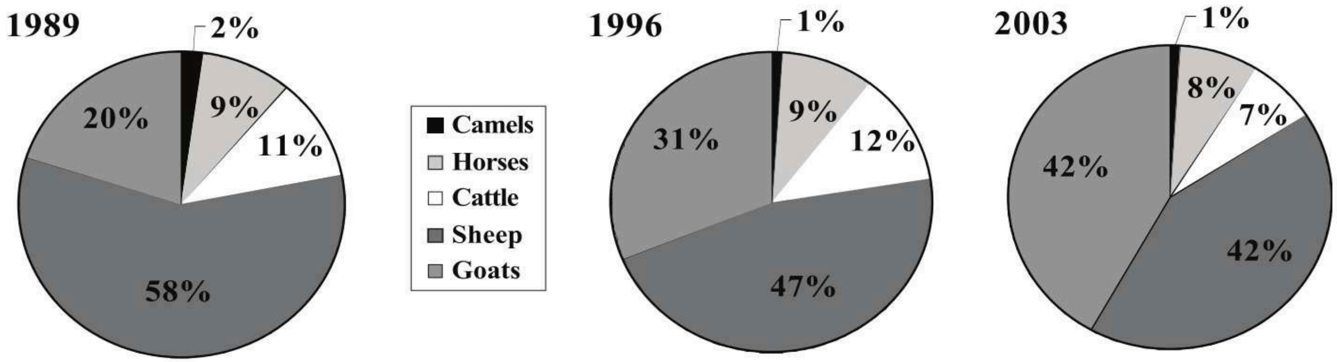
· Predicting livestock mortality is essential in making pre-disaster plans to deal with severe livestock loss.

Research question:

· Is it possible to make an prediction model to predict the livestock mortality?

Livestock in Mongolia





Data Source: Mongolian National Statistical Office (Byambatseren 2004, NSO-Mongolia 2004).

Research Objective

Objective :

The purpose of this research is to develop a prediction model of livestock mortality by machine learning from historical data.

Significance and applicability to :

1. Disaster response agencies.

The primary task of disaster response agencies is to reduce the risk of disasters (if possible) or reduce the impact of disasters. This study hopes to cooperate with relevant agencies to assess the probability of disaster in some area and formulate some kinds of response actions.

2. Mongolia government.

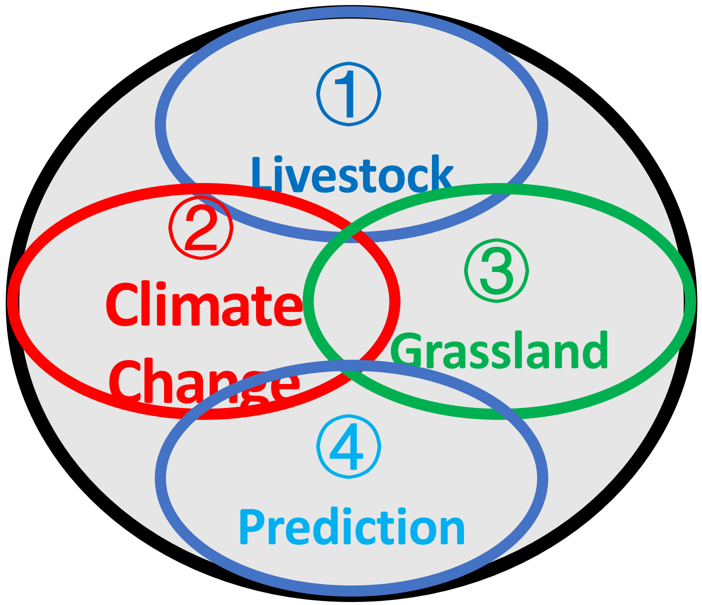
This study would assist with Mongolian governments to formulate disaster emergency plans and make suggestions for long-term disaster reduction to decision makers.

3. Herders.

Providing guidelines to herdsmen in preparing for a disaster and prevent their families from falling into extreme poverty when the disaster occurs.

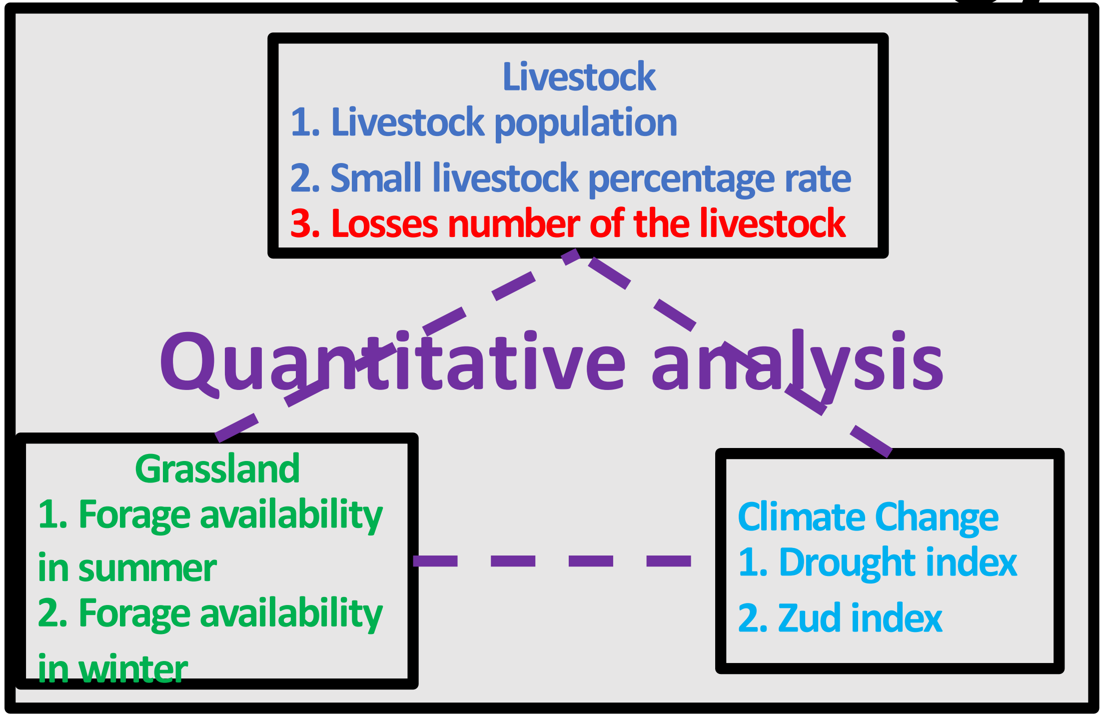
Literature review

Reference	Key Words
A mathematical model of the dynamics of Mongolian livestock populations	①
Designing index-based livestock insurance for managing snow disaster risk in Eastern Inner Mongolia, China	①②
Simulation of Pastoral Management in Mongolia: An Integrated System Dynamics Model	①②③
Recovery from a winter disaster in Töv Province of Mongolia	①②
Spatial analysis of time-series changes in livestock distribution by detection of local spatial associations in Mongolia	①②③
Vulnerability and Adaptation of Livestock Producers to Climate Variability and Change	①②③
Titanic: Machine Learning from Disaster	②④
Time series prediction: forecasting the future and understanding the past	①②④
Recurrent neural networks and robust time series prediction	①②④



- **Livestock mortality is mostly affected by extreme weather events, livestock conditions and grassland conditions in Mongolia.**

Methodology & Hypothesis



1. There is a positive relationship between the livestock population and the mortality livestock number. (a R^2 of 0.46, Tachiiri et al. 2008)
2. There is 230 livestock on the average herders family in Mongolia, more than 220 livestock are small livestock like sheep and goat, large livestock is few in number. Also, small livestock is much easier die than larger livestock.
3. A serious livestock mortality was associated with poor forage availability in summer and the substantial snow accumulation in winter, which means poor forage availability in winter.
5. Drought index and Zud index represents the total extent of the temperature and precipitation deviate from the normal (average) level in summer and winter, respectively.

Apply machine learning with the 7 selected variables' time series data could provide a prediction model on the mortality of the livestock in Mongolia.

Data collection & processing

Year	Drought Index	Zud Index	Forage summer	Forage Winter	Small Livestock Rate (%)	Livestock Population in Last Year ※1	Loss of Livestock
…	…	…	…	…	…	…	…
1994	1.79	2.64	250	91.40	79.59	2106034	26100
1995	1.82	2.84	270	90.60	78.96	2346218	25200
1996	2.76	6.63	220	78.27	78.88	2594975	70700
1997	0.2	9.27	210	86.59	79.78	2550128	26700
…	…	…	…	…	…	…	…

※1. Total livestock population increased (because of breeding or reproduction) but in some herders families their livestock loss heavily.

Data collection & Processing :

Using python crawler program to automatically download data from the public and open database.

Normalize the Data for chemotaxis and non-dimensionalization, solves data problems of different natures and the comparability of data.

A sample of the data after collection and processing showing on the table above.

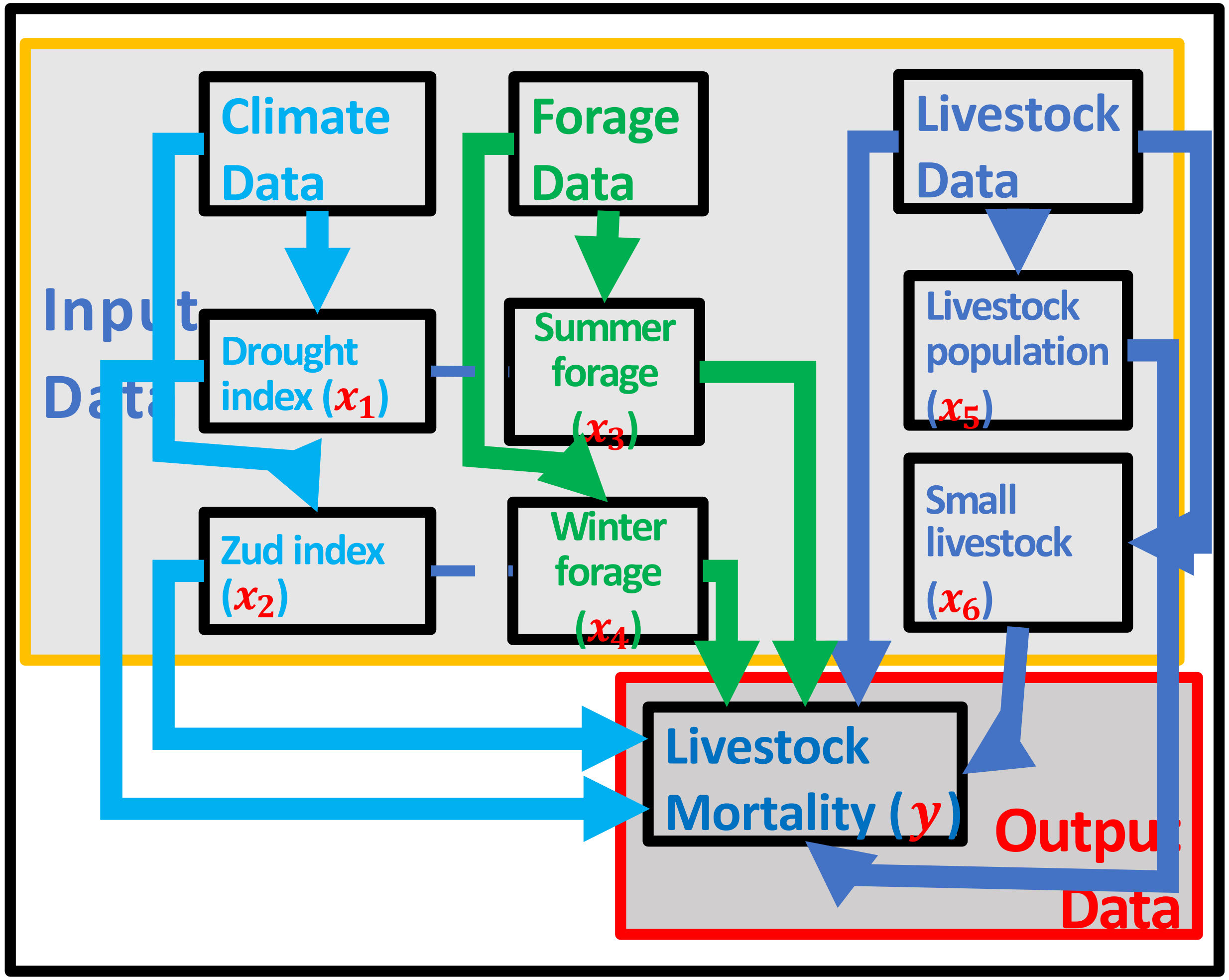
Data Source :

The data of all of those variables are collected, processed and assimilated from the database of the Global Livestock Early Warning System(GLEWS) and the Mongolian Statistical Information Service(MONSIS), from 1970 to 2017.

Global Livestock Early Warning System(GLEWS), *https://www.glews.net*

National Statistics Office of Mongolia(NSOM), *https://www.1212.mn*

Variables



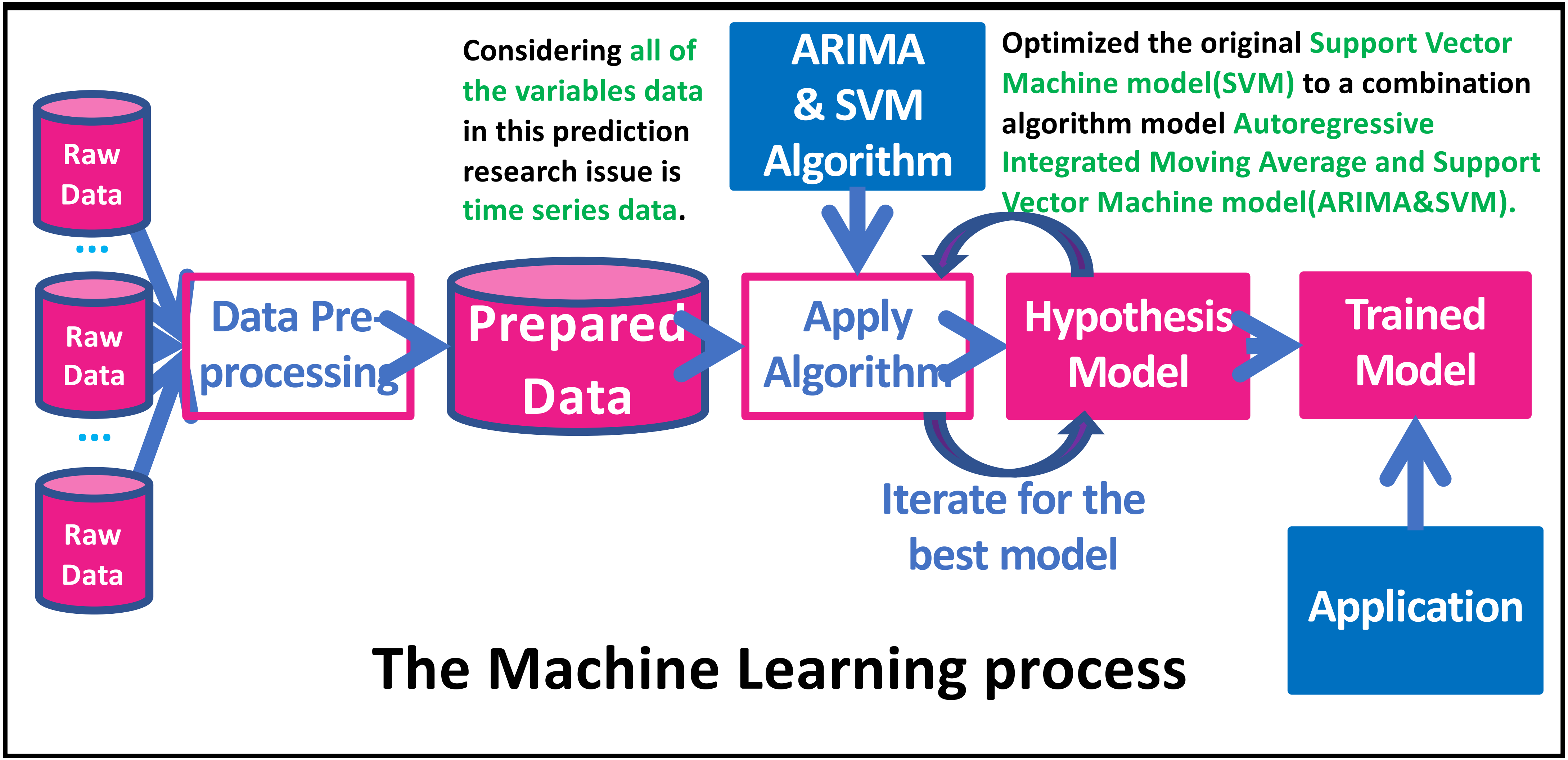
According to the previous analysis and modeling, the livestock mortality in a region depends on 6 variables, which are the increase or decrease rate of livestock population in that area, the population of small livestock, the forage availability in summer, also the forage availability in winter, and the drought index and zud index.

The logical relationship is expressed as the formula :

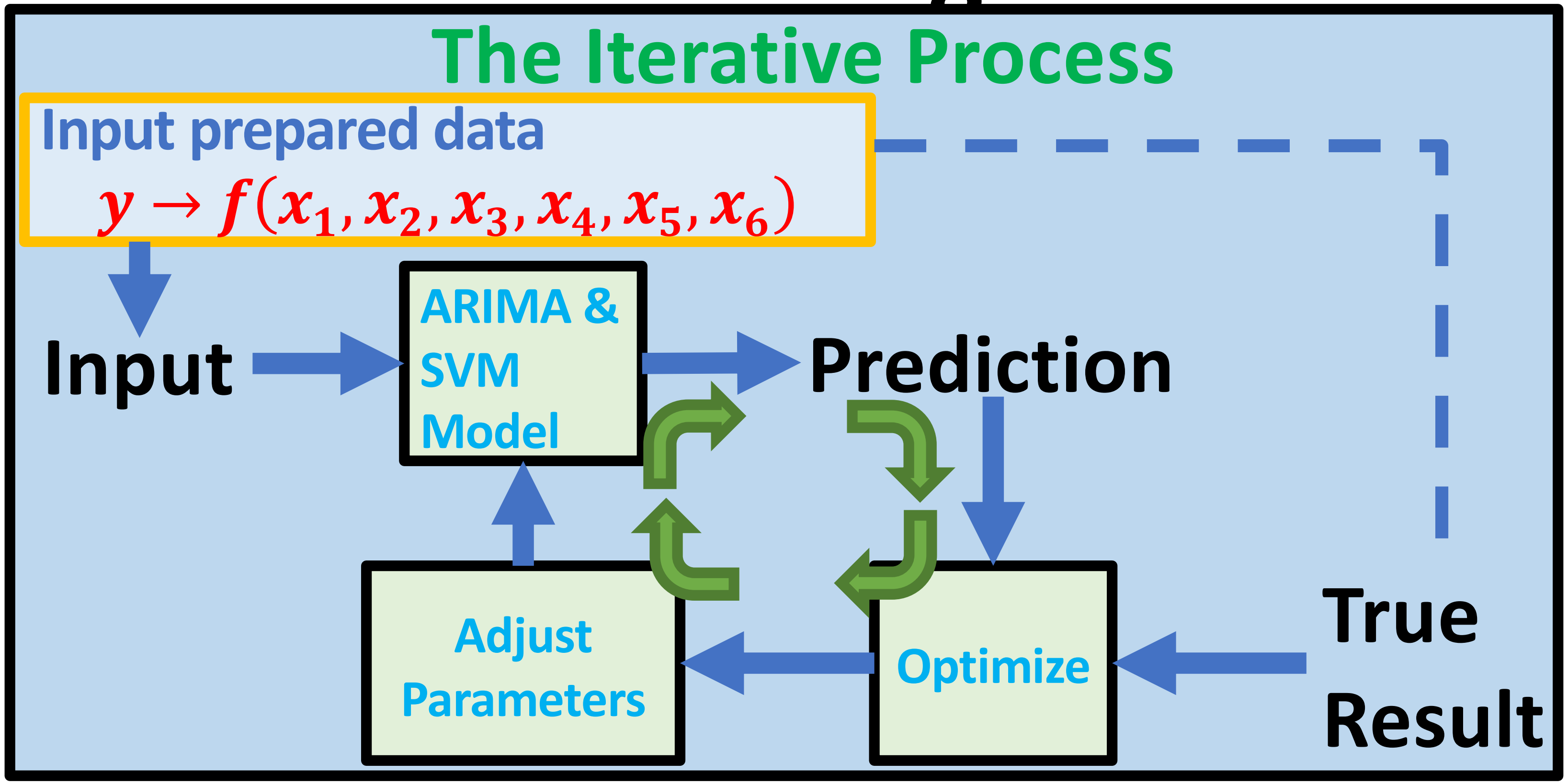
$$y \rightarrow f(x_1, x_2, x_3, x_4, x_5, x_6)$$

Next step is applying the machine learning to simulate or approximate the real model of the livestock mortality.

Machine Learning & Data Analysis



Machine Learning & Data Analysis



Mean Squared Error (MSE) MSE=

$$\frac{1}{n}\sum_{i=1}^{n}(Y_{ti} - Y_i)^2$$

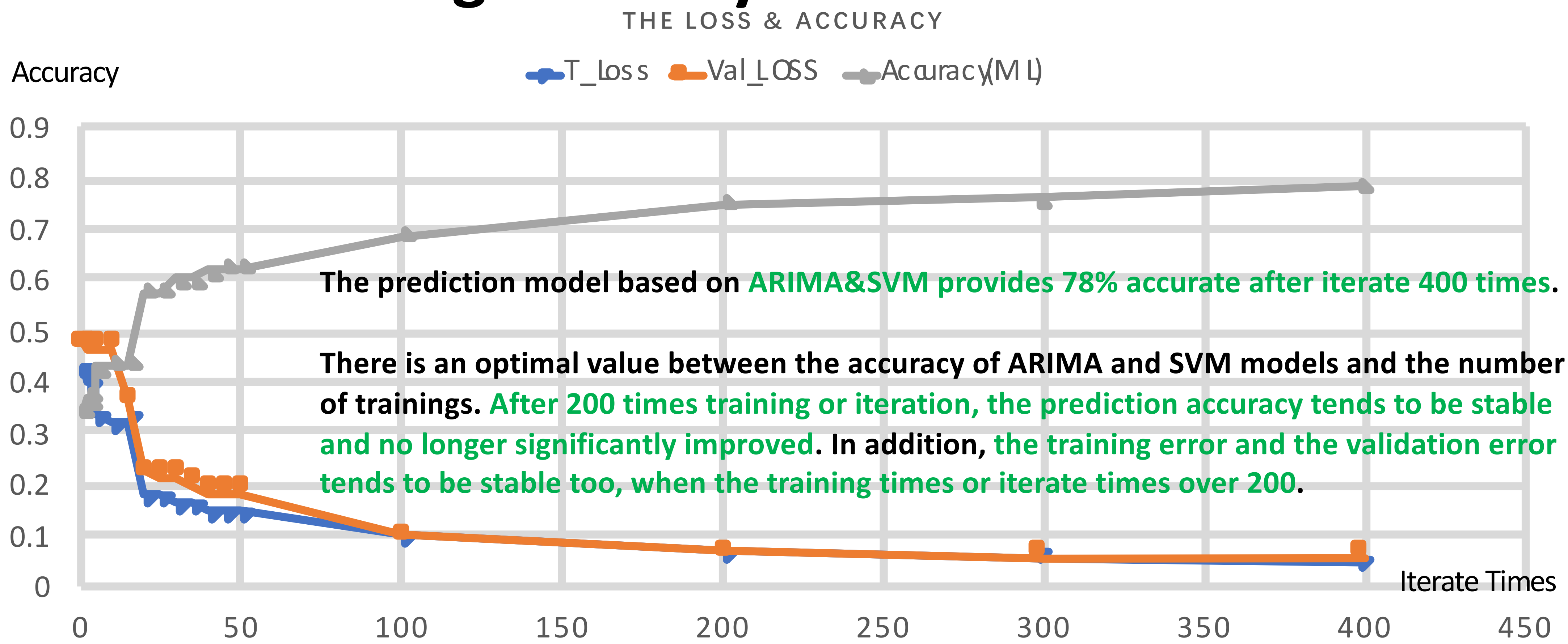
The accuracy of the model in the test set.

Acc =

$$\frac{1}{n}\cdot\sum_{i=1}^{n}\frac{|Y_{pret} - Y_{ti}|}{|Y_{ti}|}$$

Divided the prepared data into 3 groups, training group, test group, and forecast group. Input the data from 1970 to 1985 for training data, the data from 1986 to 1990 were used as verify predictions, data from 1991 to 2017 as the forecast group. Verify the accuracy of the model by comparing the predict livestock mortality data with the true livestock mortality data.

Training accuracy and Predict Result

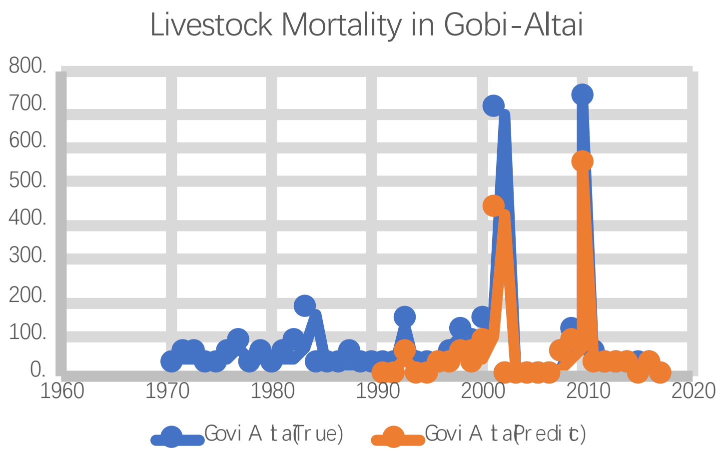


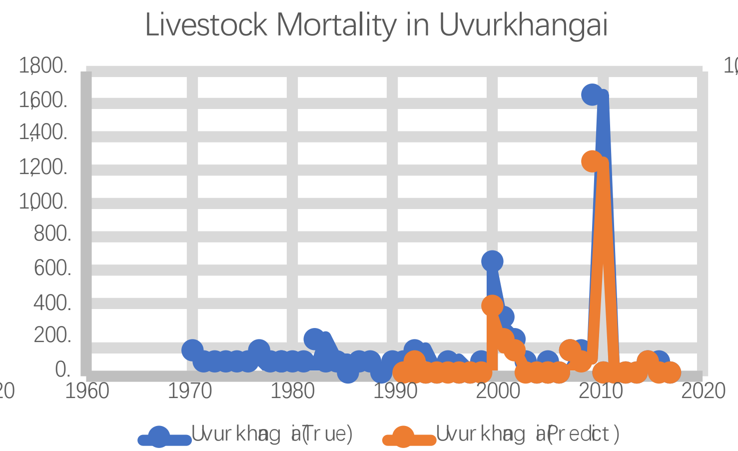
Iterate Times	5	10	25	50	100	200	400	Multiple Liner Regression	
Accuracy	0.43	0.43	0.58	0.62	0.69	0.75	0.78	Accuracy	0.47

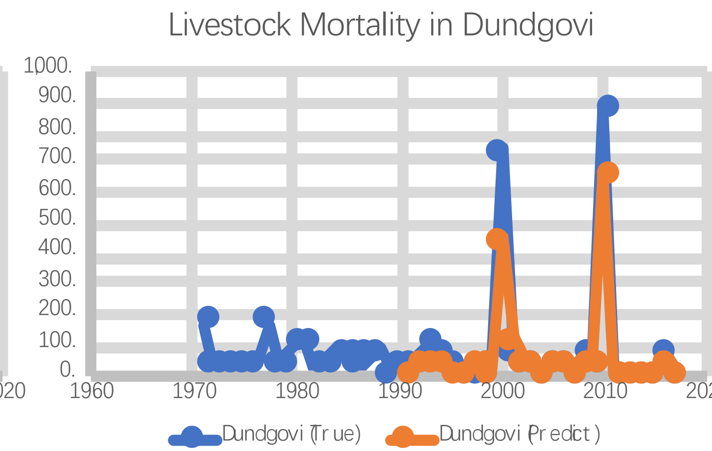
The model based on ARIMA&SVM provides 78% accurate which is a closer result to the actual data than 47% accurate of the multiple linear regression model.

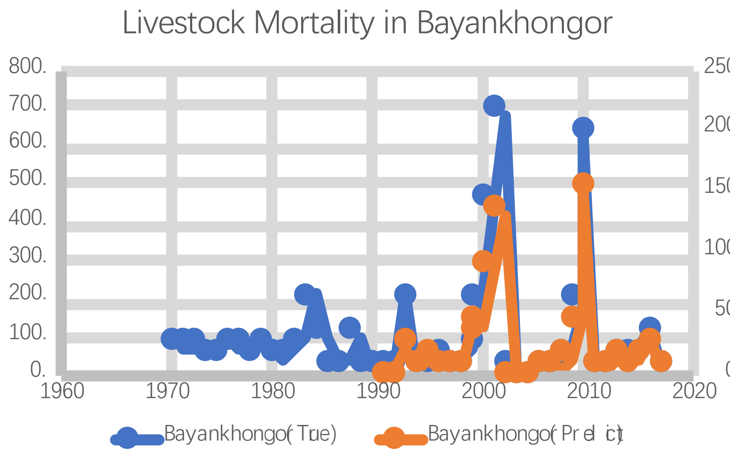
Training accuracy and Predict Result

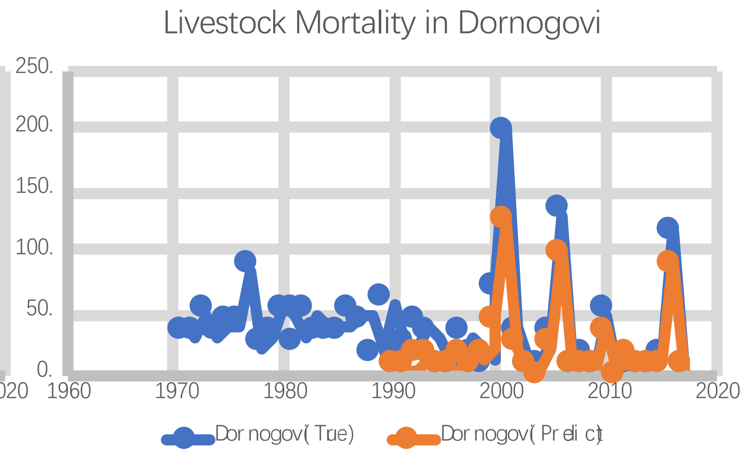
Provinces	Gobi-Altai	Bayankhongor	Uvurkhangai	Dornogobi	Dundgobi	Umnugobi
Average accuracy	0.76	0.73	0.76	0.75	0.76	0.73

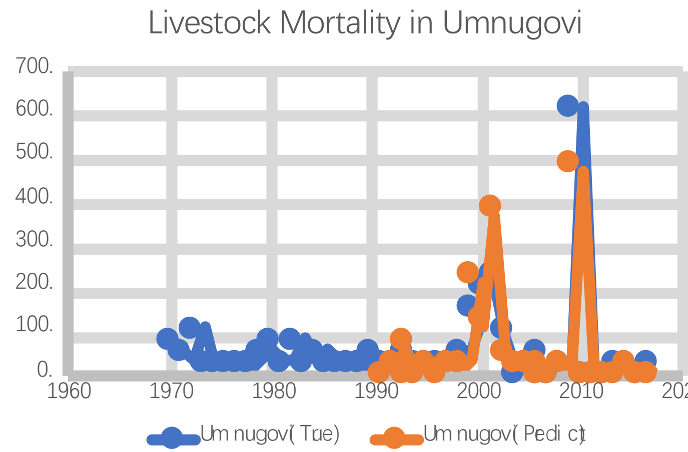












Discussion & Conclusion

· The trained model predicts the number of livestock mortality from 1991 to 2017 in the Gobi or semi-Gobi region of Mongolia, as shown in the form slide. From the results, the average prediction accuracy of livestock mortality in the 6 provinces is close to 75%, highly consistent with the final accuracy of the trained model which is 78%.

· In fact, from the final result, the trained model does have a strong generalization. After all, the average prediction accuracy in the 6 provinces is very close to the final prediction accuracy obtained during the training.

· The accuracy of this ARIMA&SVM model is much higher than the traditional multi-regression model. Due to the excellent performance of structural risk minimization, the ARIMA&SVM model has good generalization or good promotion and can be accurately applied to predict the forecasting groups.

Discussion & Conclusion

- From the perspective of disaster prediction, this study hopes to give some help to the Mongolian government and organizations based on the prediction of the livestock mortality. For example, before each winter, accurate prediction of livestock mortality in a relevant region can help the government or institutions develop some temporary policies, such as emergency feeds from international aid organizations or the government, are expected to reduce the livestock loss.

- For the final results of the study, there is a basically convincing result in the prediction of livestock mortality.

- However, due to the lack of relevant data, the study can only predict livestock mortality at the provincial level. Looking forward to predicting livestock mortality at the county level in the future, of course, in order to achieve this level, more detailed and fine-scale data must be available, also a deeper understanding on the mechanism of the severe livestock loss is necessary.

References

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Thank you very much for your attention！

Frontiers for International Environmental Cooperation
-An integrated approach of Policy and Natural science for Combating Desertification

国际环境合作的新天地
--综合政策科学在防沙治沙中的实践
严网林　庆应大学出版社　2008

Wanglin Yan, Keio University

（背景はエンカルタ総合大百科 2003 使用）

図 1-1　ホルチン草原の地理範囲

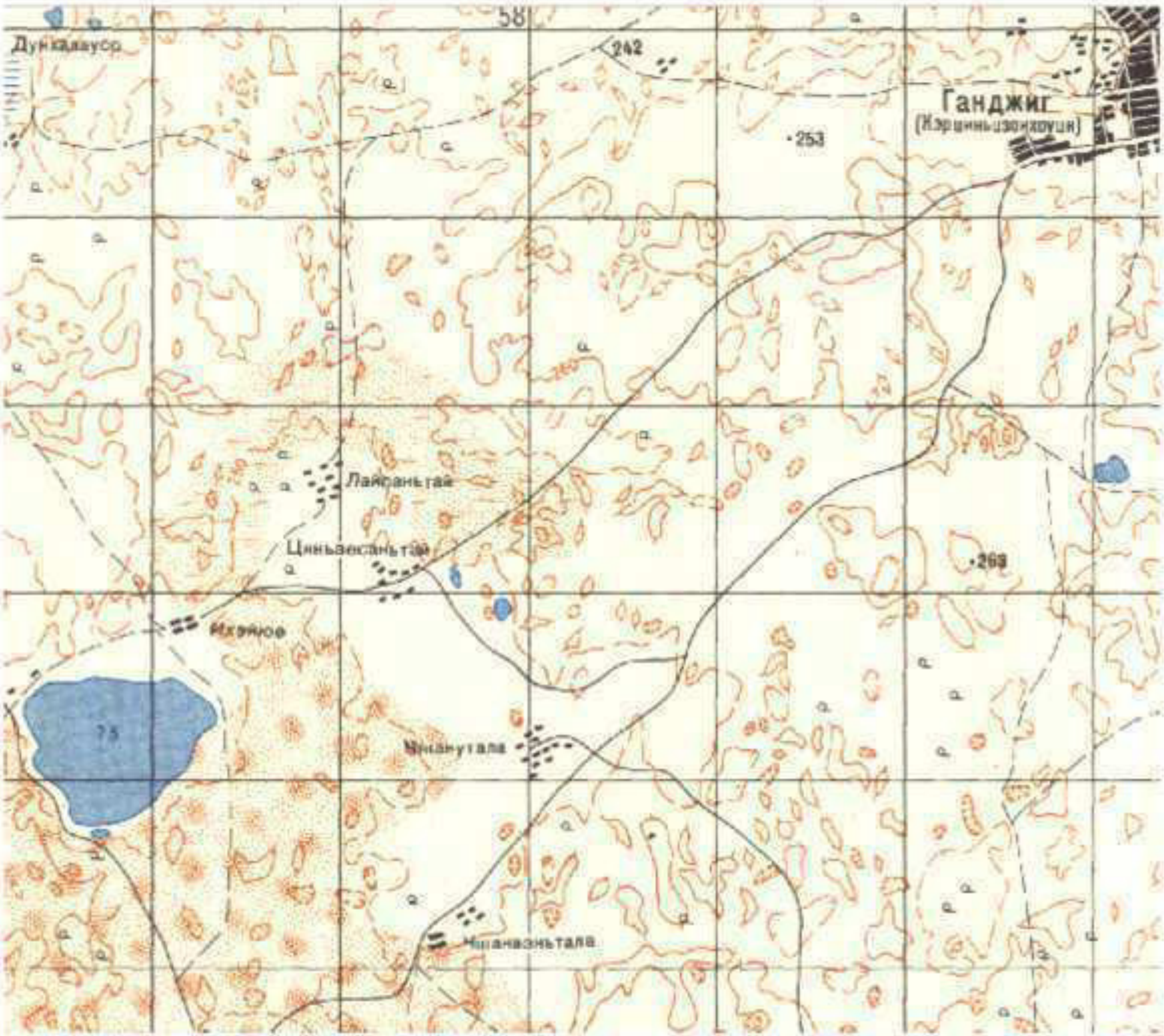


図 2-2　ロシア製 10 万分の 1 地形図（図番 K－51-41 の局部）

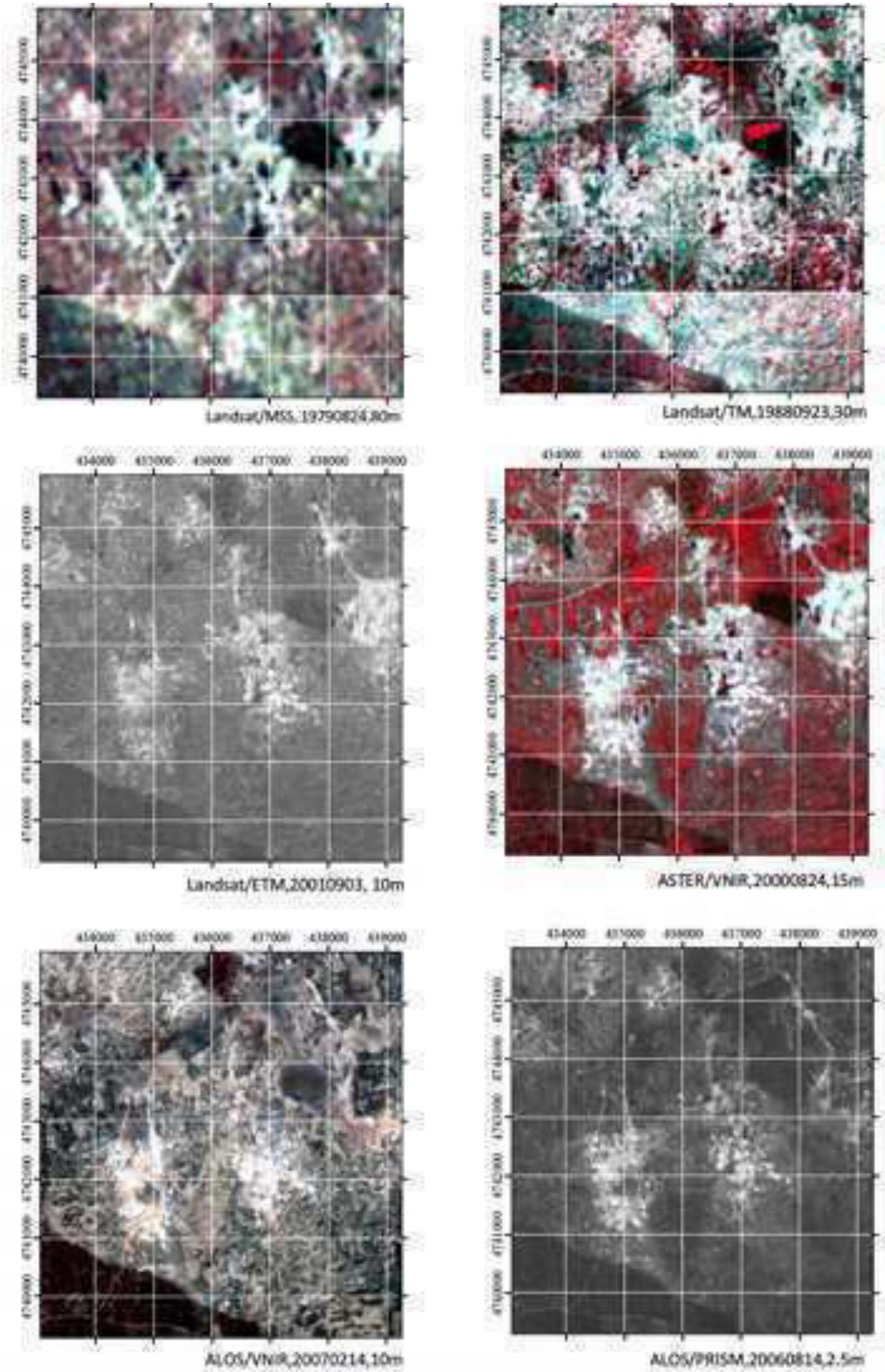
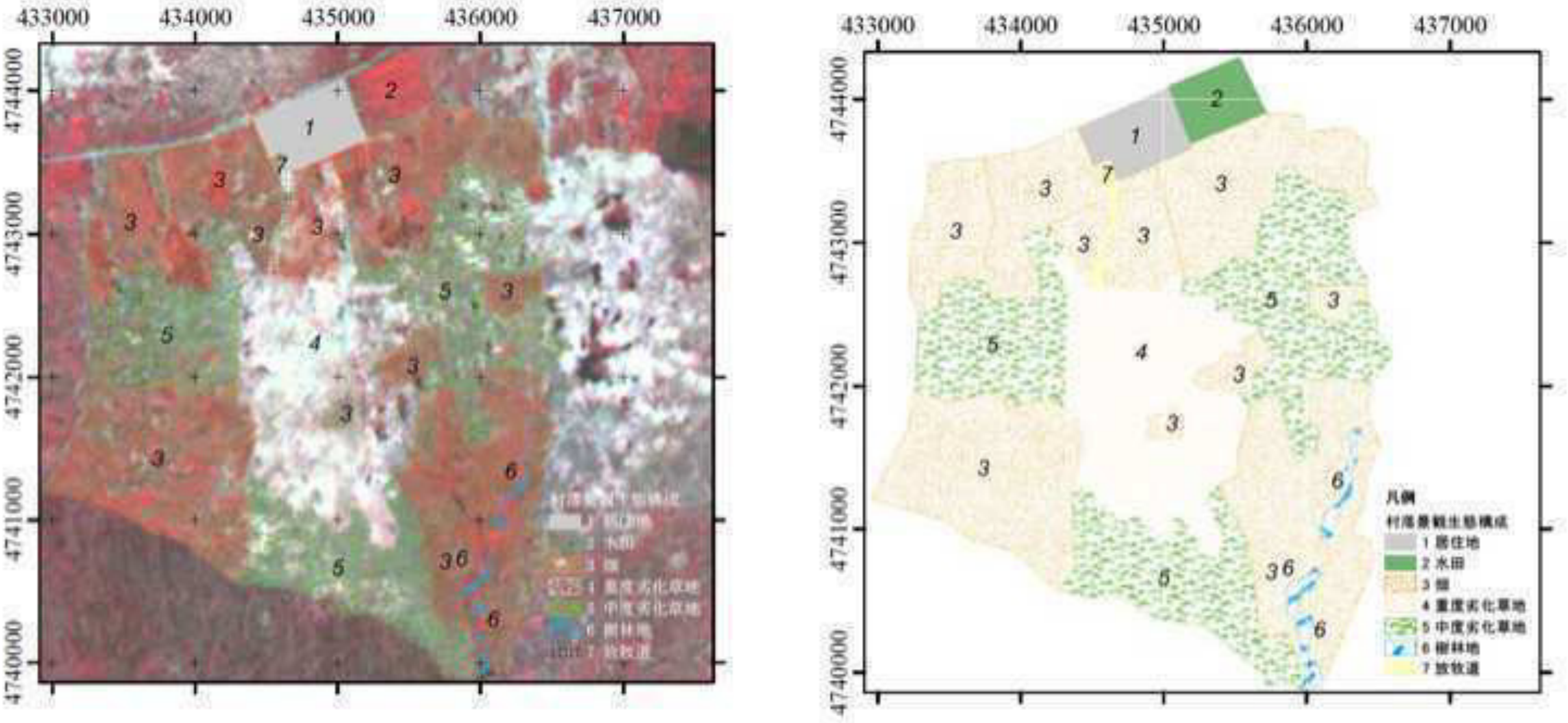


図 2-4 代表的衛星画像の比較



(a) ASTER/VNIR(2000.8.24)　　(b)村落の景観生態区分

図 3-3　マントウ村（図 3-2 の局部）の景観生態区分

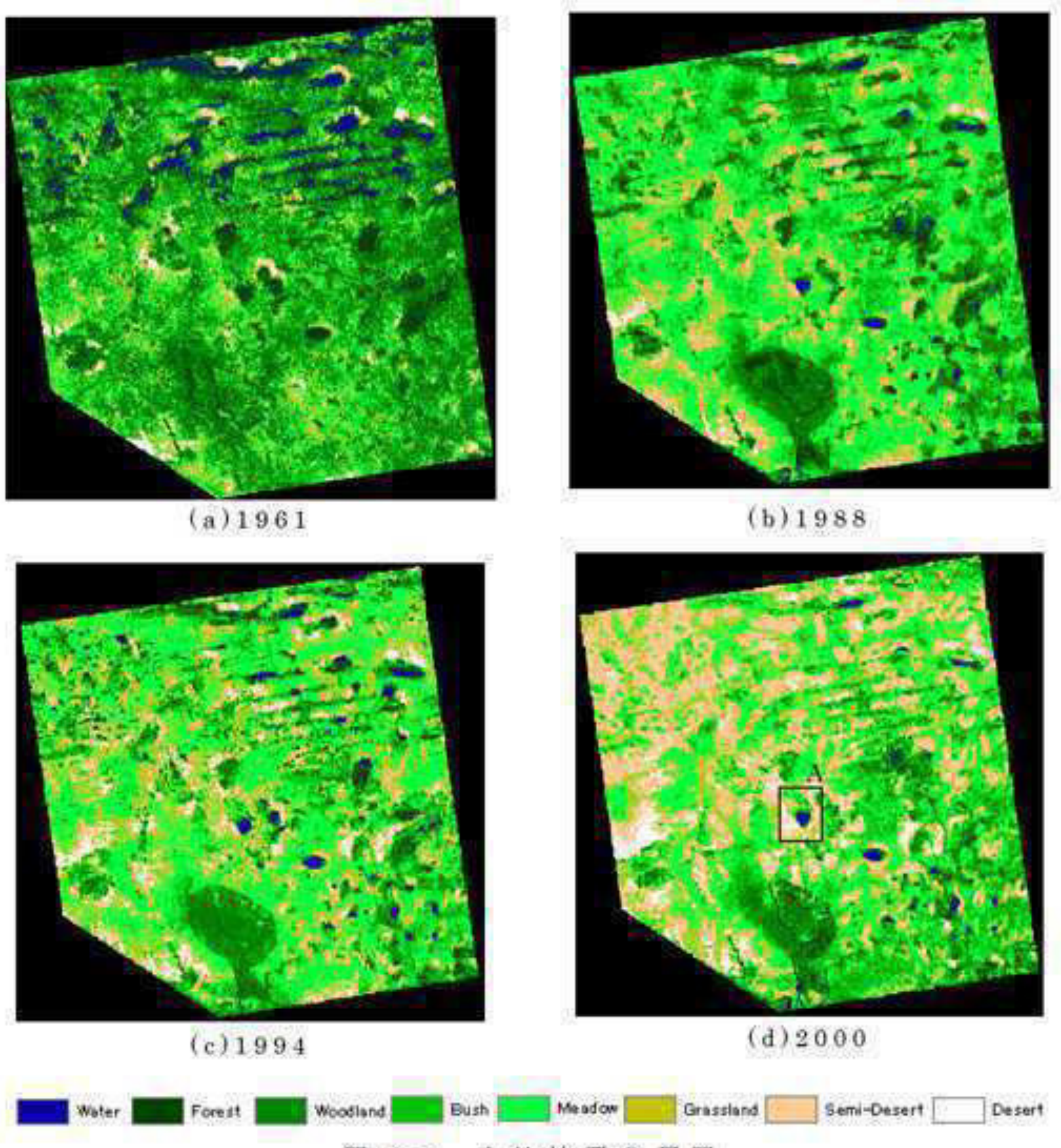

(a)1961
(b)1988
A
(c)1994
(d)2000
Water
Forest
Woodland
Bush
Meadow
Grassland
Semi-Desert
Desert

図 3-4　土地被覆分類図

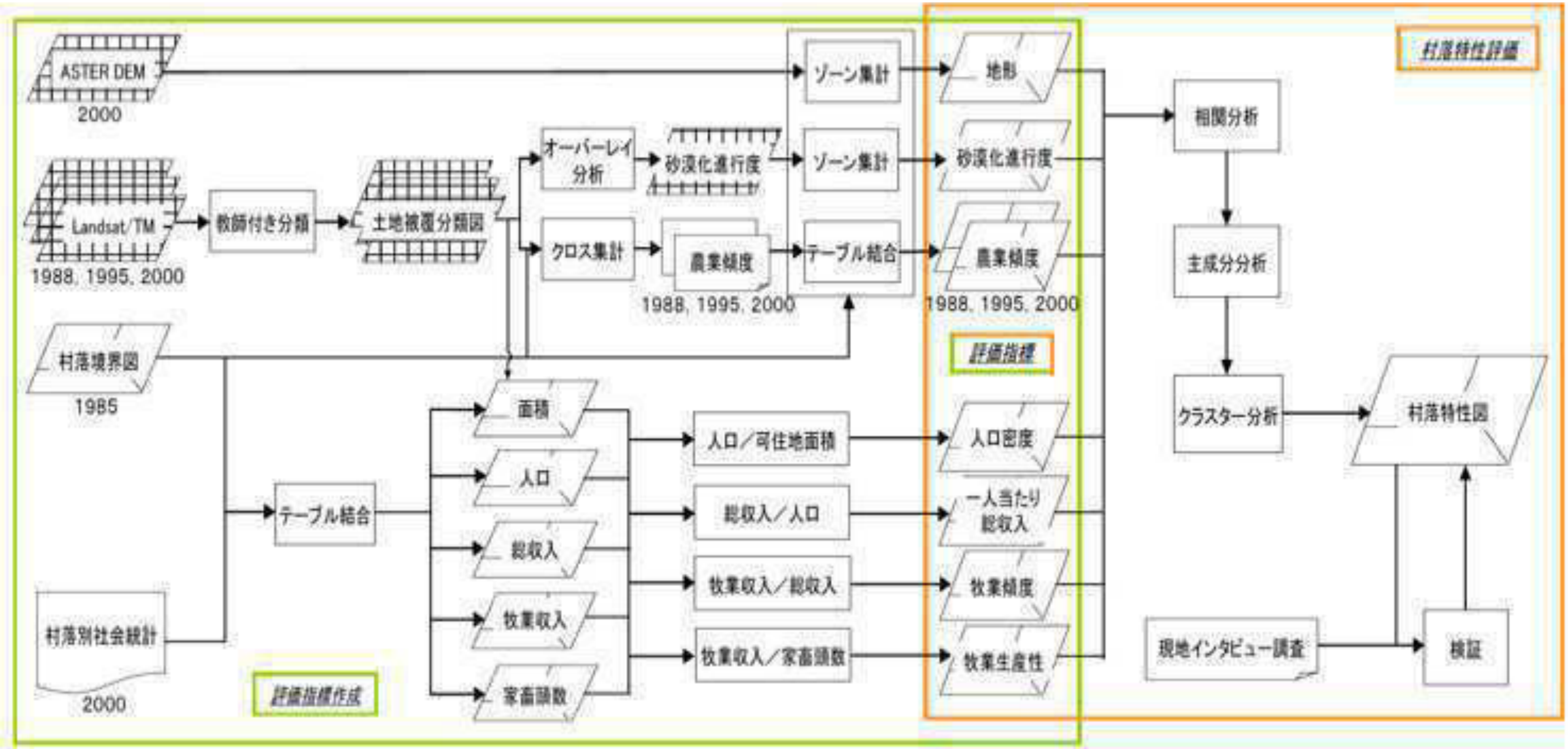


図 4-1 分析のフローチャート

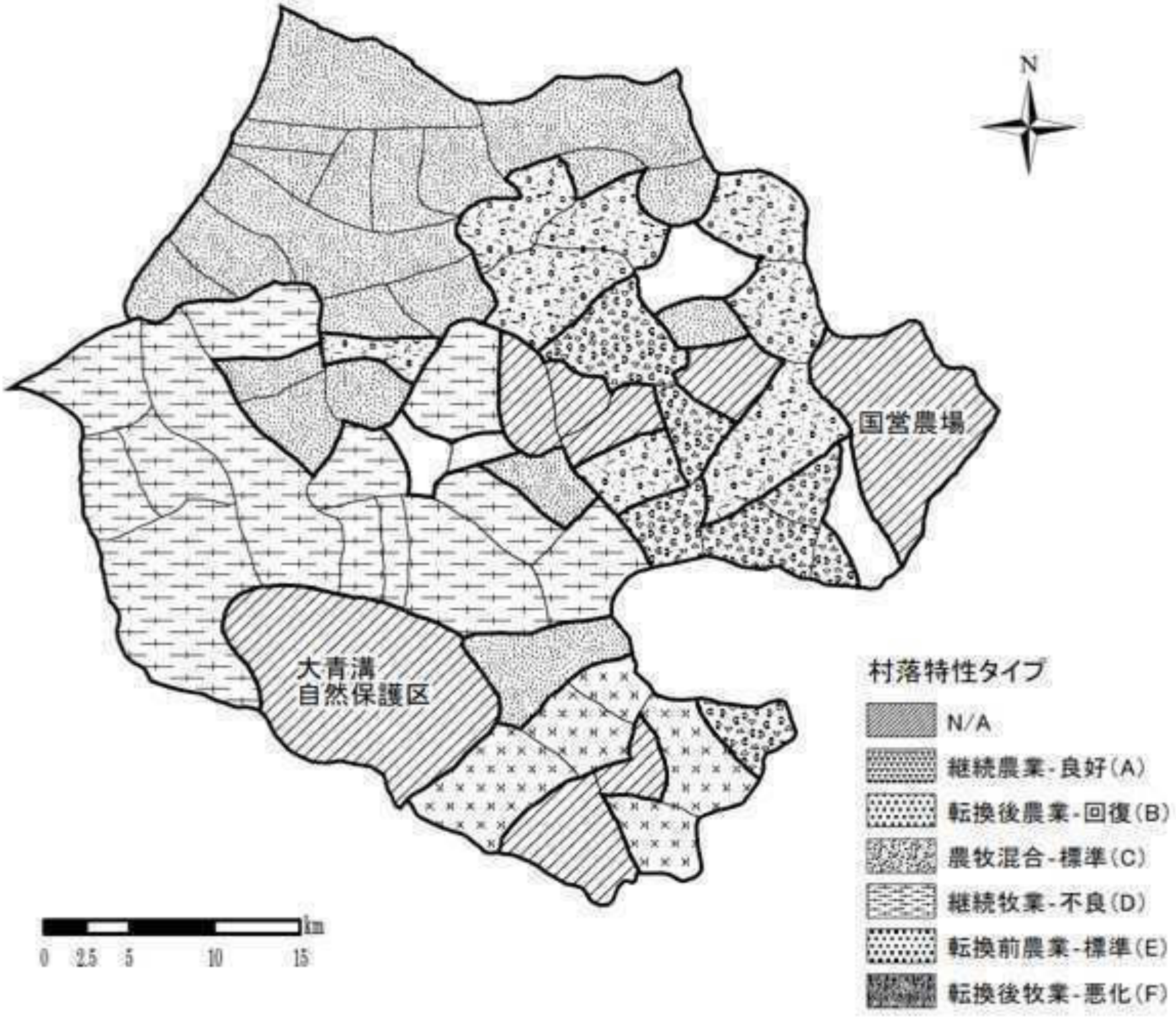

N
国営農場
大青溝
自然保護区
0
2.5
5
10
15
km
村落特性タイプ
N/A
継続農業-良好(A)
転換後農業-回復(B)
農牧混合-標準(C)
継続牧業-不良(D)
転換前農業-標準(E)
転換後牧業-悪化(F)

図 4-5 村落特性

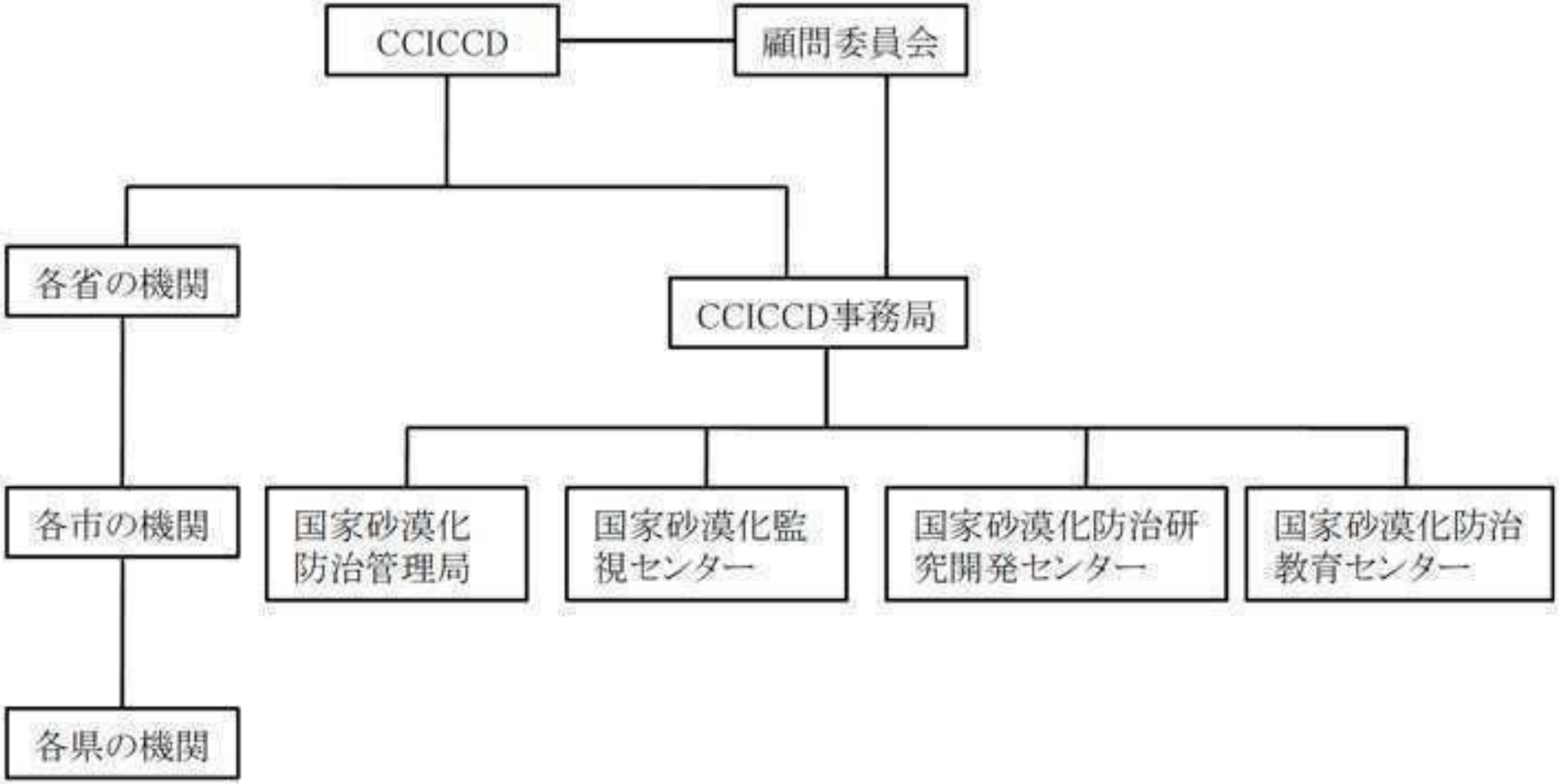


図 5－1　中 国 の 砂 漠 化 防 治 組 織

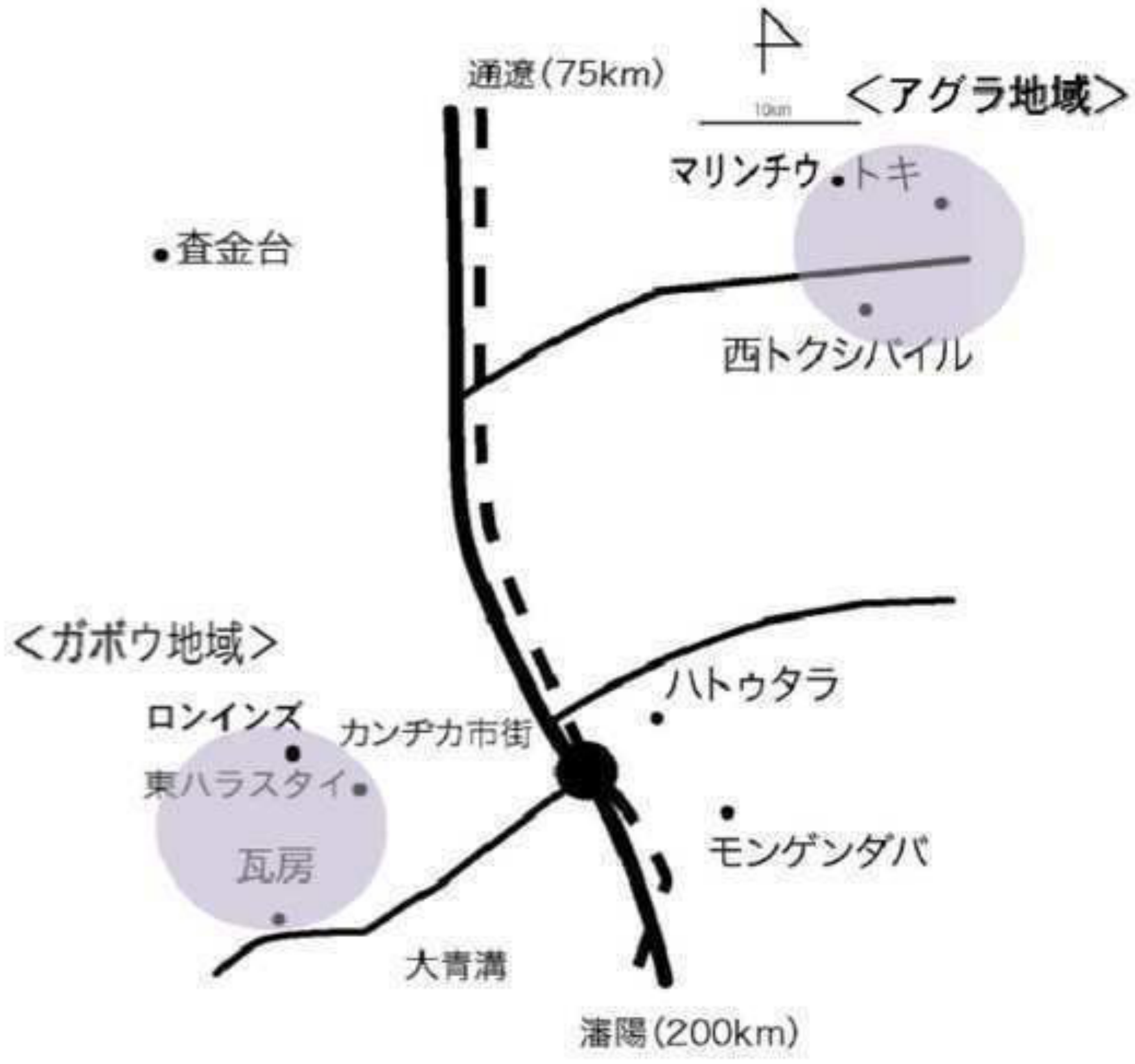


図 6-1　緑化地の位置分布

表 7-1　２００６年日中共同砂漠緑化フィールドプログラム
＜　＞内は，プログラムの実施主担当

日程		午前	午後	夜間	宿泊
	6月	募集説明会（慶応SFC，6月中旬）			
		申込締切日　6月23日（金）			
	8/27	事前研修			
		研修ガイダンス	講義：地域の自然と砂漠化の進行＜厳＞		
		講義：ホルチン地域の歴史と社会＜厳＞	ディスカッション フィールド研修の視点		
1	8/31（木）	出発			
		成田空港集合	CZ-628 成田(13:25)→瀋陽(15:30) 到着後すぐバスにて後旗へ移動		後旗
2	9/1（金）	フィールド：村の社会調査（農民，村長）	フィールド：村の土地調査 （境界，権利確認）＜慶應大学＞		後旗
3	9/2（土）	フィールド：土地利用現況調査 ＜慶應大学＞	フィールド：植林地内の植生調査 ＜慶應大学＞		後旗
2	9/3（月）	植生調査結果の整理＜慶應大学＞ 講義：ホルチン砂漠化の実態と対策 ＜後旗林業局＞	フィールド：砂漠視察， 砂と砂丘の移動，砂地植物 ＜緑化ネット＞	交流会	後旗
3	9/4（火）	フィールド：既植林地の継続調査（ガボウ南）　＜慶應大学＞	フィールド：草方格づくり ＜緑化ネット＞ フィールド：九頭山放牧地の視察＜緑化ネット＞	サンセット	後旗
4	9/5（水）	フィールド：植林体験 ＜緑化ネット＞	フィールド：植林体験・大青溝見学＜緑化ネット＞		後旗
7	9/6（水）	バスにて移動 （ガンチカ→瀋陽）	昼食後，瀋陽市内自由行動＜故宮博物館等＞	別れ会	瀋陽
8	9/7（木）	CZ-627　瀋陽(08:30)→成田(12:25)	解散		

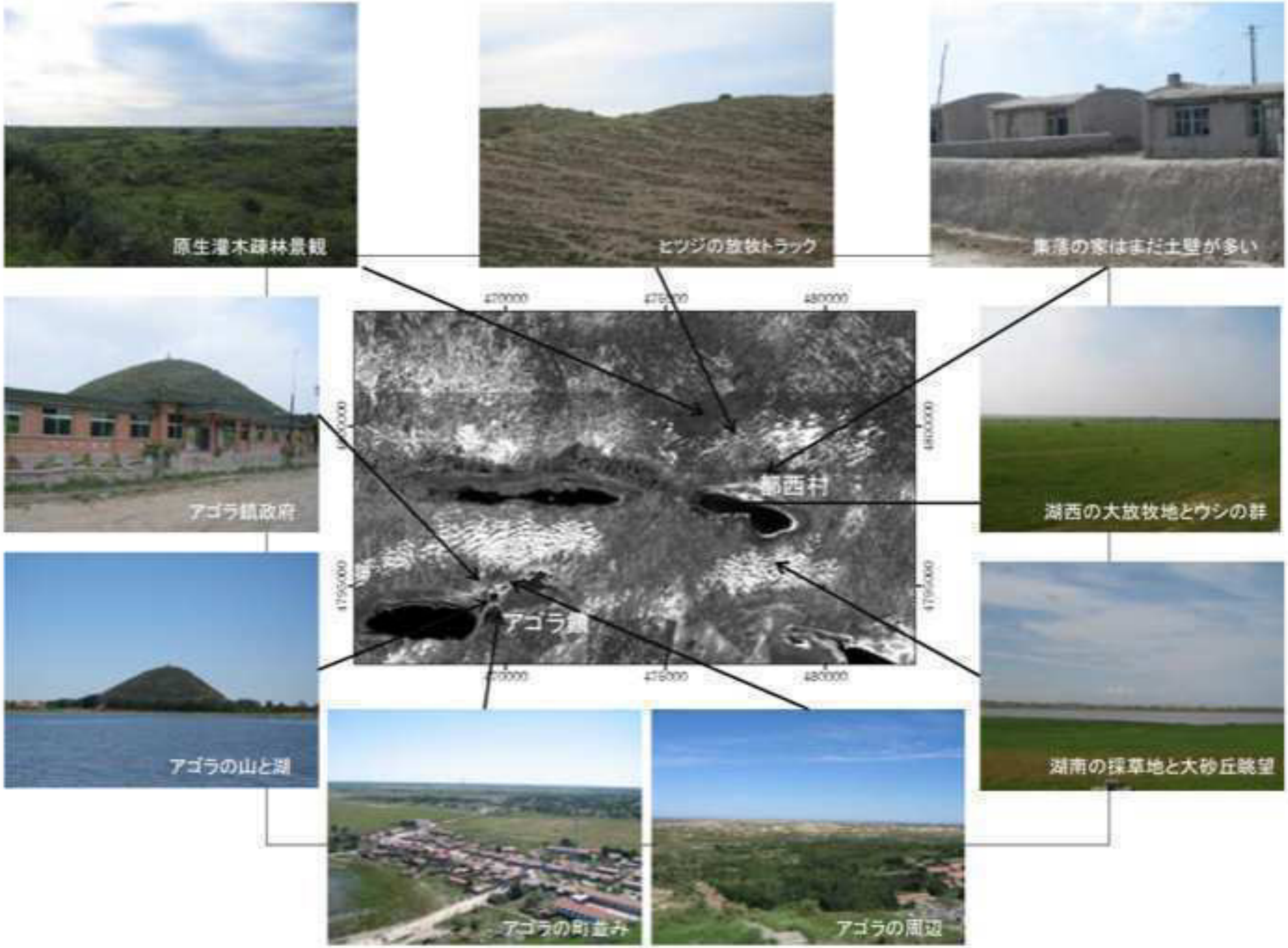


図 8-1　都西村の位置と最寄りの町ーアゴラ鎮

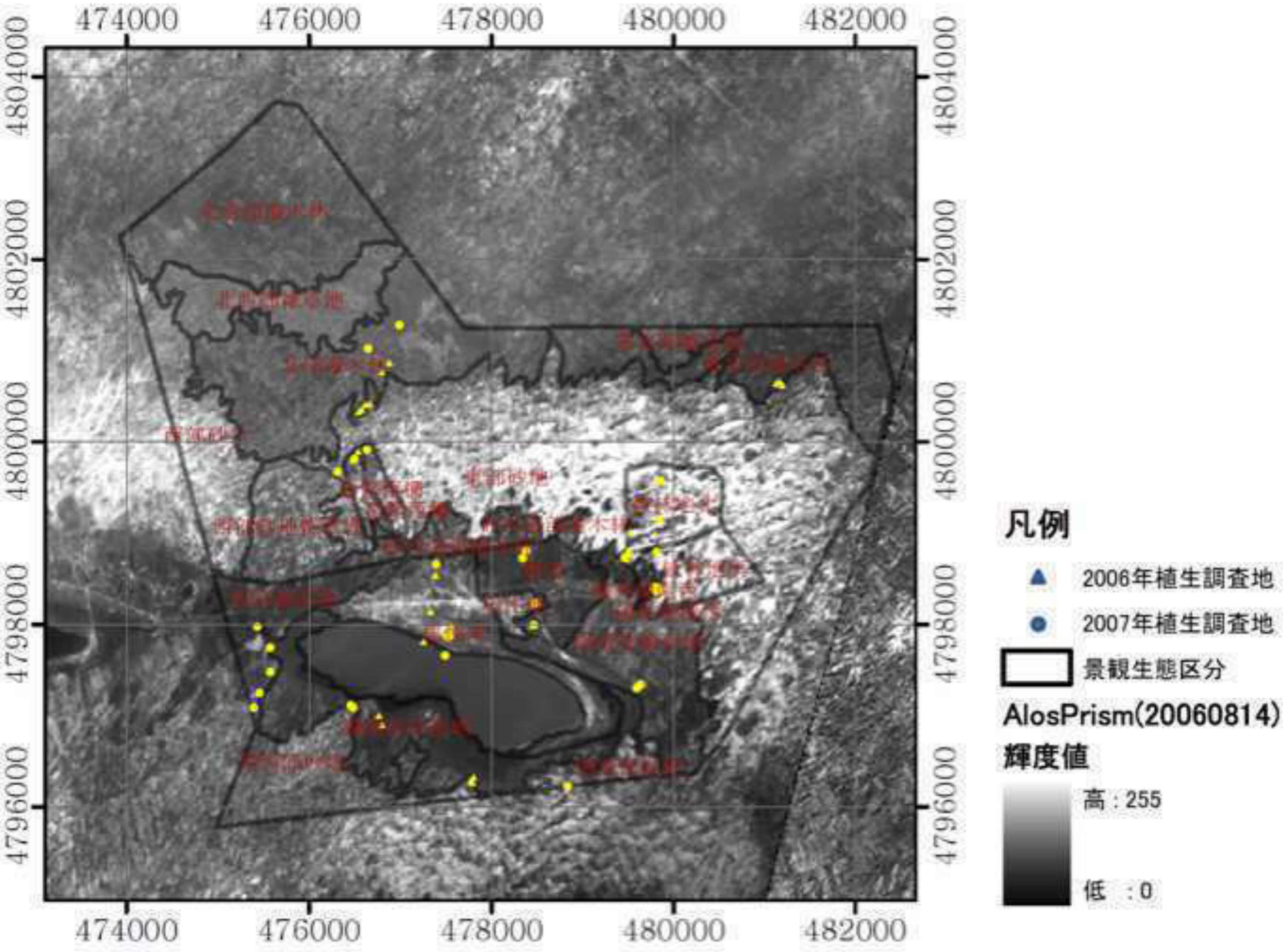


図 8-3 都西村の景観生態区分図

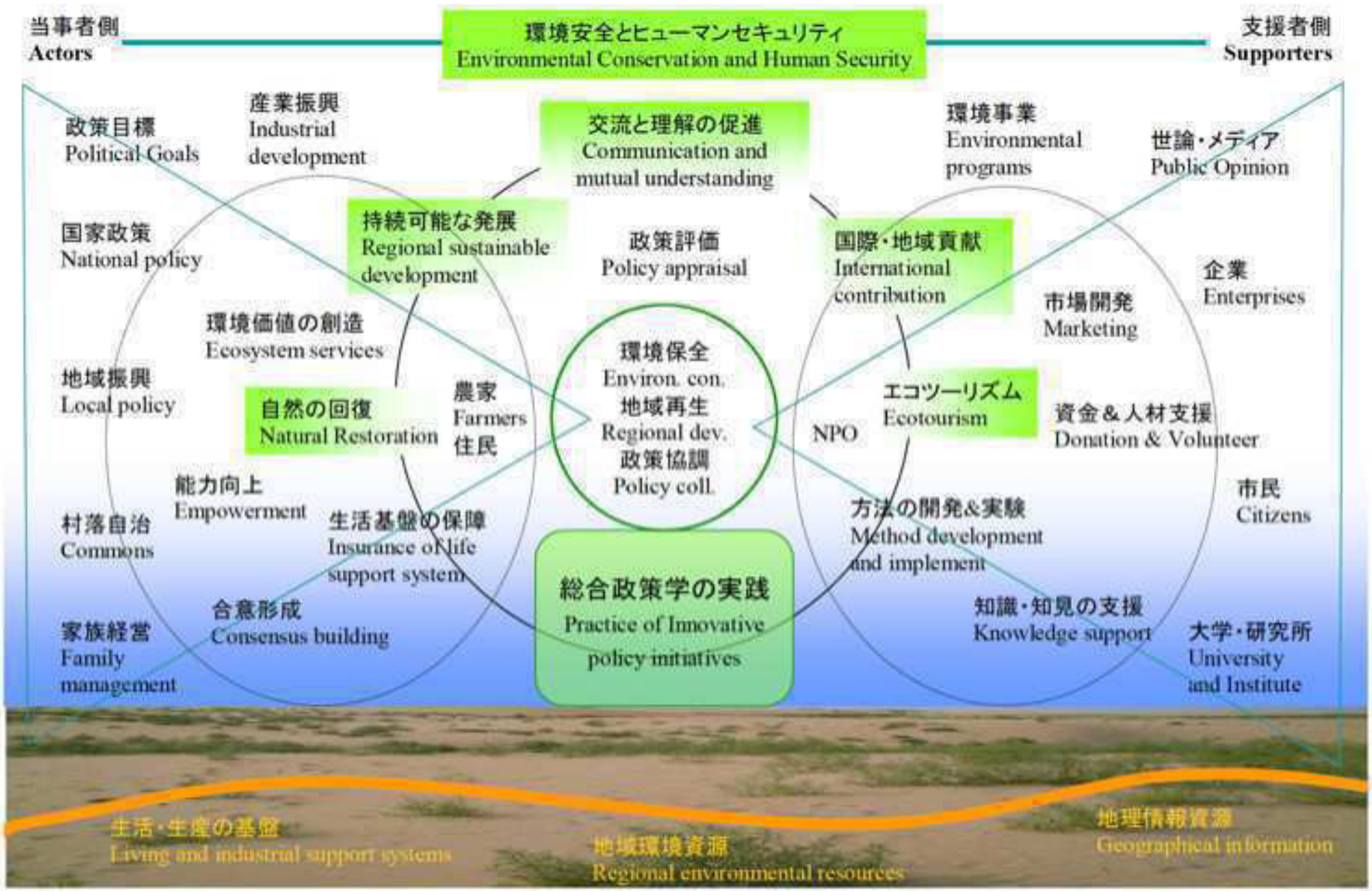


図 10-1　総合政策学による砂漠化対策のパラダイム

Northwest Institute of Eco-environment and Resources, CAS

Growing vulnerability of desertification reversion in Horqin sandy land of China

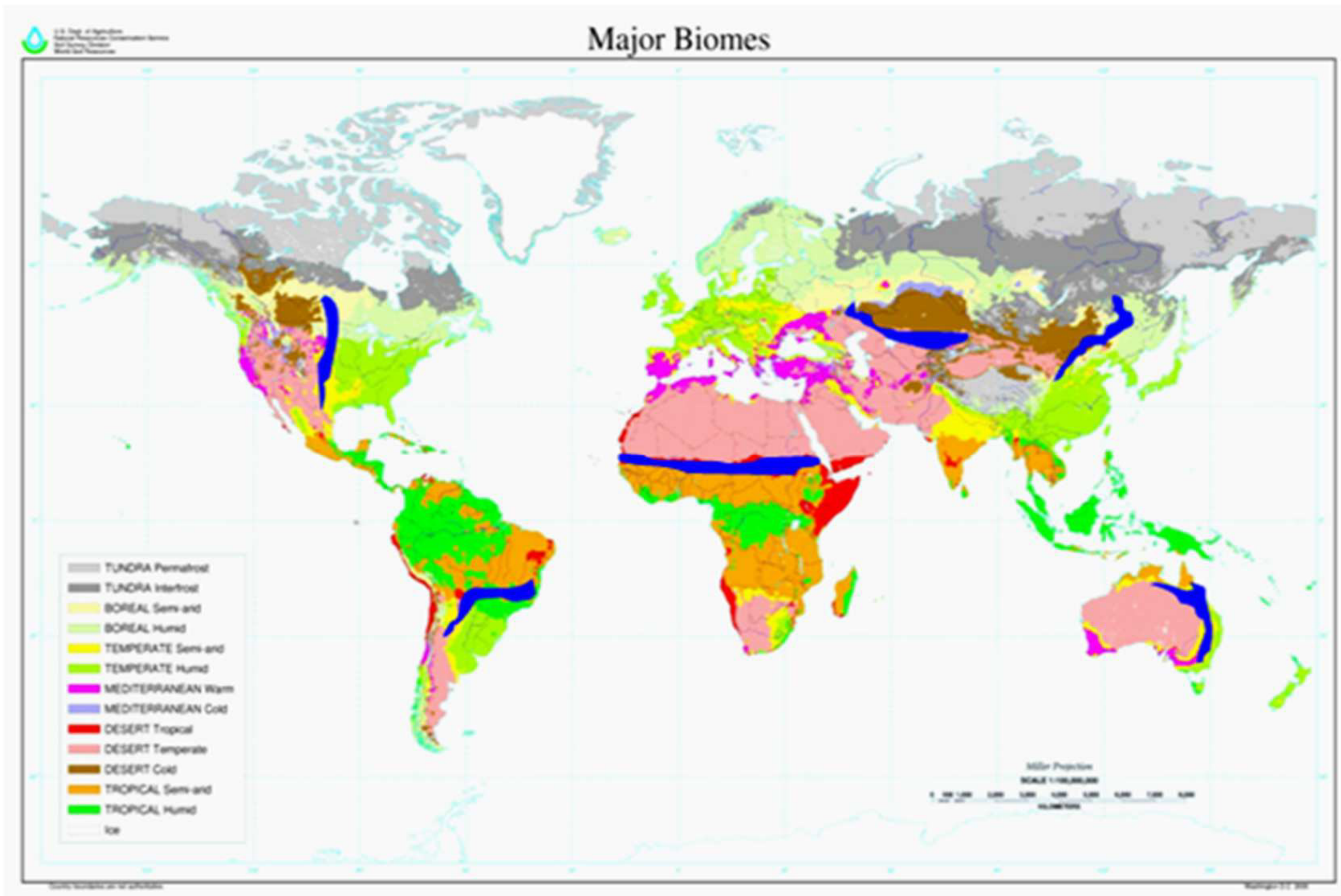
Zhao Xueyong
Research professor in dryland ecology
zhaoxy@lzb.ac.cn, Nov. 23, 2016

Content

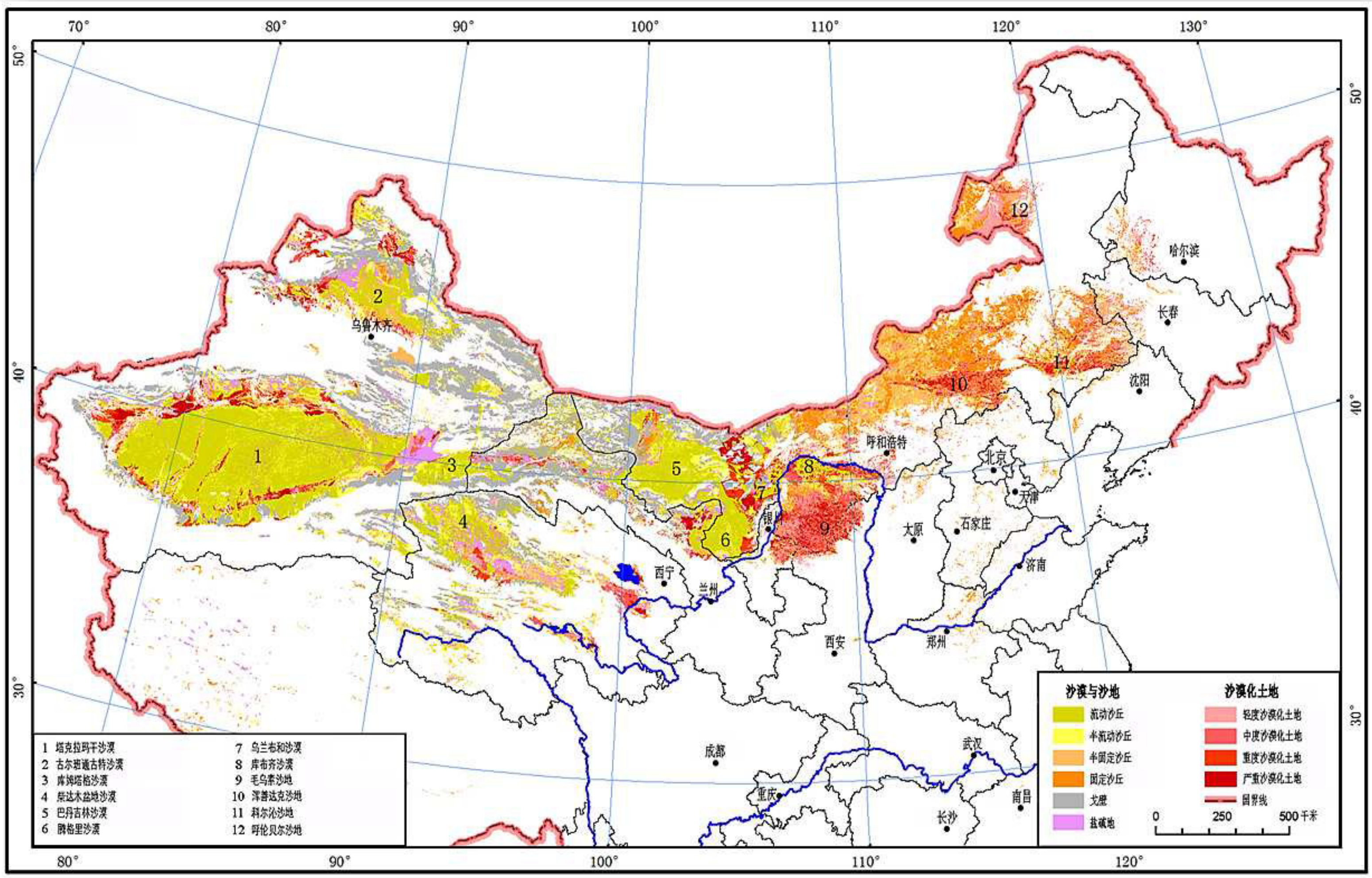
1, Introduction
2, Research
3, Facts
4, Suggests

1, Introduction

1.1 World Biomes and fragile zones

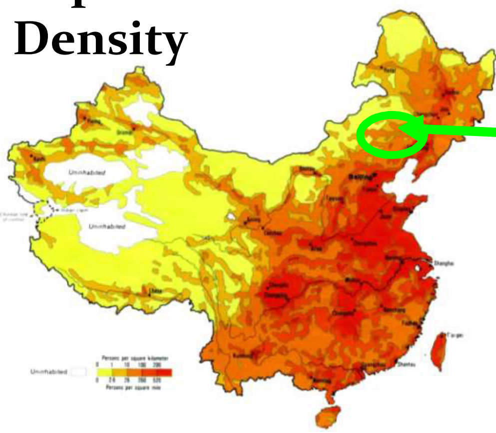


1.2 Deserts and desertified land in China



1.3 Characteristics of Horqin Sandy Land

Population Density



- •1 Multi-transitional area
- •2 Unstable land cover
- •3 Growing Pressure
- •4 Potential severe threat
- •5 Fragile ecosystems

Agro-pastoral area

Isohyet of 380mm

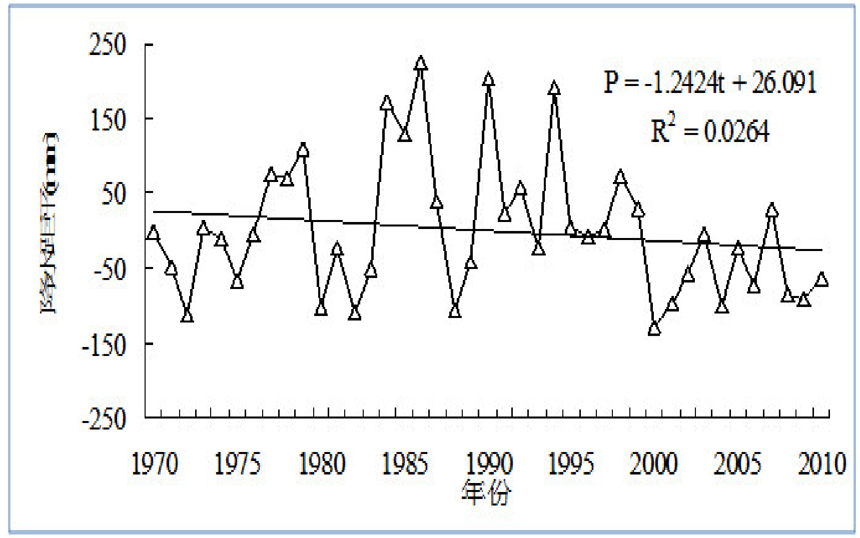
Plateau to Plain

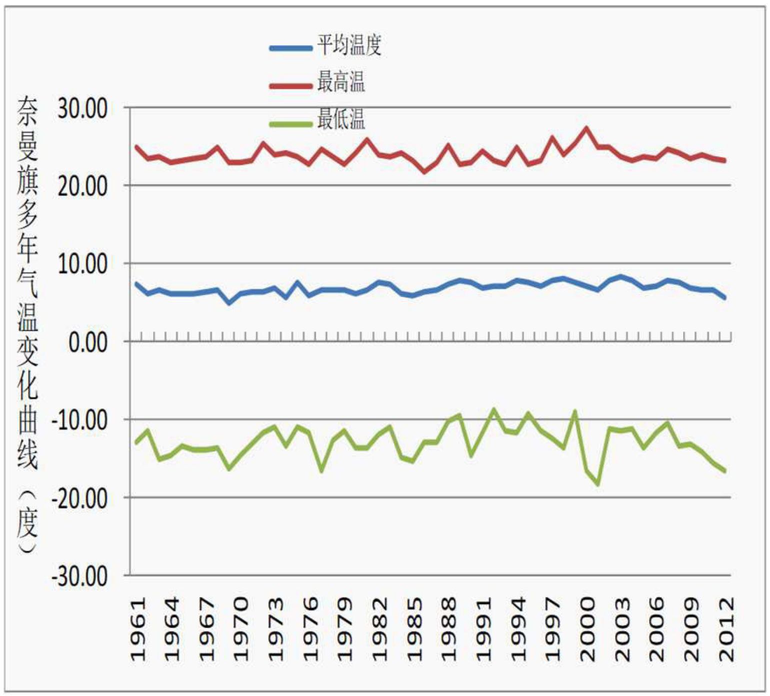
1.4 Research orientation & sites

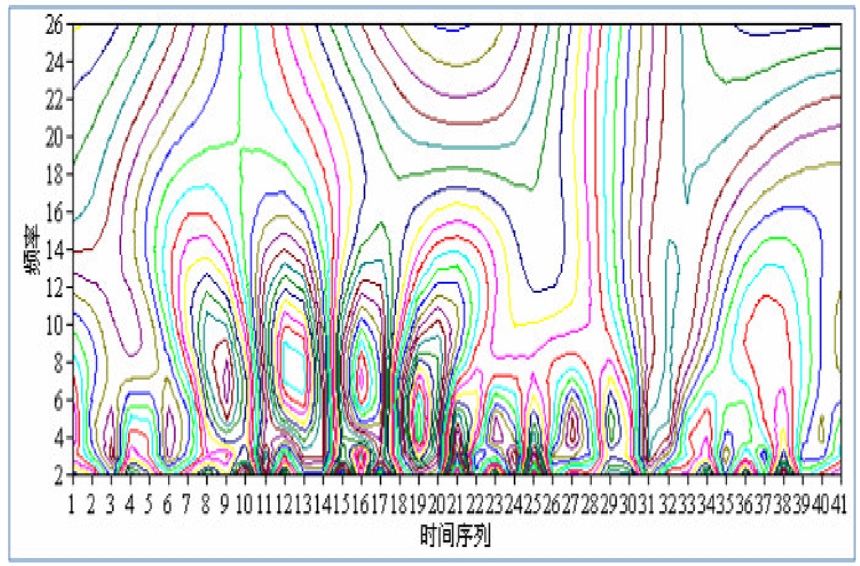
2 Research

2.1 Climate & water change

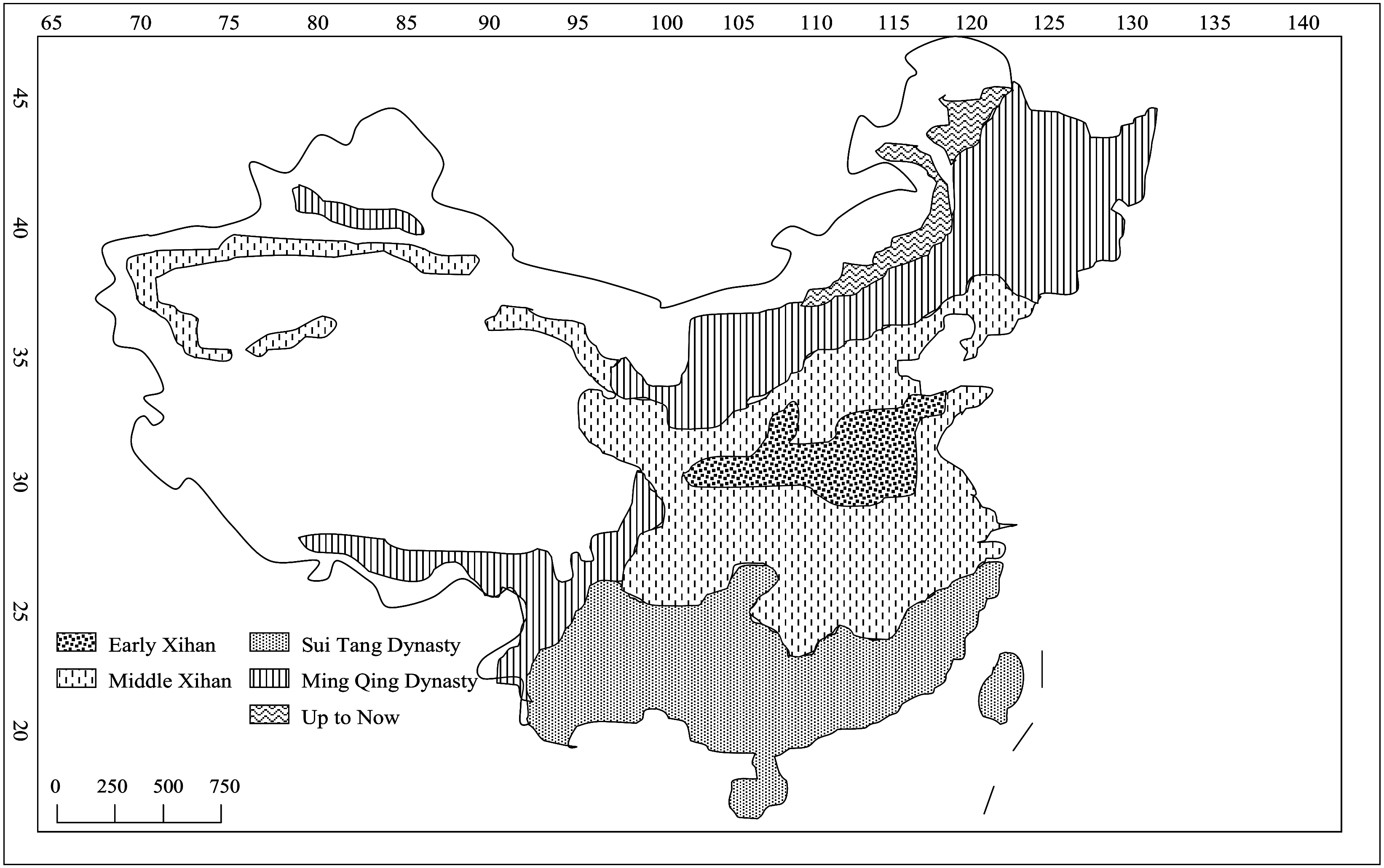
- To be drier and warmer in the east and warmer and moist in the west (Dahe Qin, 2002);
- It is nearly true in eastern China.





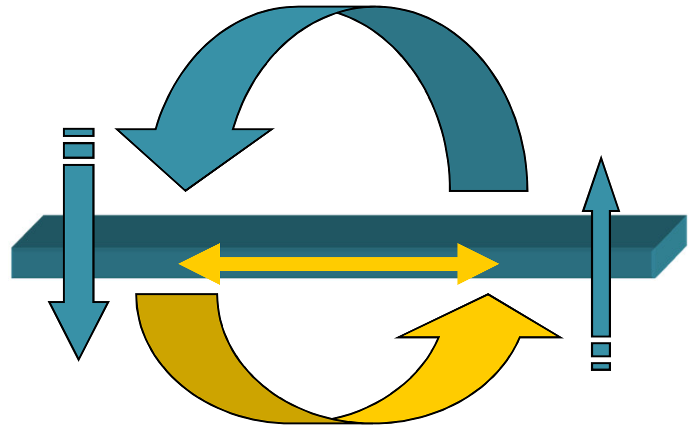


2.2 Land use change in China

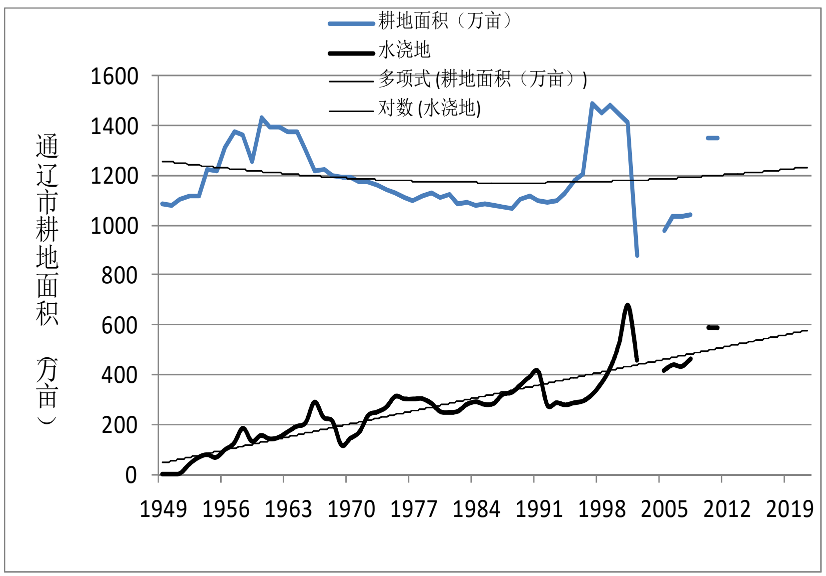


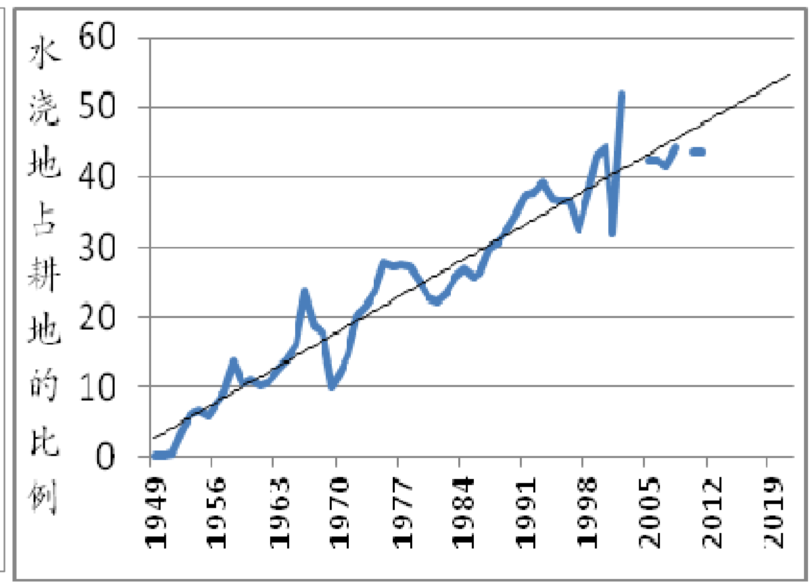
2.3 Land use change & impact

- Increasing population;
- Cropland invasion into fragile ecosystems since Han (206b.c. - a.d. 220) caused grassland degradation (Zhu, etc. 1994);
- Impacts changed from 2D to 3D.

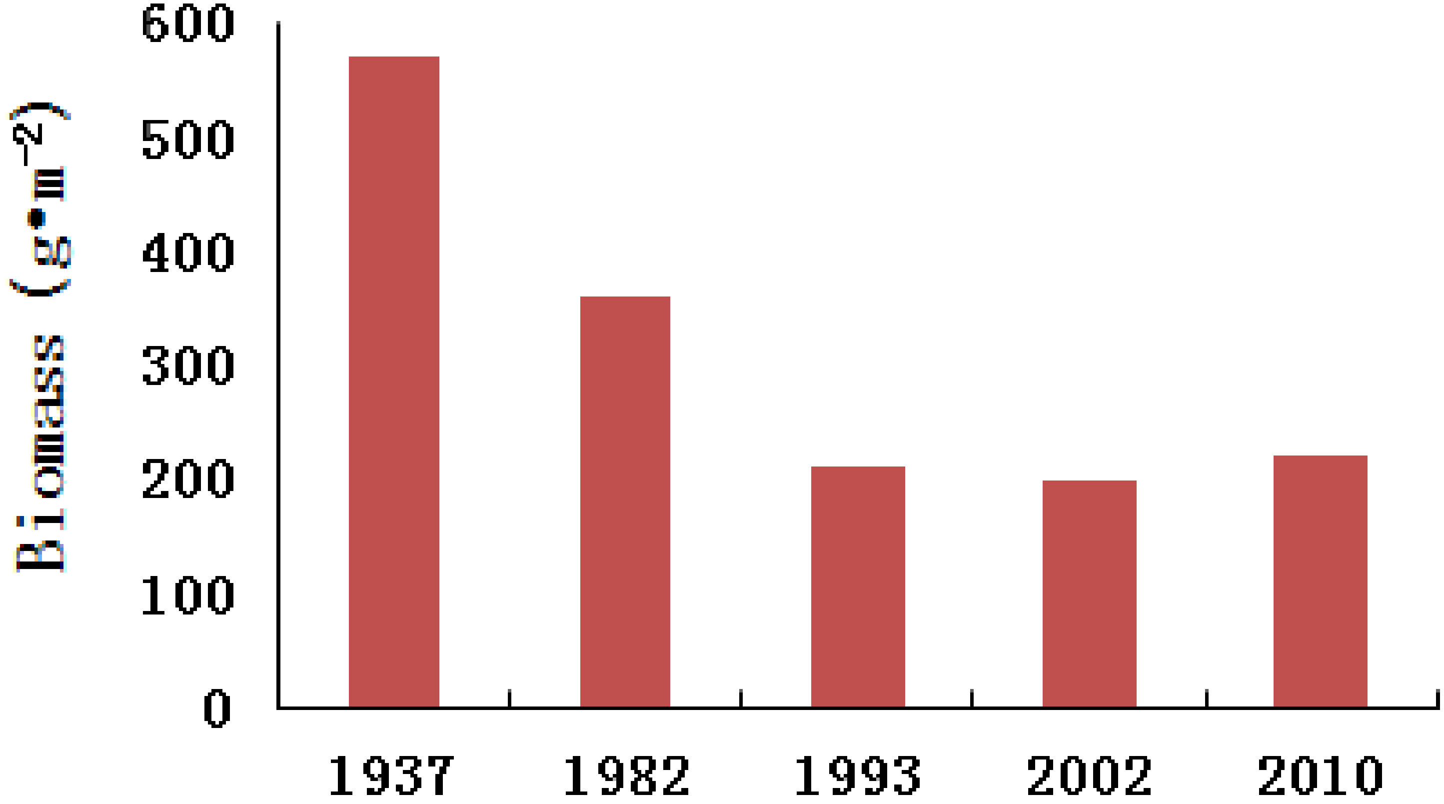


E & M 2D & 3D exchange

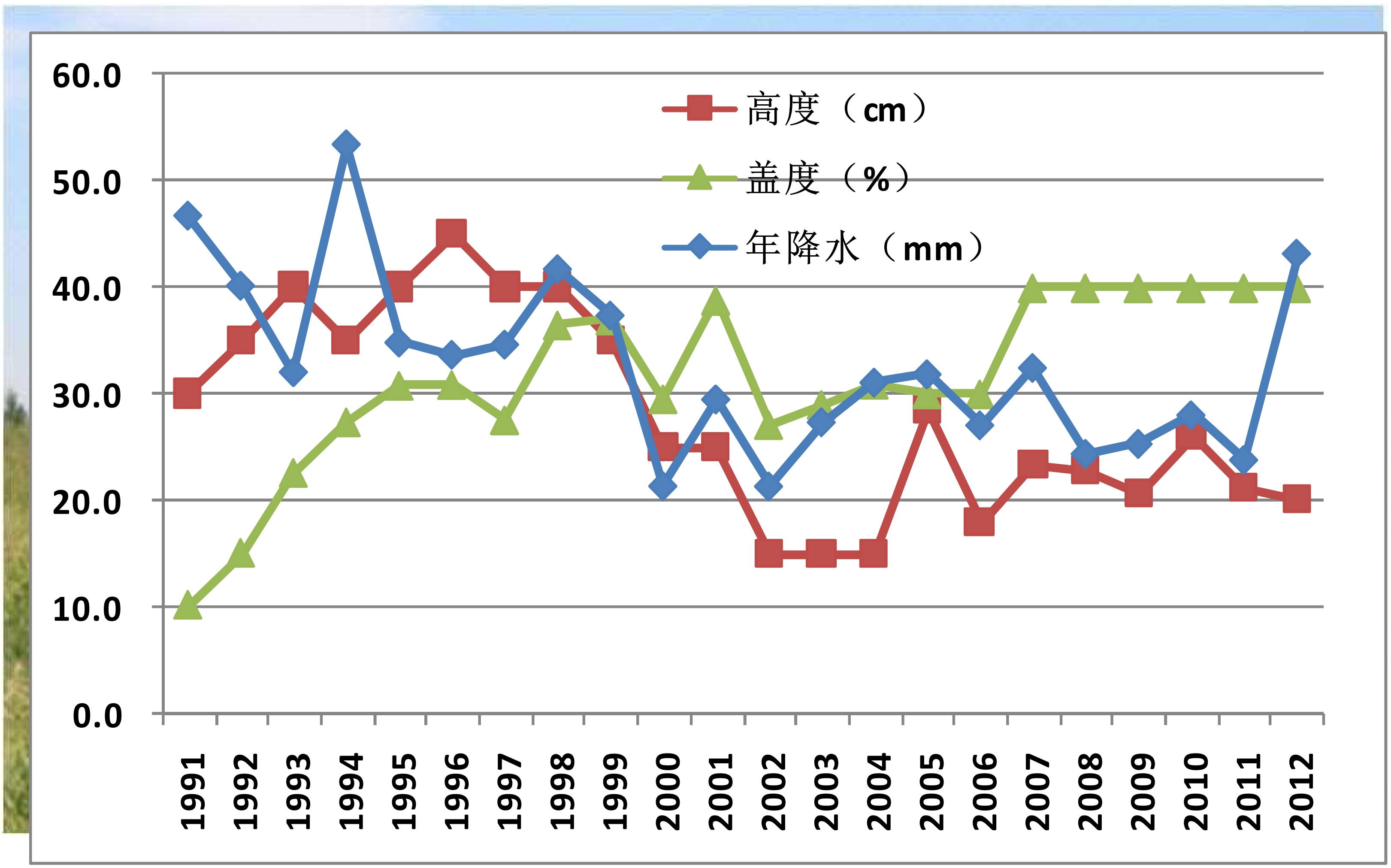




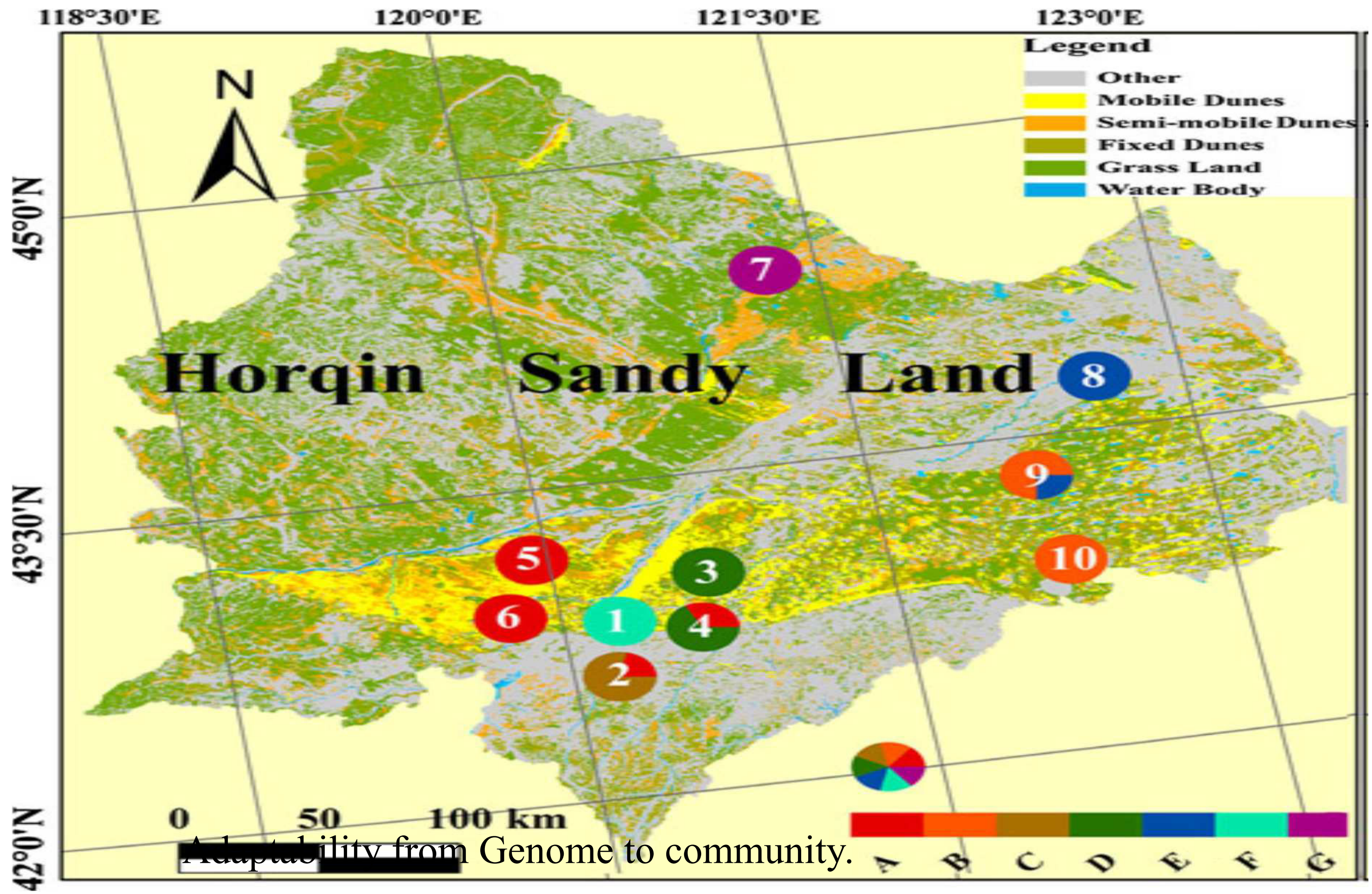
2.4 Productivity change



2.5 Restoration of over-grazed grassland

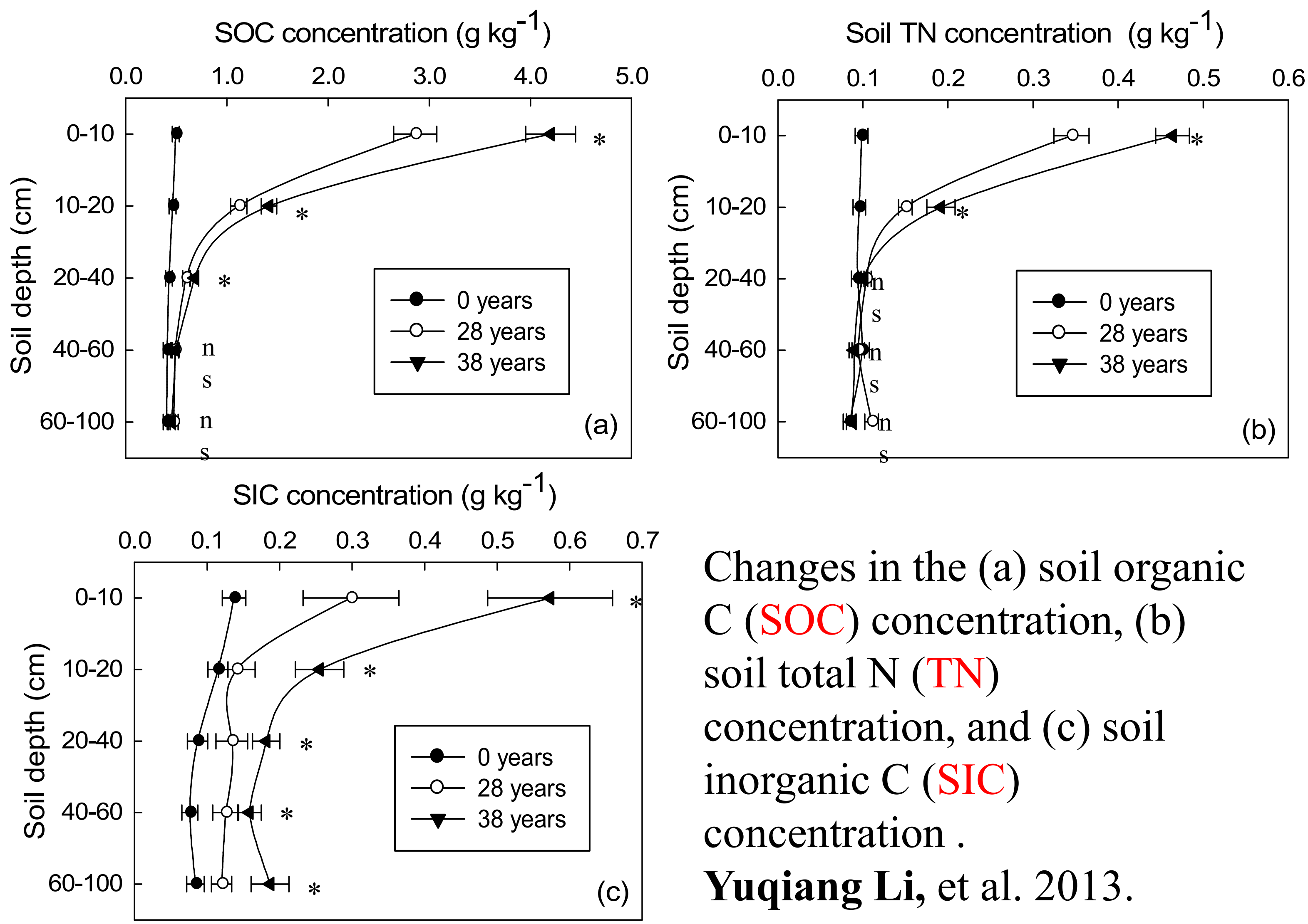


2.6 Genome response to habitat gradient



Adaptability from Genome to community.

2.8 Soil C change with restoration age



Changes in the (a) soil organic C (SOC) concentration, (b) soil total N (TN) concentration, and (c) soil inorganic C (SIC) concentration .

Yuqiang Li, et al. 2013.

2.9 Desertified land change

3 Facts

3.1 Natural and human-aided restoration

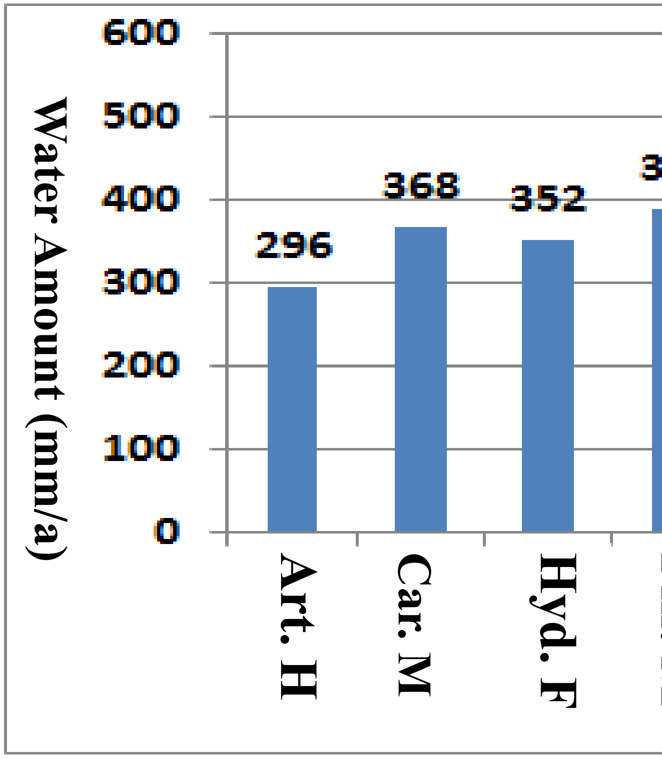
3.2 Restore degraded patches with DOM

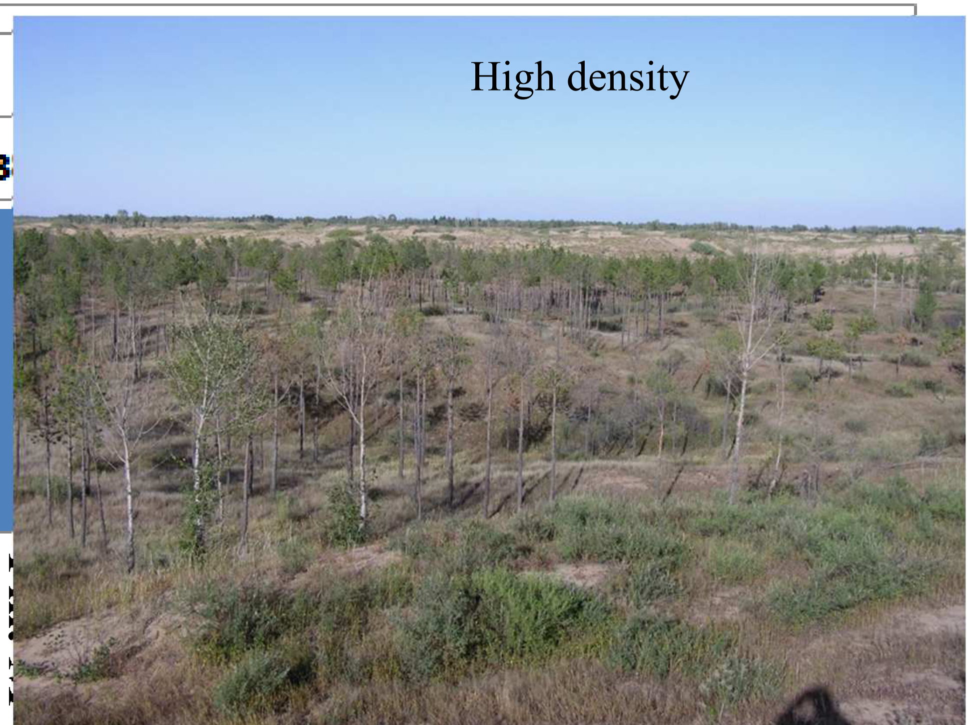
Waste use, pollution reduction , fodder and manure making …..

3.3 Restored grassland by shifting sand fixation

1) Natural Restoration and 2) Man-aided restoration

3.4 Tree-planting scale & species

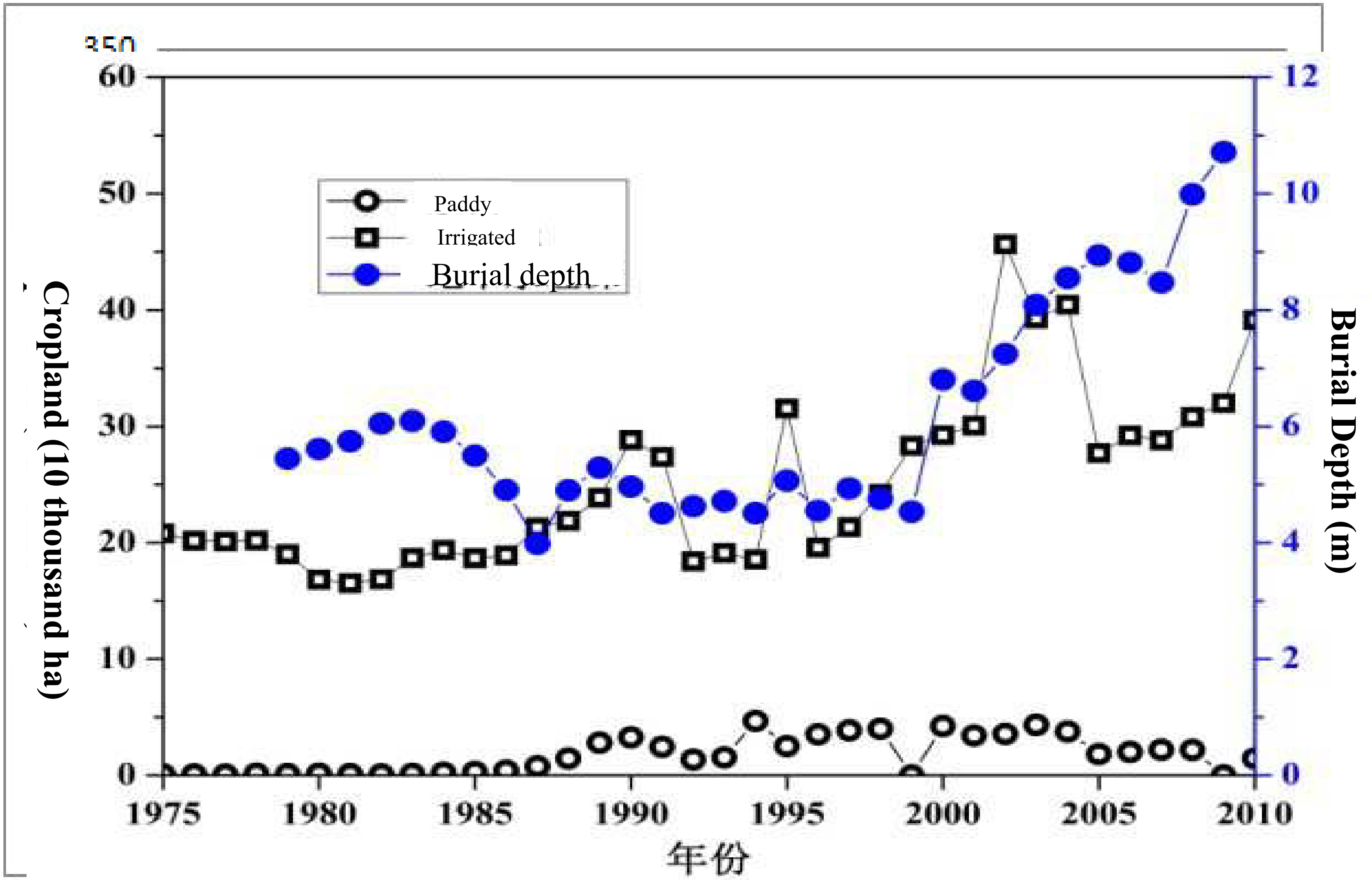




1 Water consumed by most of the aboriginal species was less than the annul mean precipitation （360mm） in Horqin Grassland.

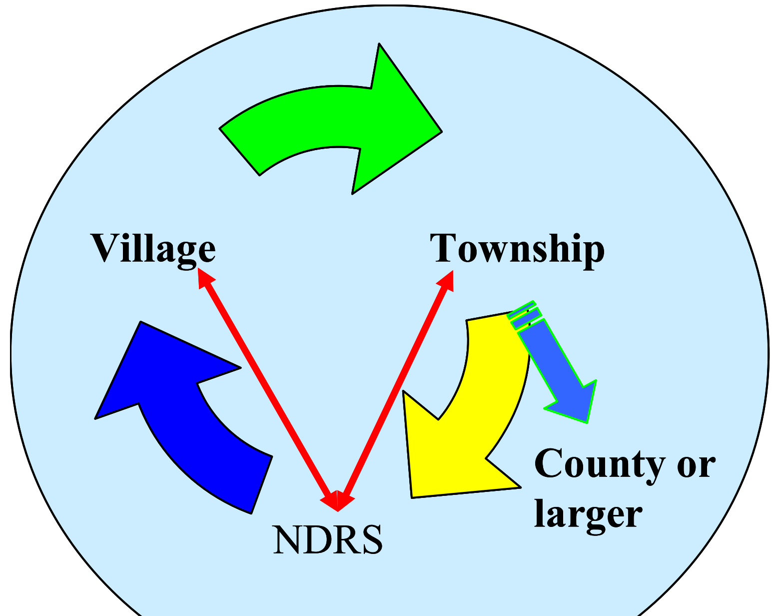
2 Combined observation with Sap flow meter, Lysimeter showed that tree density should be in the range of 225 to 375/ha, much lower the actual density of 1425-1575/ha.

3.5 intensified driving forces



3.6 Go to the "users"

- **Demonstration of ecosystem restoration techniques and models;**
- **Dissemination;**
- **Decision-making support;**
- **Scientific education of Youth.**

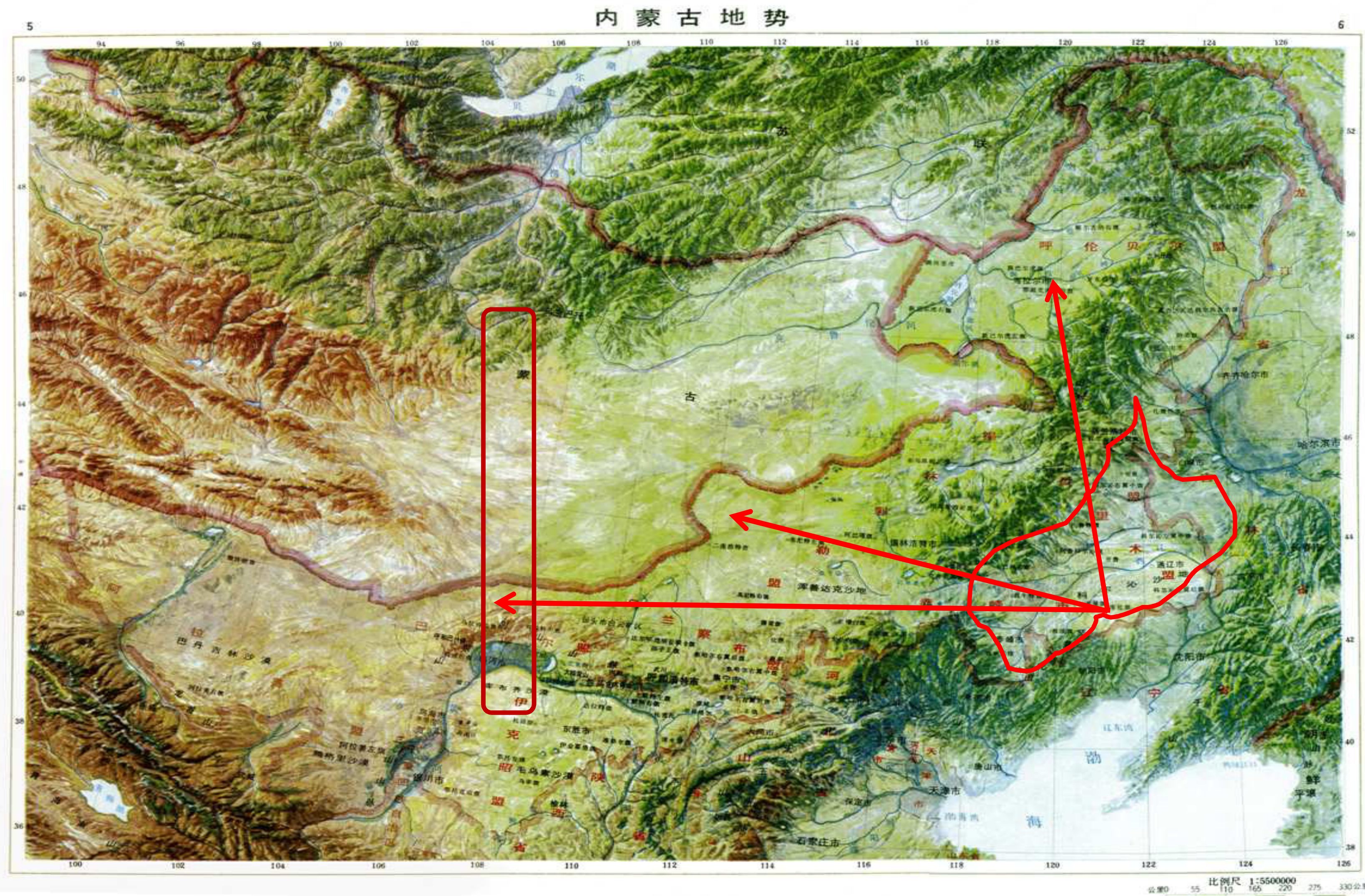


4 Suggests

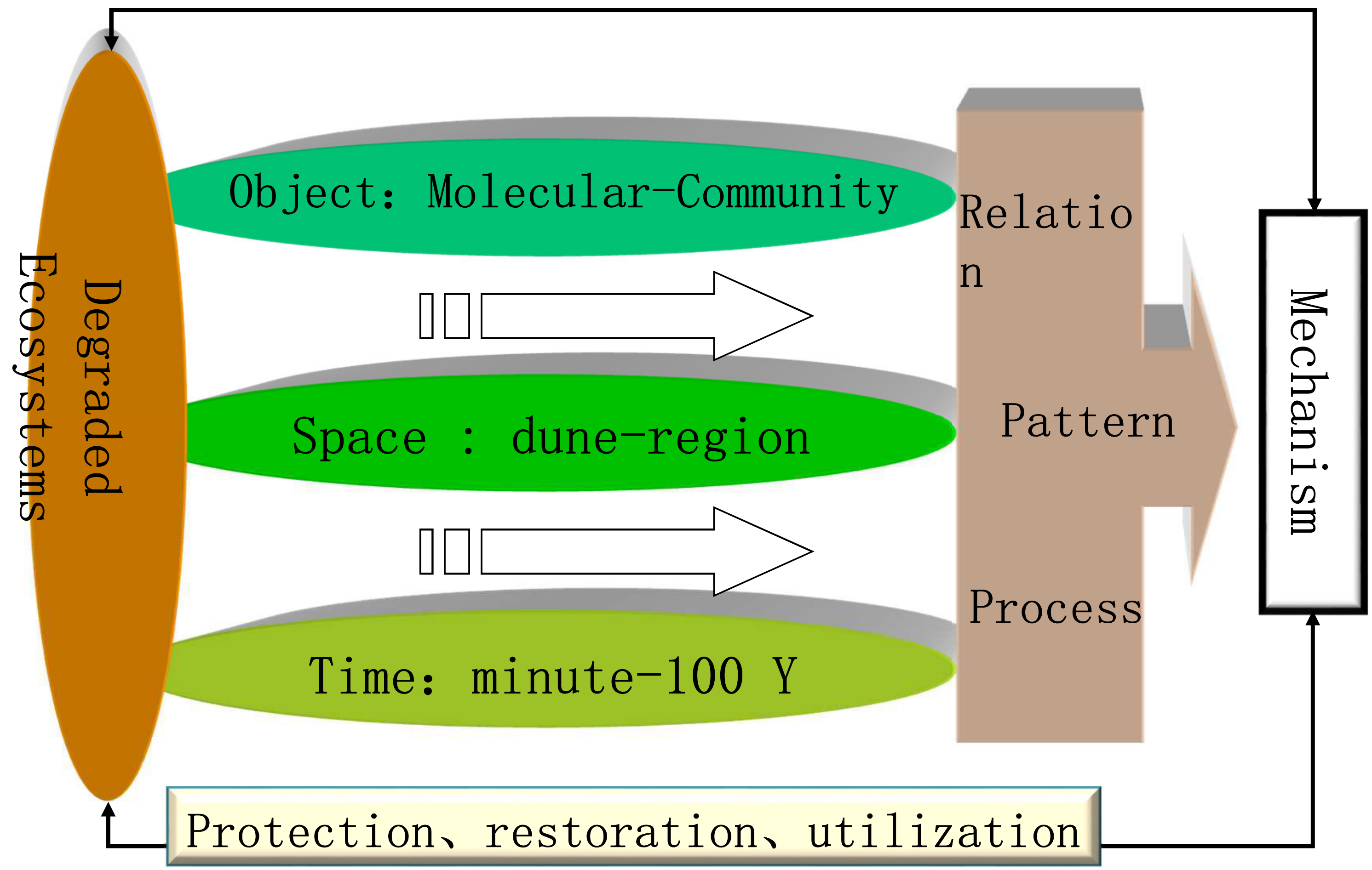
4.1 Plant-soil-water observation system

4.2 Responses of plants to CO_2

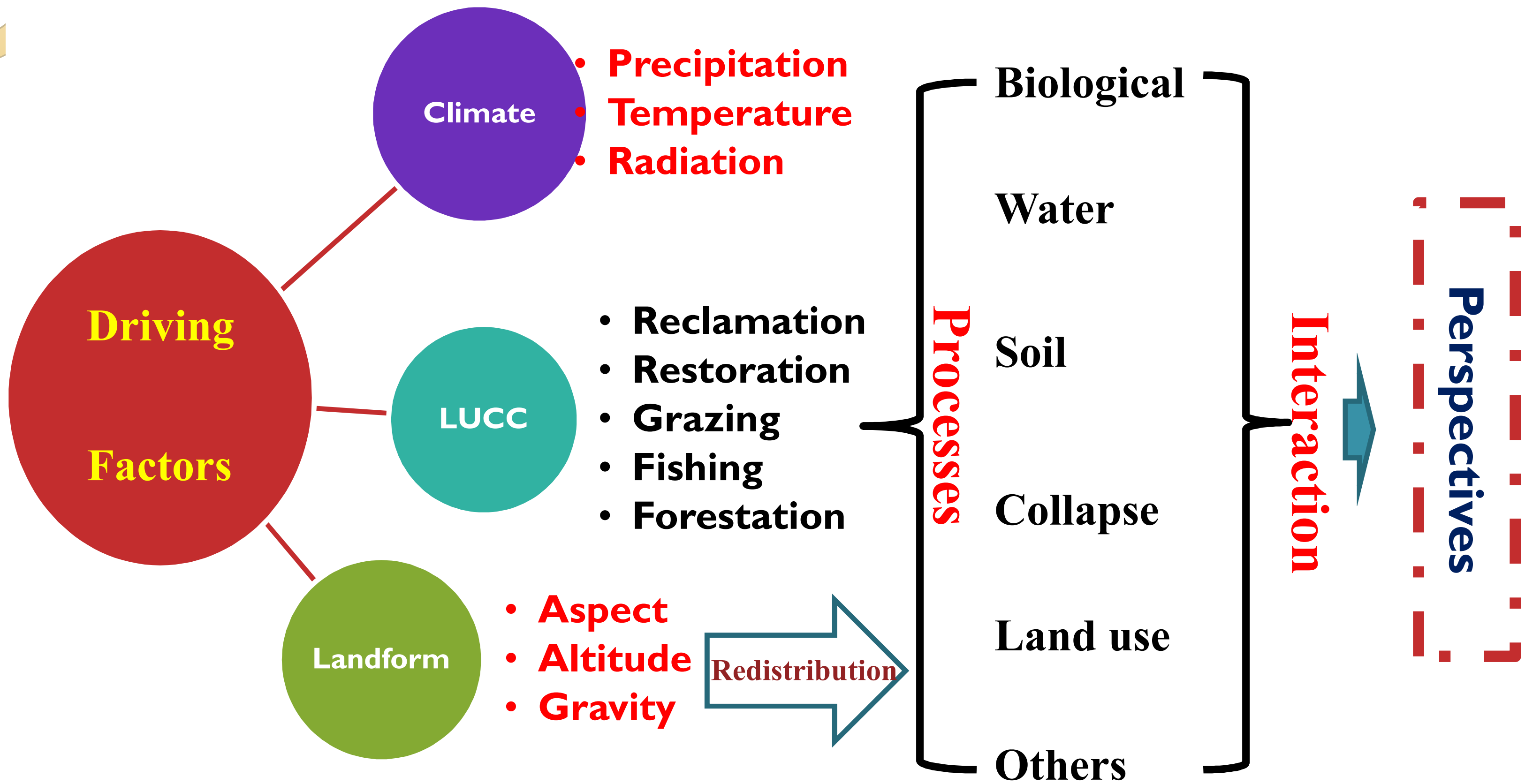
4.3 Transect monitoring



4.5 Research Framework



4.6 Vulnerability assessment



Thanks!

Discussion workshop on ecological vulnerability assessment
(5-8 July 2018, Tongliao, Inner Mongolia, China)

Carbon sequestration in the plant–soil system following grazing exclusion and afforestation in desertified area of Horqin Sandy Land

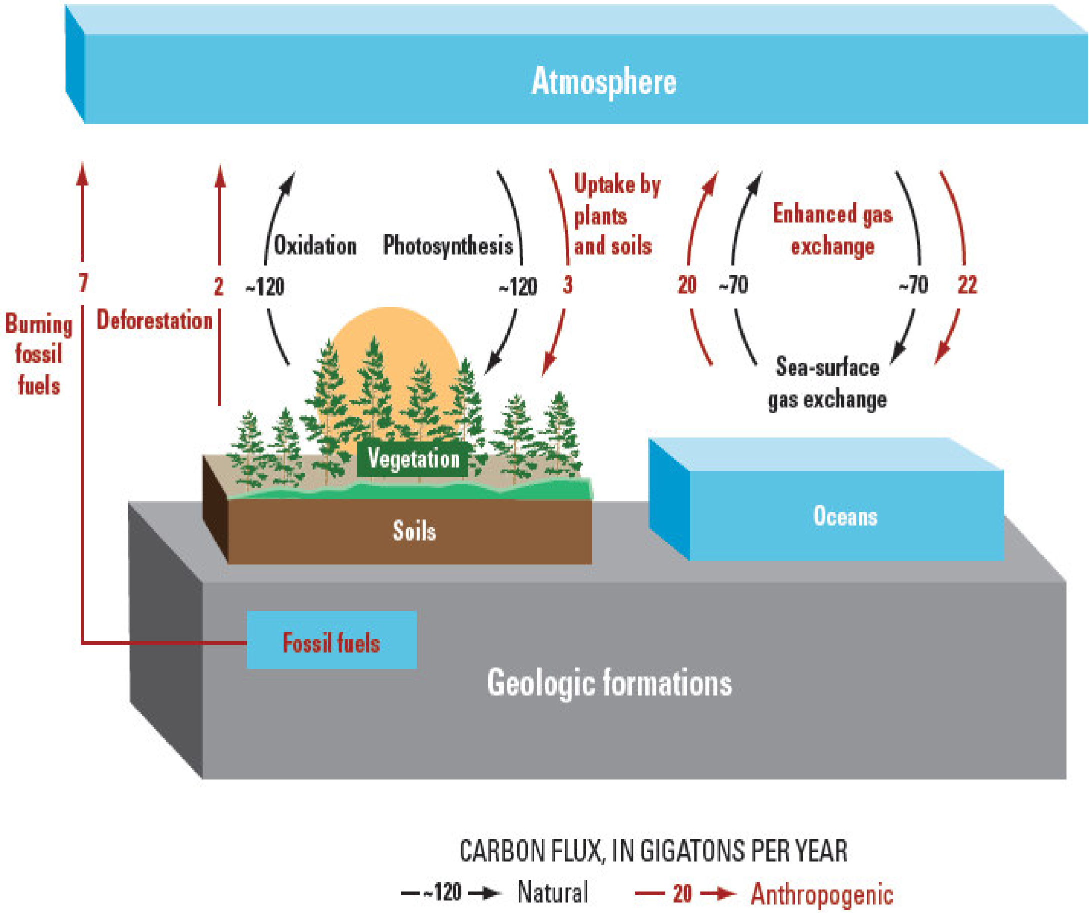
Li Yuqiang

Naiman Desertification Research Station
Northwest Institute of Eco-environment and Resource, CAS

Talk Themes

- What is carbon sequestration?
- Why does carbon sequestration has attracted considerable scientific attention?
- Is there a link between desertification and accelerated greenhouse effect?
- Potential of desertification control to sequester carbon;
- Carbon sequestration through grazing exclusion and afforestation in Horqin Sandy Land.

What is carbon sequestration?



The Global Carbon Cycle (Sundquist et al., 2008)

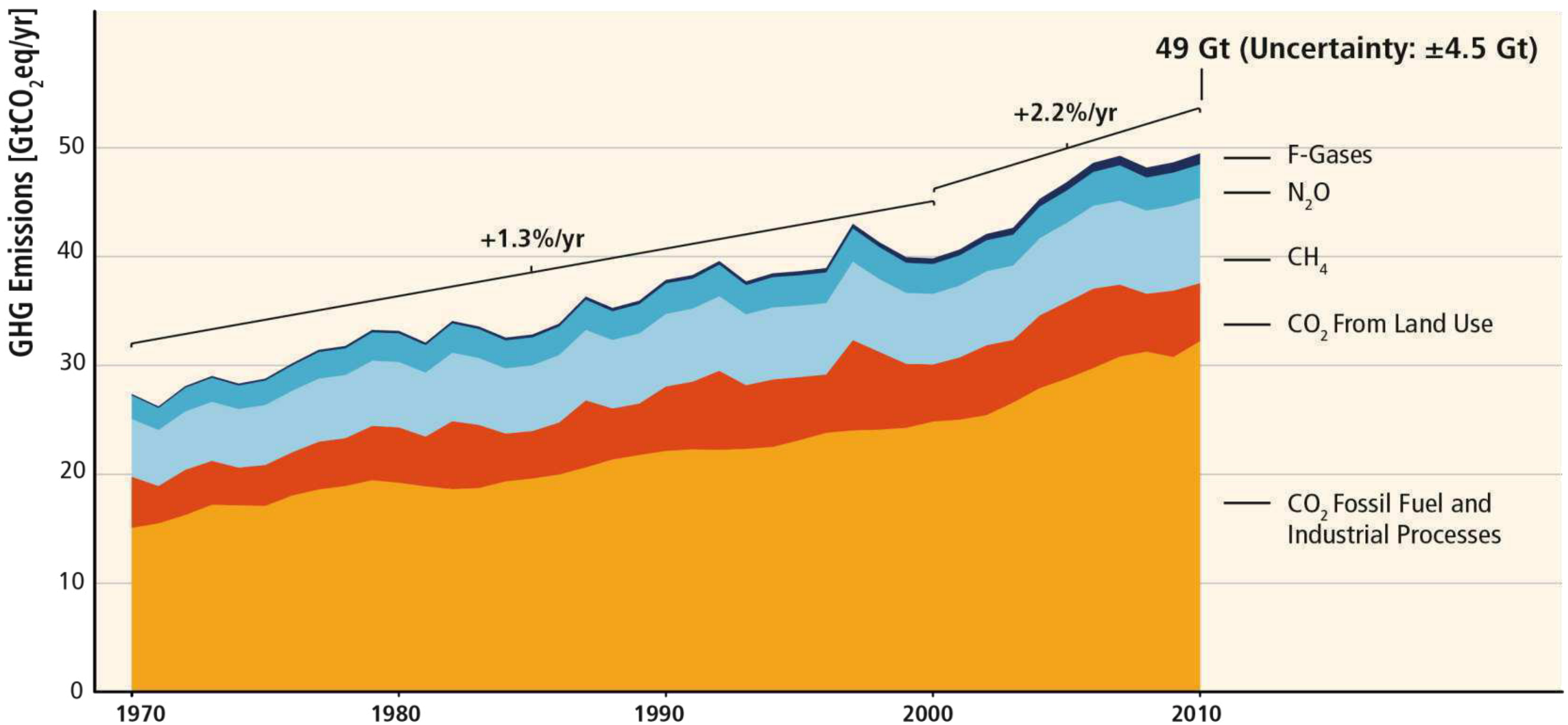
Carbon sequestration is used to describe both **natural** and **deliberate** processes by which CO_2 is either removed from the atmosphere or diverted from emission sources and stored in the **ocean**, **terrestrial environments** (vegetation, soils, and sediments), and **geologic formations**.

Forms of carbon sequestration

- **Oceanic carbon sequestration:** The world's oceans are **the primary long-term sink for human-caused CO_2 emissions**. This uptake is not a result of deliberate sequestration, but occurs naturally through chemical reactions between seawater and CO_2 in the atmosphere.
- **Terrestrial carbon sequestration:** (sometimes termed "**biological sequestration**") is typically accomplished through **forest and soil conservation** practices that
  - ✓ **enhance** the storage of carbon (such as restoring and establishing new forests, wetlands, and grasslands), or
  - ✓ **reduce** CO_2 emissions (such as reducing agricultural tillage and suppressing wildfires).
- **Geologic carbon sequestration:** Geologic sequestration begins with capturing CO_2 from the exhaust of fossil-fuel power plants and other major sources. Compared to the rates of terrestrial carbon uptake, geologic sequestration is currently used to **store only small amounts** of carbon per year.

Why does **carbon sequestration** has attracted considerable scientific attention?

- Increased emissions of **anthropogenic greenhouse gases** **[CO_2, CH_4, N_2O, and fluorinated gases]** have caused measurable global warming. Carbon dioxide is the most important GHGs.
- Carbon sequestration has been proposed as a way to **MITIGATE THE GREENHOUSE EFFECT.**



Total annual anthropogenic GHG emissions ($GtCO_2eq$ /yr) by groups of gases 1970 – 2010. F-gases: fluorinated gases (IPCC, 2014)

Importance of the Study on Climate Change and Carbon Budget of China

- 27.6% of the global CO_2 emissions
- closely related to population size and economic growth

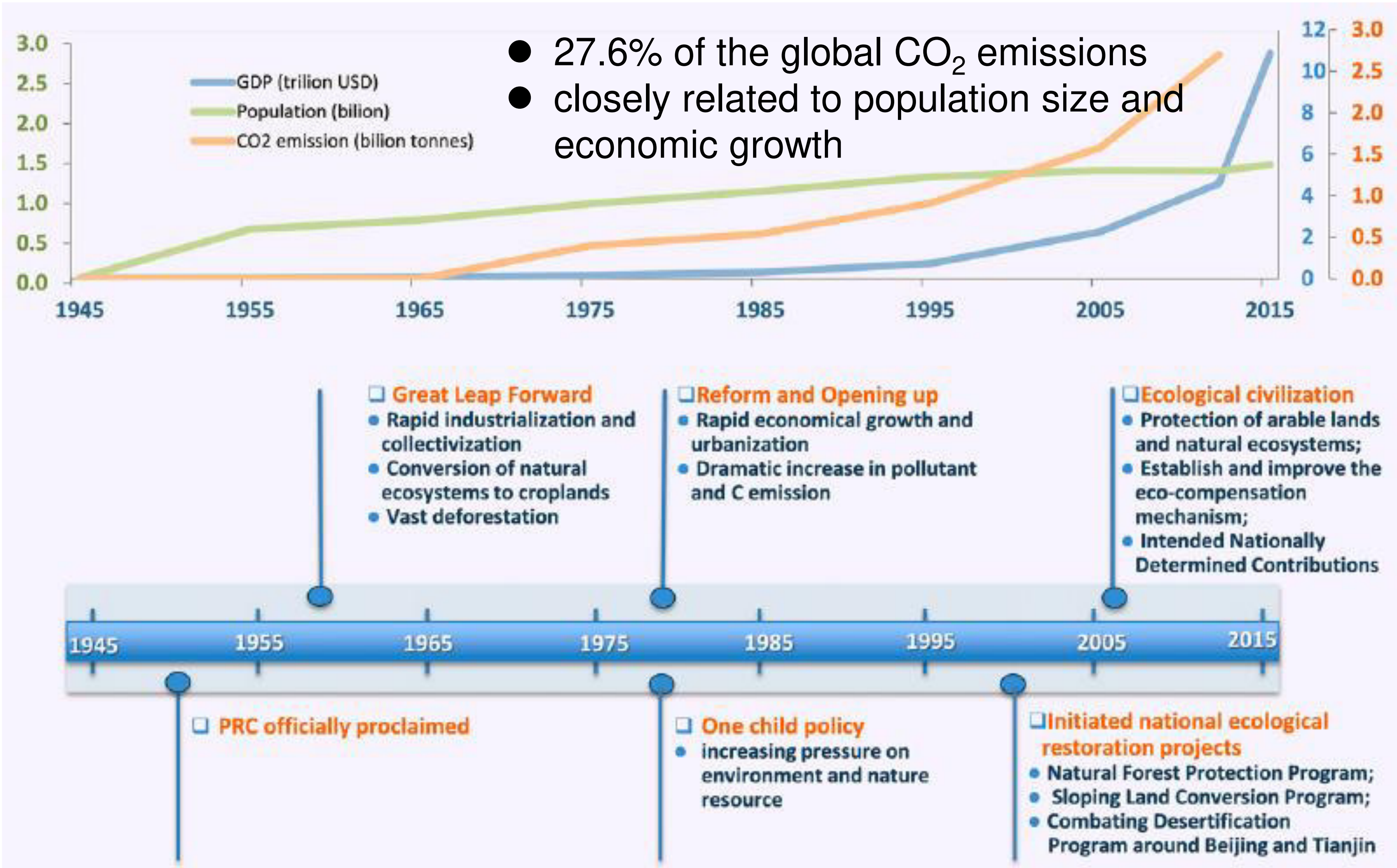


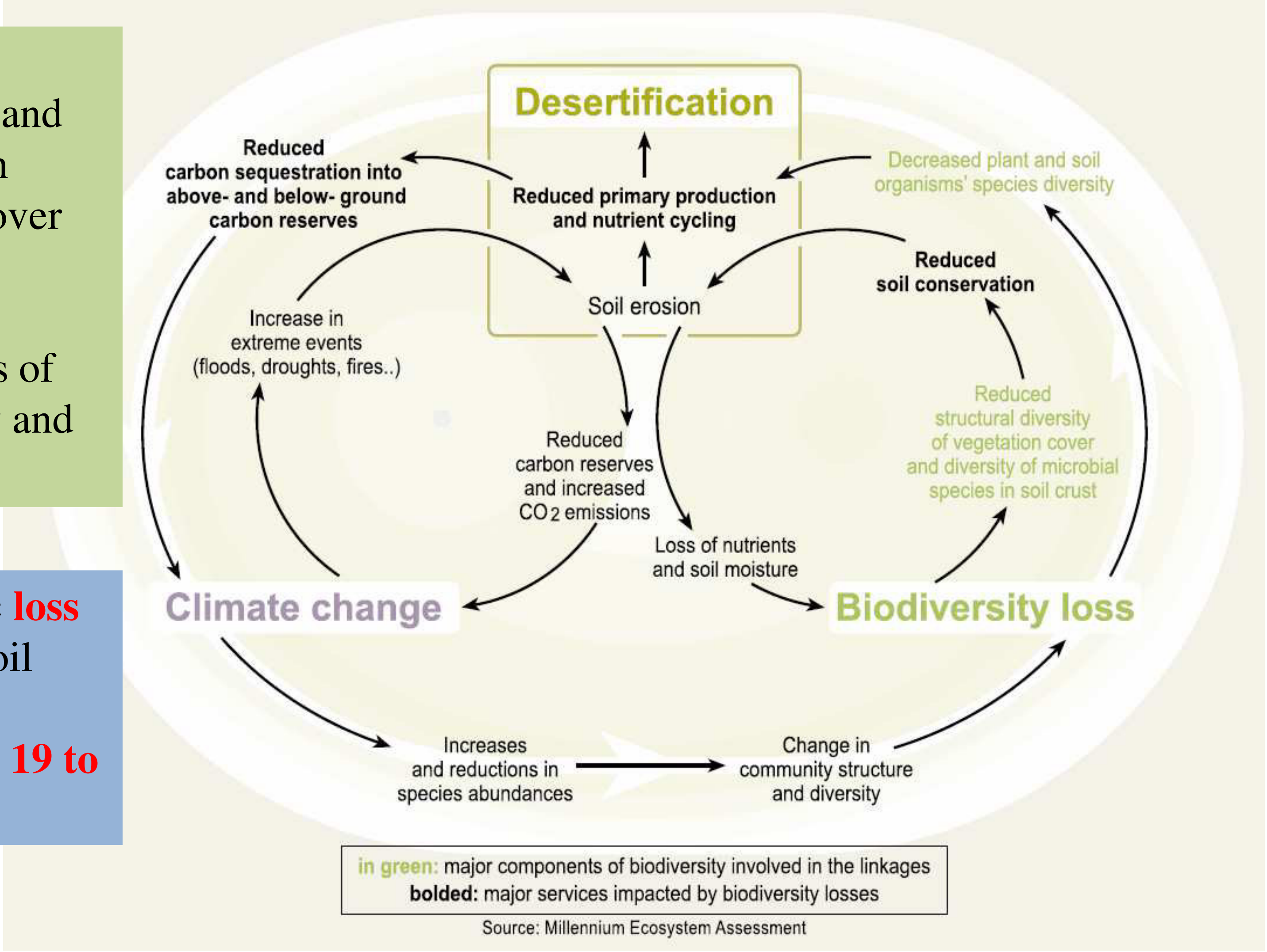
Fig. 1. Evolution in total national GDP, population, and fossil fuel CO_2 emissions (*upper*) and national economic policies and key ecological restoration projects (*lower*) in China between 1945 and 2015 [*Fang Jingyun et al.*, PNAS, 2018. 115 (16) 4015-4020].

Is there a **link** between desertification and accelerated greenhouse effect?

Desertification:

- **reduced** soil quality and effective rooting depth
- **decreased** vegetal cover
- **reduced** biomass productivity
- **accentuated** vagaries of climate especially low and variable rainfall

Globally, total historic **loss of C** from the plant–soil continuum due to desertification may be **19 to 29 Pg** (Ral 2001).

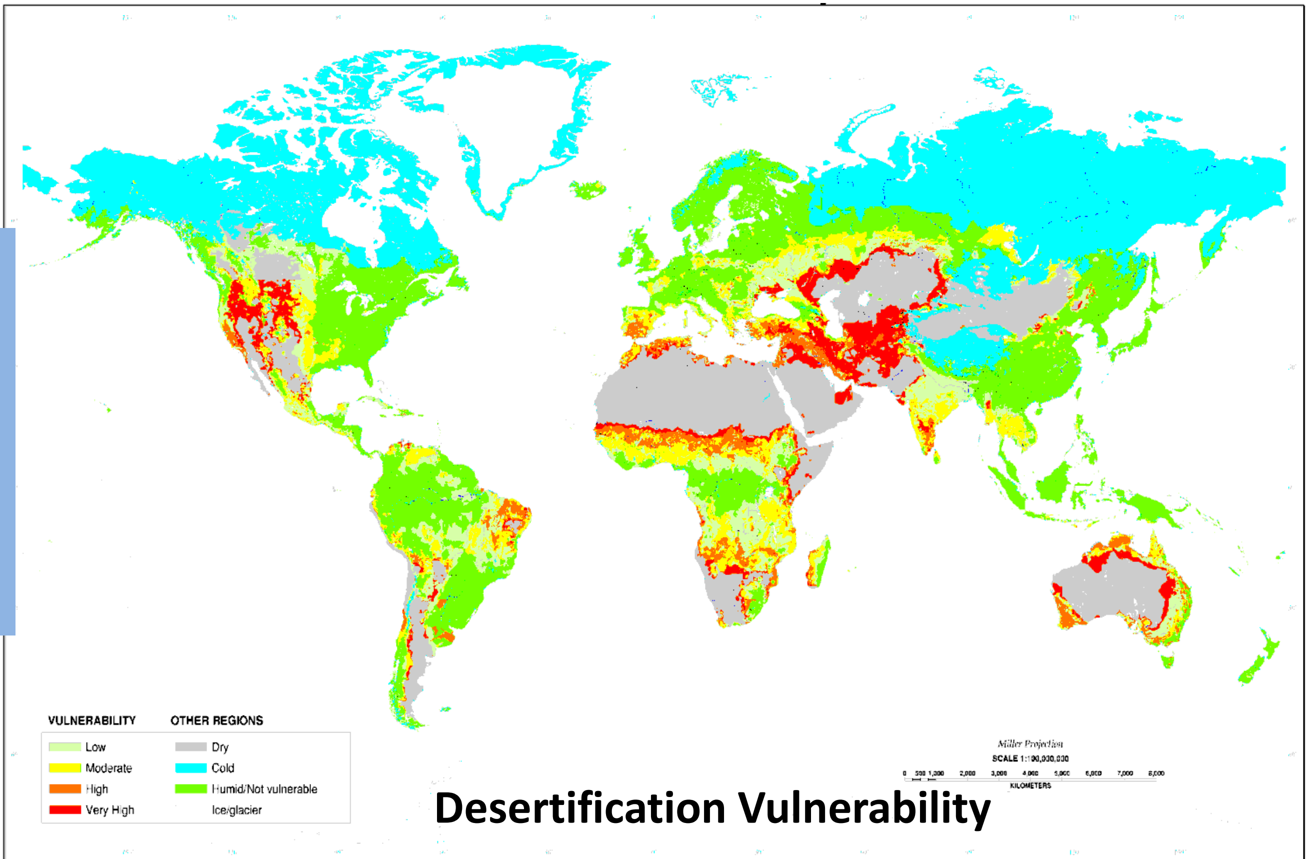


Linkages between Desertification, Global Climate Change, and Biodiversity Loss. Source: Millennium Ecosystem Assessment

Potential of desertification control to **sequester** carbon

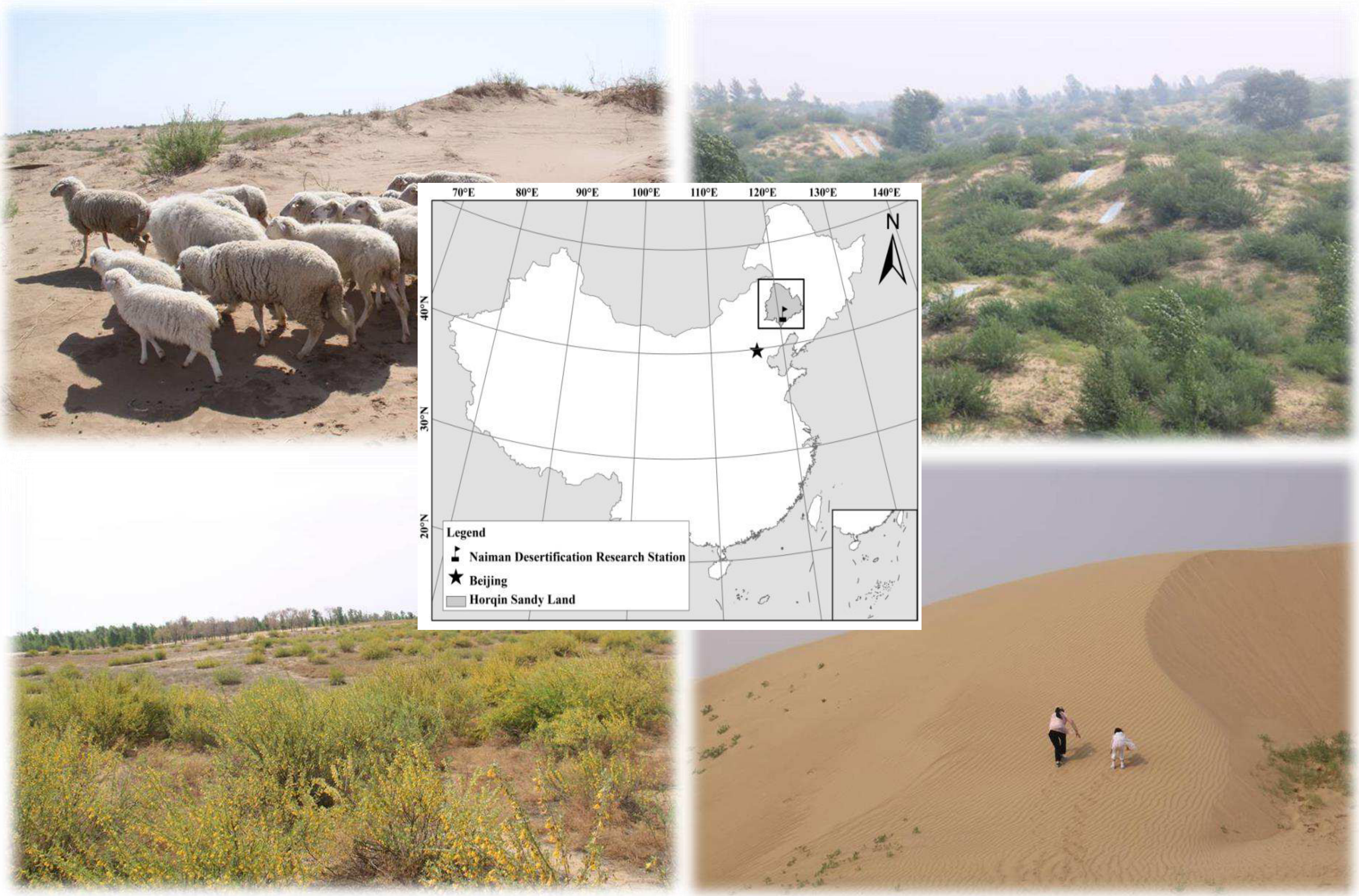
- **Vast area:** Drylands occupy approximately 40–41% of Earth’s land;
- **Widely degraded:** 70% of the earth's dryland is affected by desertification (Source: UN 2000)

A **good potential sink** for C in drylands through **desertification control**



Desertification Vulnerability

Carbon sequestration through **grazing exclusion** and **afforestation** in Horqin Sandy Land



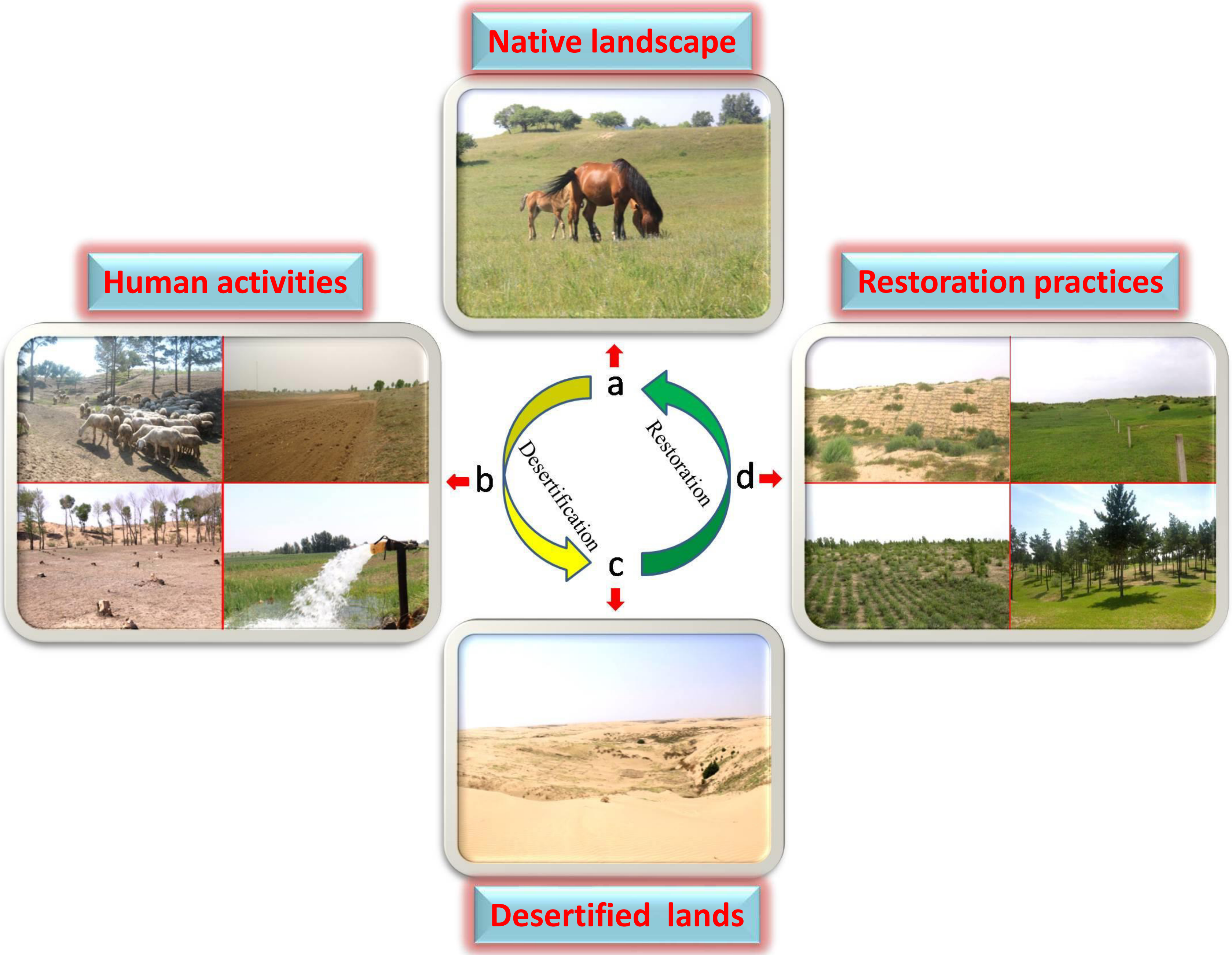
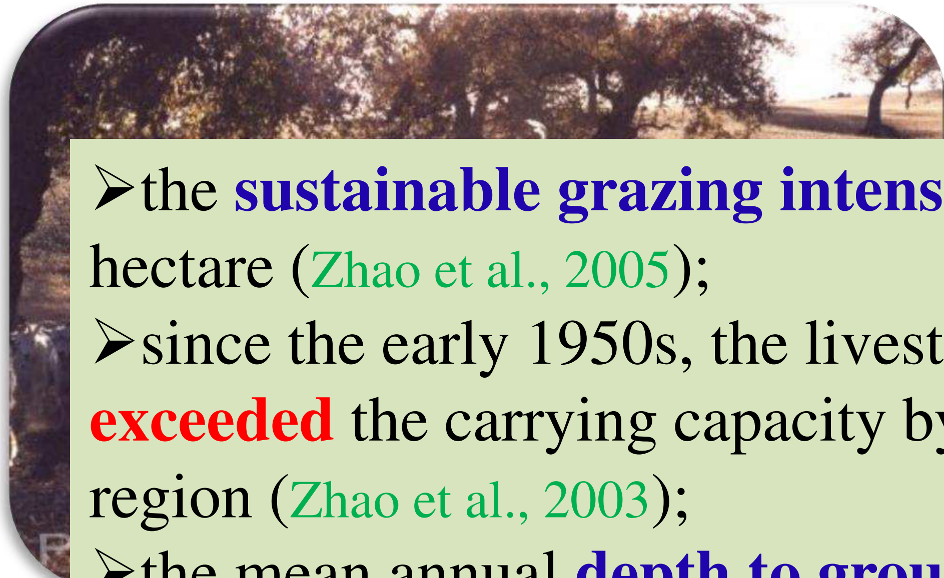


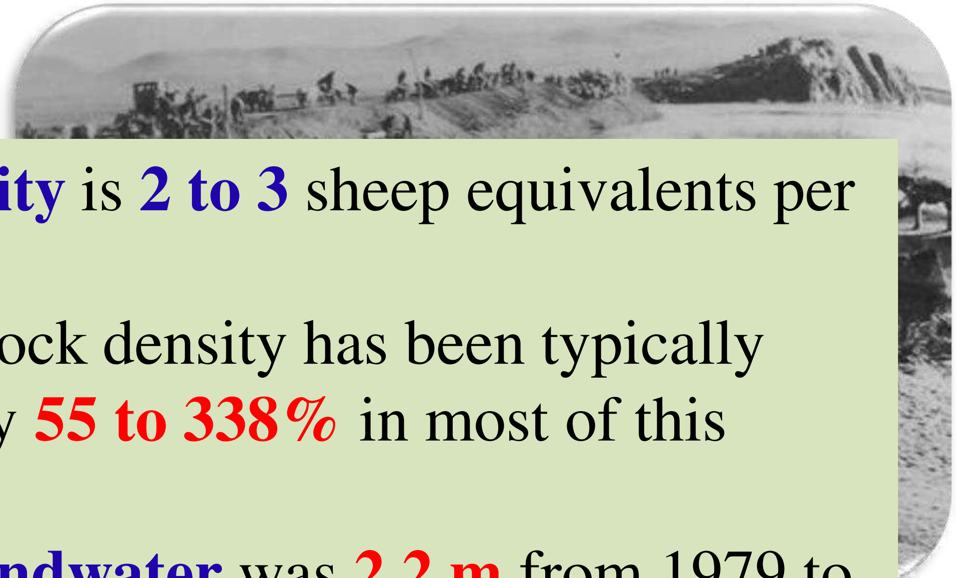
Illustration of the grassland **desertification process** and the subsequent **restoration practices** in the Horqin Sandy Land.

Native landscape

- **Horqin Sandy Grassland**
- The original vegetation is **tree-scattered grassland,** characterized by grass species such as *Stipa grandis*, *Leymus chinensis*, and *Agropyron cristatum* communities along with sparsely scattered woody species such as *Ulmus pumila*, *Populus simonii*, *Populus pseudo-simonii*, and *Quercus mongolica*.
- A major region of **pasture resources** in Inner Mongolia in northern China

The primary anthropogenic drivers of desertification





- the **sustainable grazing intensity** is **2 to 3** sheep equivalents per hectare (Zhao et al., 2005);
- since the early 1950s, the livestock density has been typically **exceeded** the carrying capacity by **55 to 338%** in most of this region (Zhao et al., 2003);
- the mean annual **depth to groundwater** was **2.2 m** from 1979 to 1997 (Zhao et al., 1999), this depth increased to **7.6 m**, from 2005 to 2012.

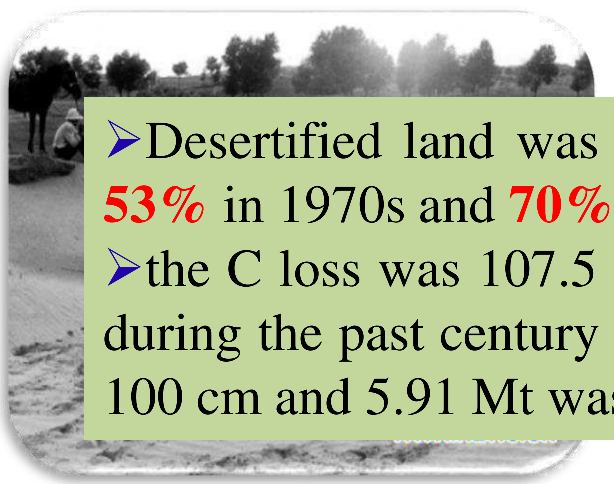
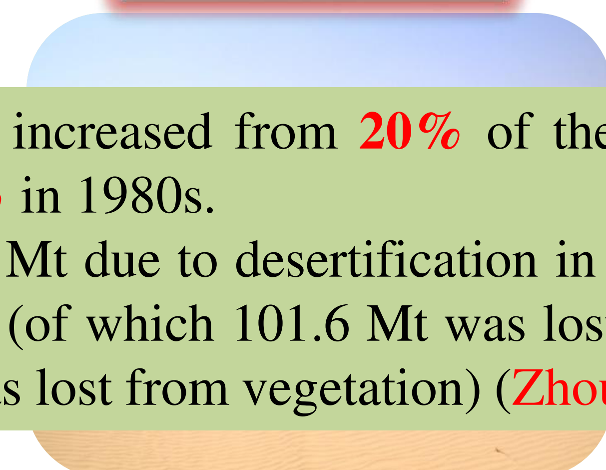
- continental **semiarid monsoon temperate climate** regime
- mean annual **precipitation 366 mm**
- mean annual potential **evaporation 1935 mm**
- mean annual air temperature of 6.8 ºC
- mean wind speed 4.3 m s^{-1}, with occasional occurrences of gales ≥ 20 m s^{-1}
- soils are derived from alluvial and aeolian sediments

from 2000 to 2009 compared with the average from 1959 to 1999

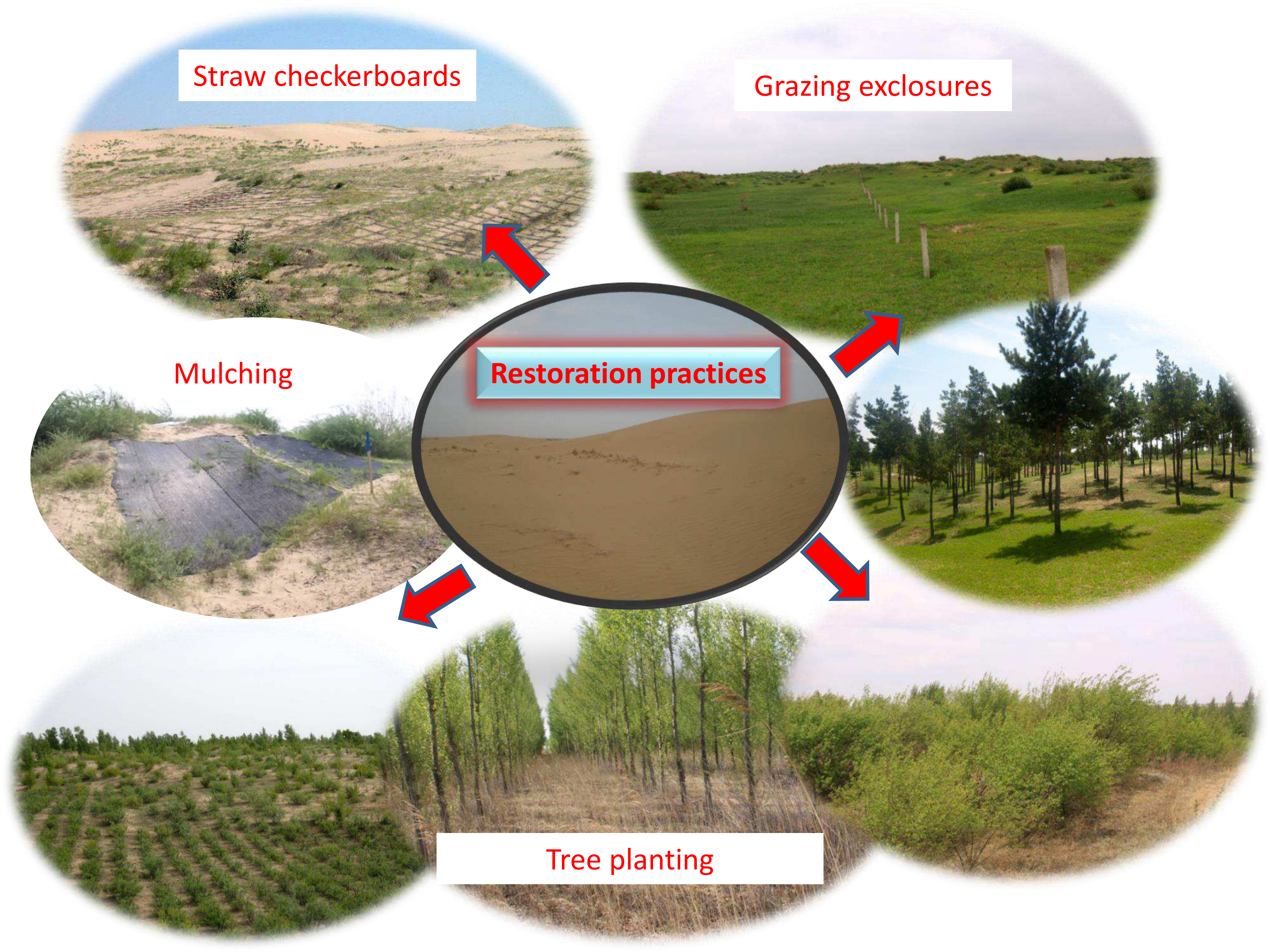
- ✓**air temperature** has **increased** by 0.9 ºC
- ✓**rainfall** has **decreased** by 81.4 mm based on mean values

Region‘s fragile ecology + **Climate change** + **Human activities**

Desertified lands


- Desertified land was increased from **20%** of the total land in 1950s to **53%** in 1970s and **70%** in 1980s.
- the C loss was 107.5 Mt due to desertification in the Horqin Sandy Land during the past century (of which 101.6 Mt was lost from soil to a depth of 100 cm and 5.91 Mt was lost from vegetation) (Zhou et al. 2008).

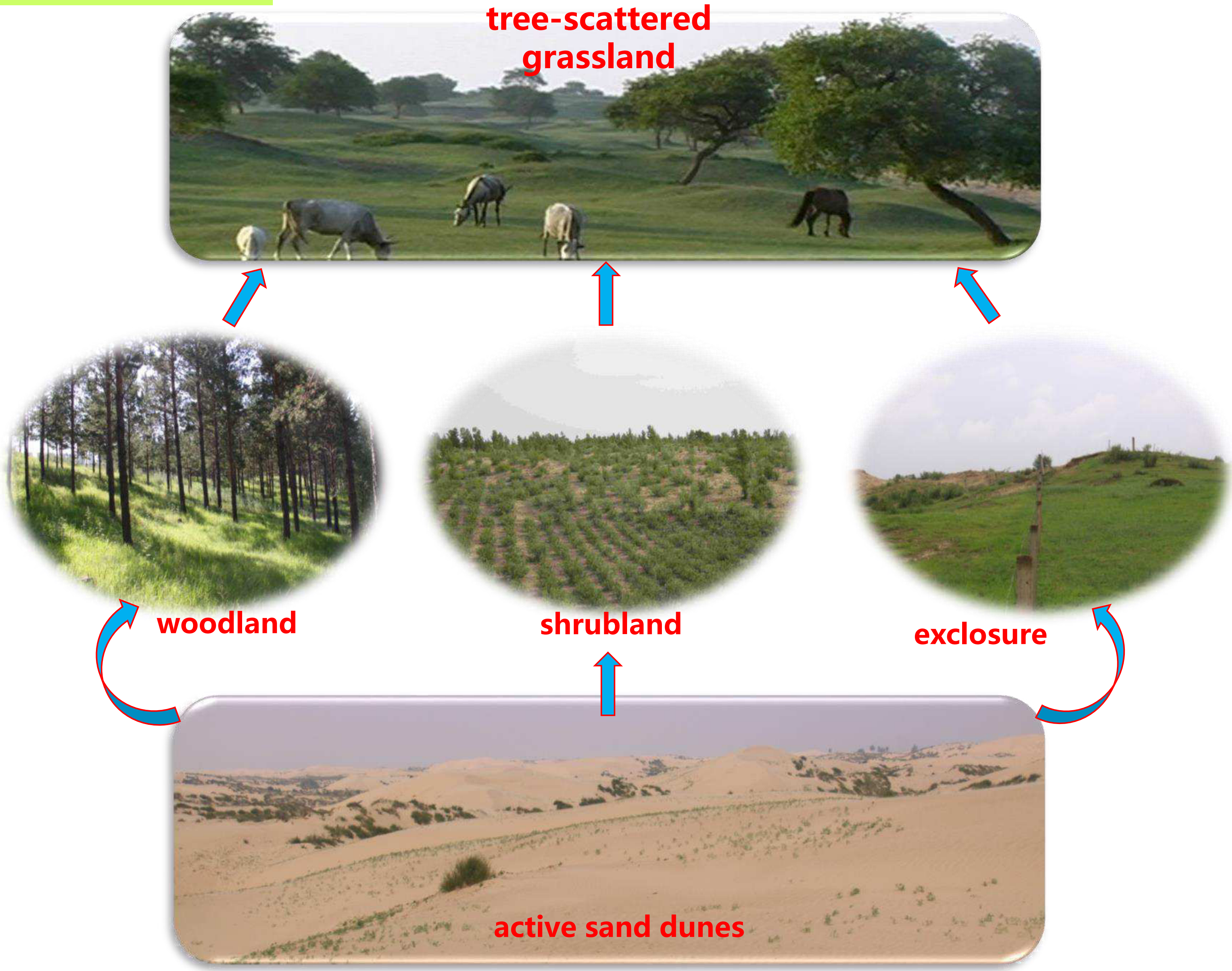

Straw checkerboards
Grazing exclosures
Mulching
Restoration practices
Tree planting

Two of the most widely suggested options

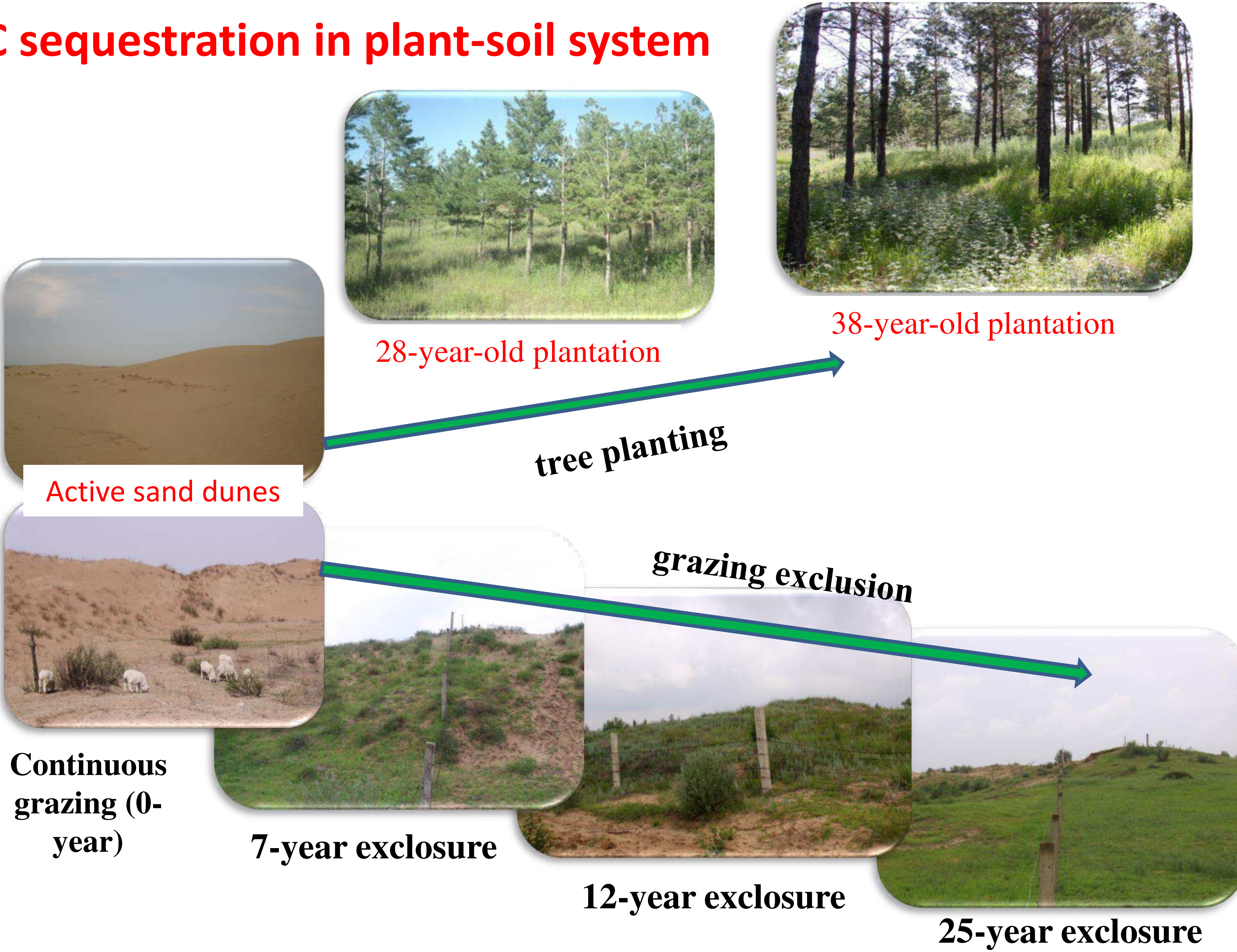
- grazing exclusion
- afforestation (tree planting)

- grazing exclusion primarily depend on **natural processes** rather than potentially expensive **artificial measures**
- afforestation can **increase C influx** through a higher and more efficient use of resources for primary production
- both these practices **favour C sequestration** through reduced soil erosion due to increased coverage of the ground by vegetation
- the **slower C turnover** rates associated with wood carbon allocation in afforestation
- the **cessation of biomass removal** by livestock decrease C losses in exclosures

Objectives

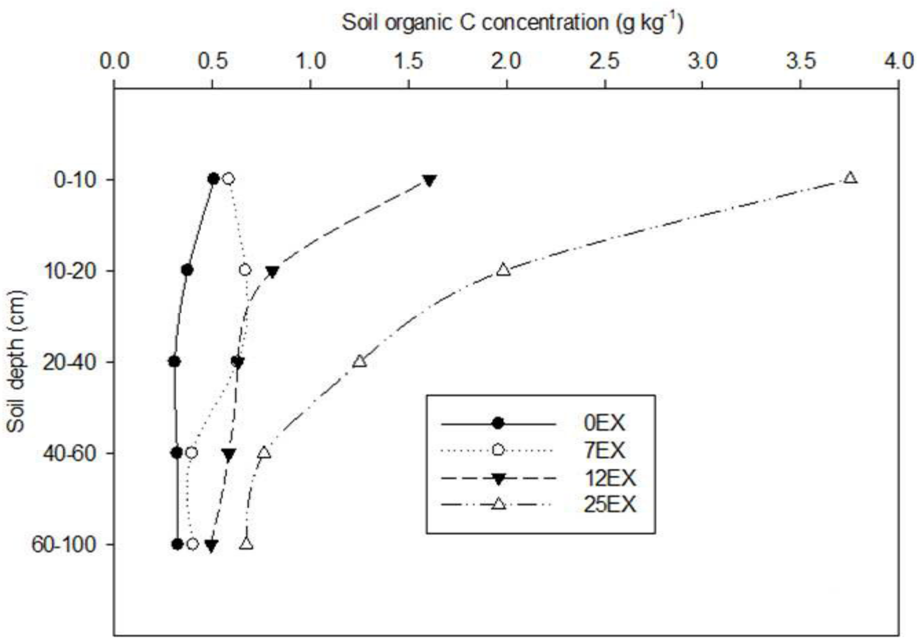

tree-scattered grassland
woodland
shrubland
exclosure
active sand dunes

C sequestration in plant-soil system



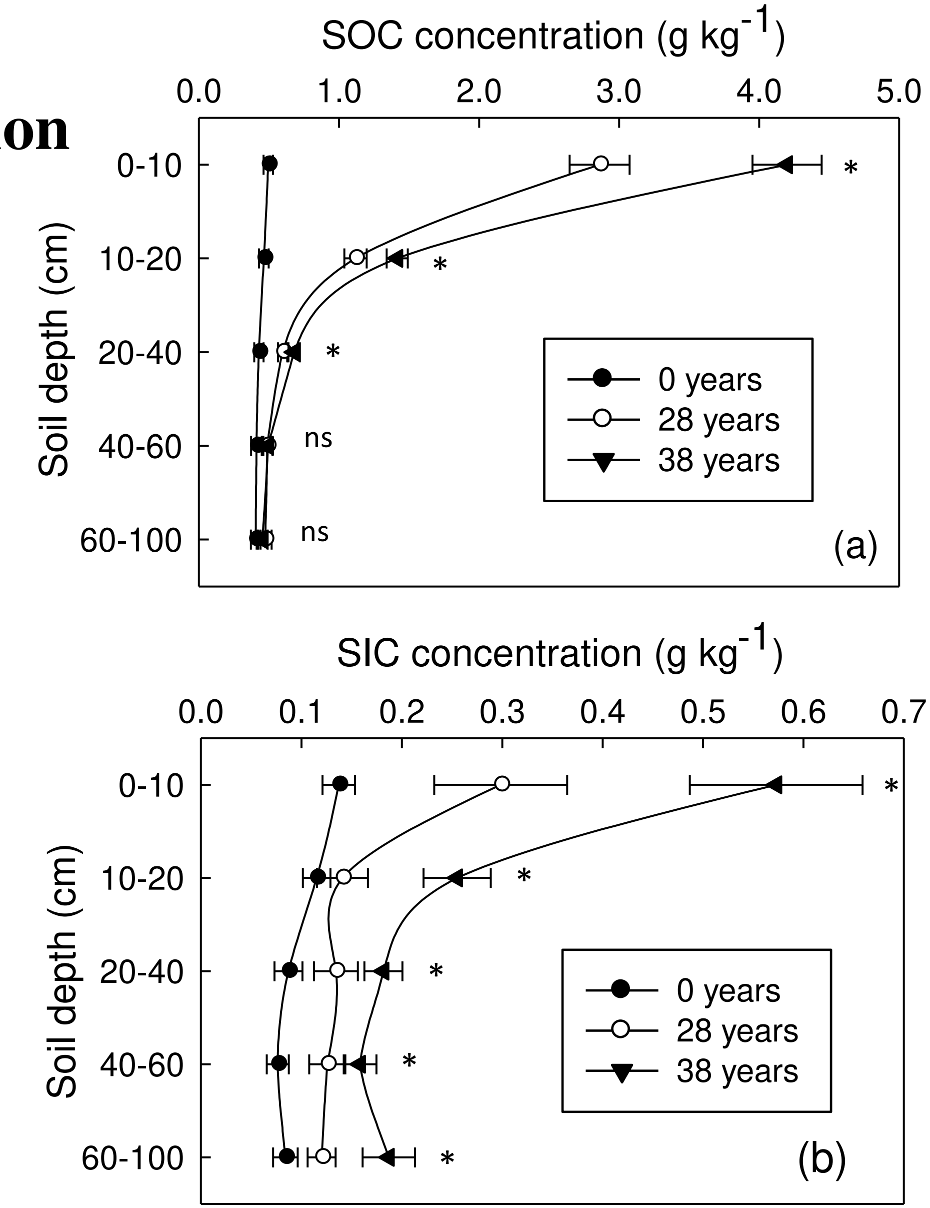
Results

➢Changes in soil C concentration



0EX, 0 years; 7EX, 7 years; 12EX, 12 years; 25EX, 25 years

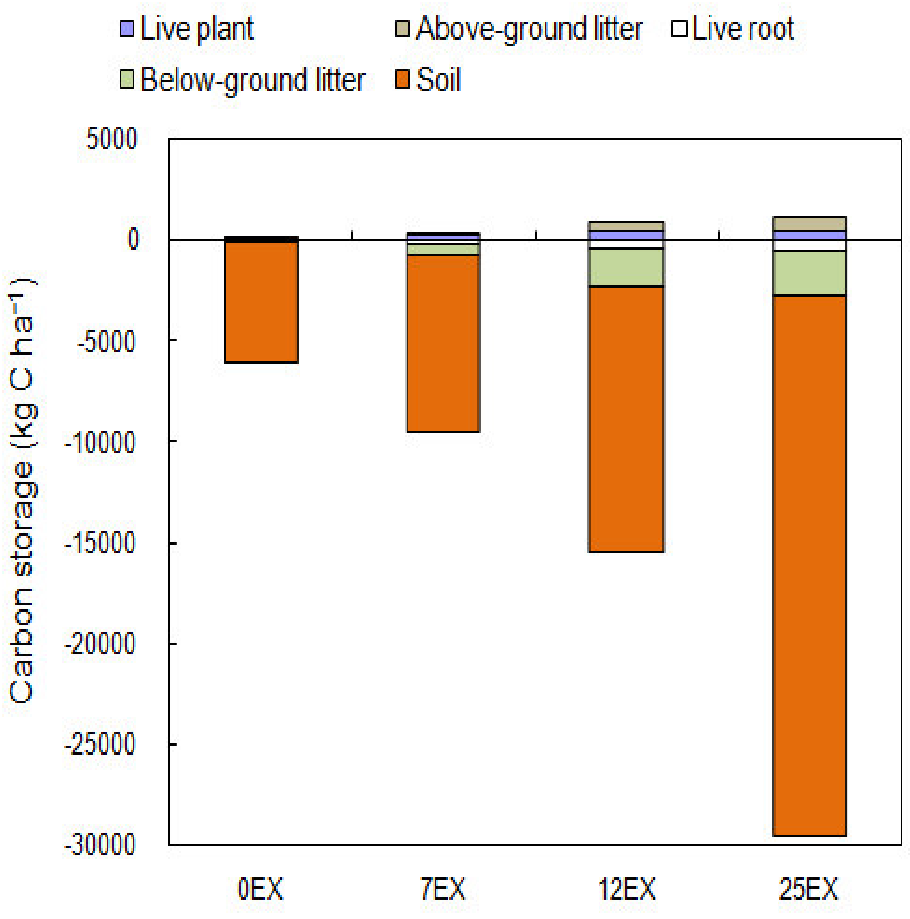
■Grazing exclusion

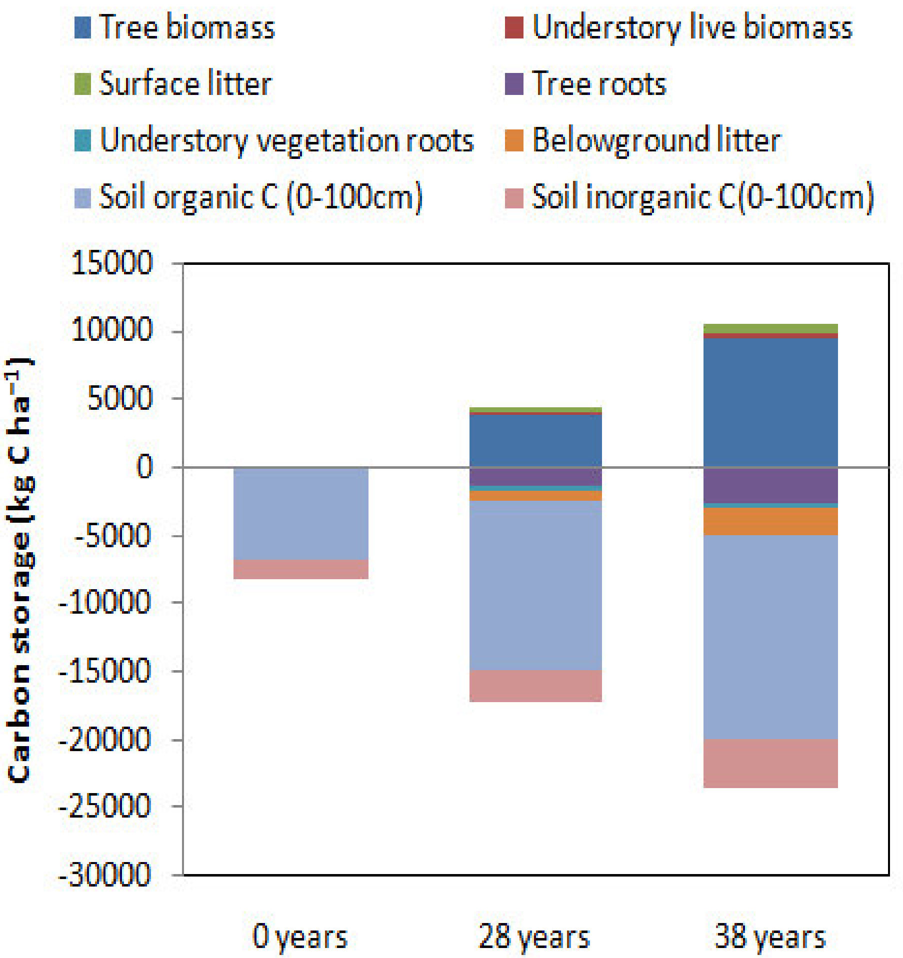


■Afforestation

Results

➢Changes in plant-soil C storage

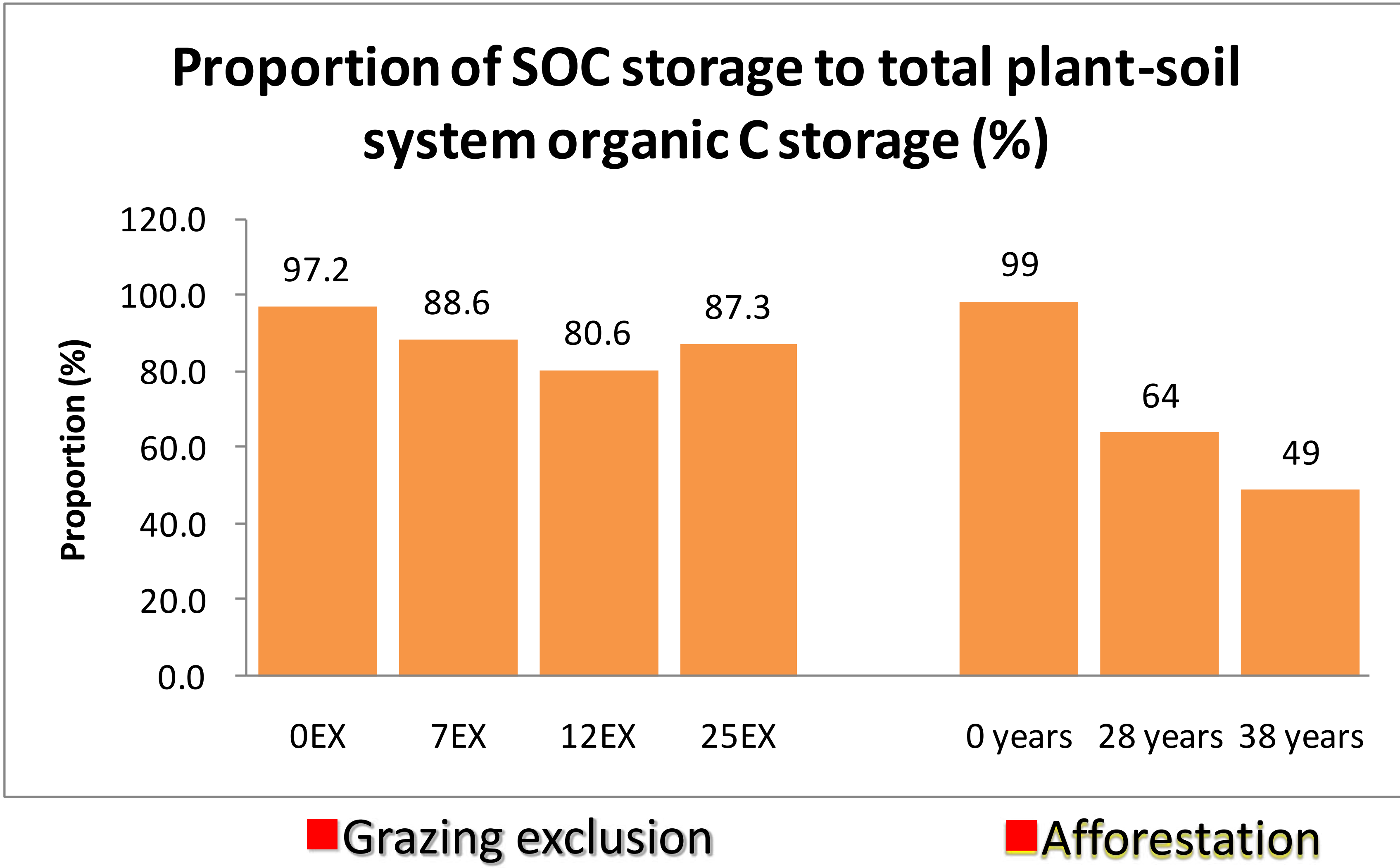




■Grazing exclusion

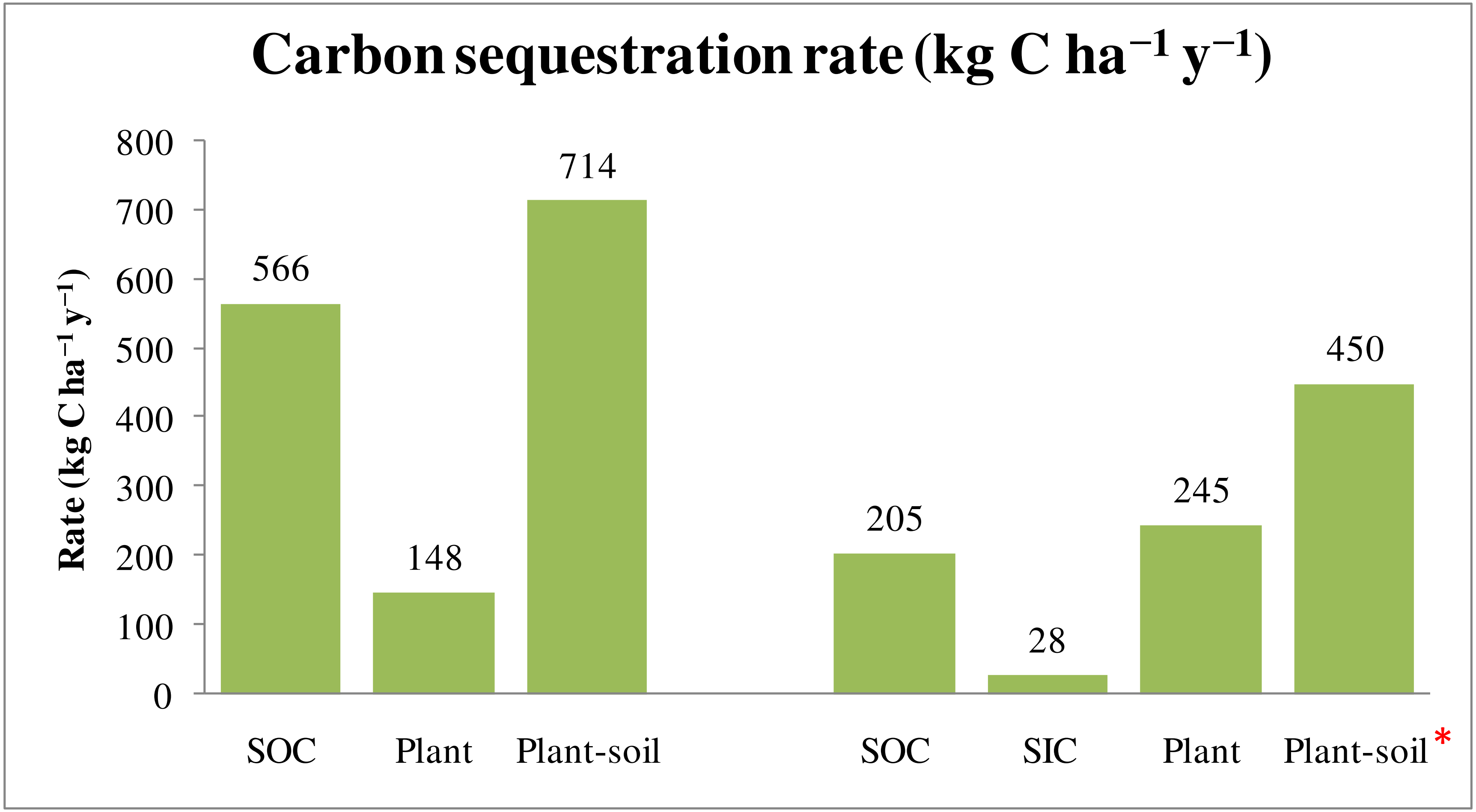
■Afforestation

Results



Proportion of SOC storage to total plant-soil system organic C storage (%)
Proportion (%)
120.0
100.0
80.0
60.0
40.0
20.0
0.0
97.2
88.6
80.6
87.3
99
64
49
0EX
7EX
12EX
25EX
0 years
28 years
38 years
Grazing exclusion
Afforestation

Results



Grazing exclusion

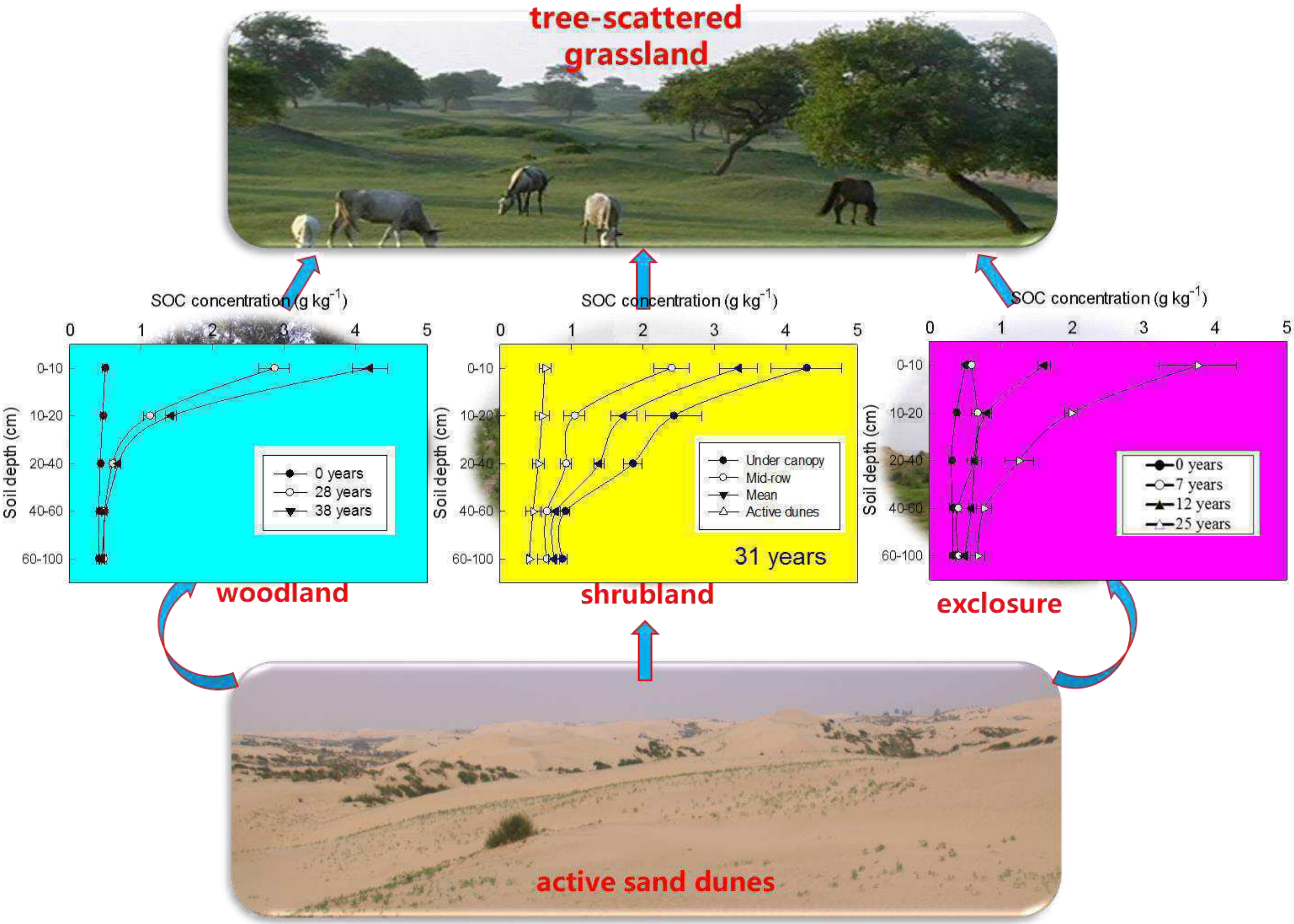
(Based on the term 0 to 25 years)

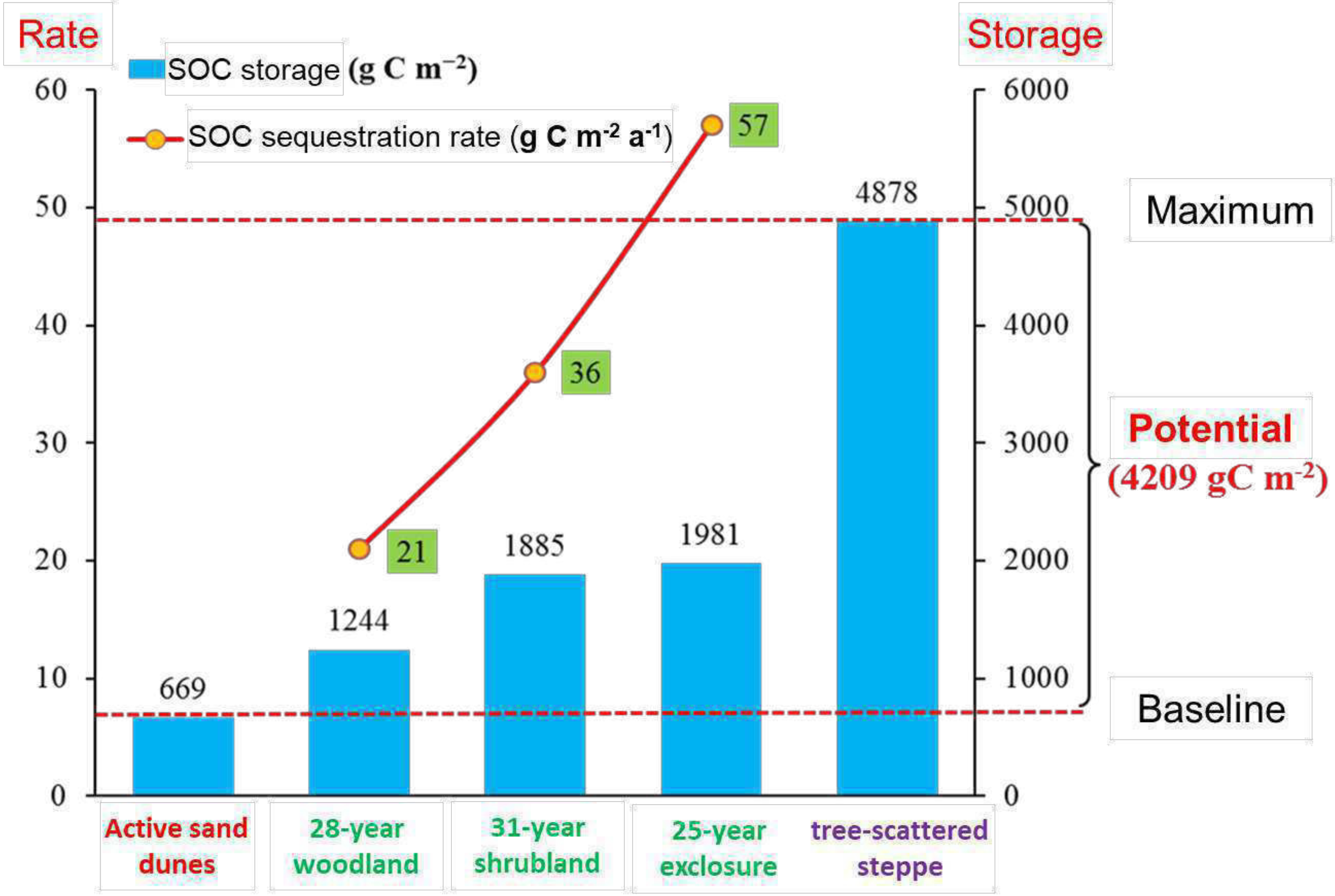
Afforestation

(Based on the term 0 to 28 years)

* exclude SIC

Organic C sequestration in soil





To fully restore the SOC storage (top 100 cm) of the active sand dunes, it would take:

- 74 years through grazing exclosures
- 117 years through afforestation using the shrub species *C. microphylla*
- 205 years through afforestation using Mongolian pine.

Conclusions

- Grazing exclusion showed a higher C sequestration rate in plant-soil system than that of afforestation;
- The strongest effects on soil C appeared in the upper 20 cm of the soil.
- The soil played a more important role than the plant for C sequestration following grazing exclusion, but the plant played a more important role than the soil following afforestation;
- Grazing exclusion and afforestation are effective ways to sequester C and to restore degraded soils, but the process was slow.

Thinking…

问题2：水资源匮乏日趋严重

奈曼西湖，16000 ha

2001年干涸，2013年地下水位降至13 m

湖心种地出绿色，西湖风沙已无边

亚洲最大的2座沙漠水库

莫力庙水库(库容1.9亿m³), 2003年干涸

舍力虎水库(库容1.2亿m³), 2010年干涸

问题3：生态建设成果反弹

沙地樟子松人工林自然成熟年龄为52-60年，天然林为120年。

京通铁路樟子松防护林（1974年）

灌溉养护

THANK YOU!

Ecological vulnerability assessment in Khovd province of Mongolia

Kherlenbayar.B , Researcher of Sustainable development institute for Western region of Mongolia

Suvdantsteteg.B, Director of Sustainable development institute for Western region of Mongolia

Tonglia city, China, 5-7 July 2018

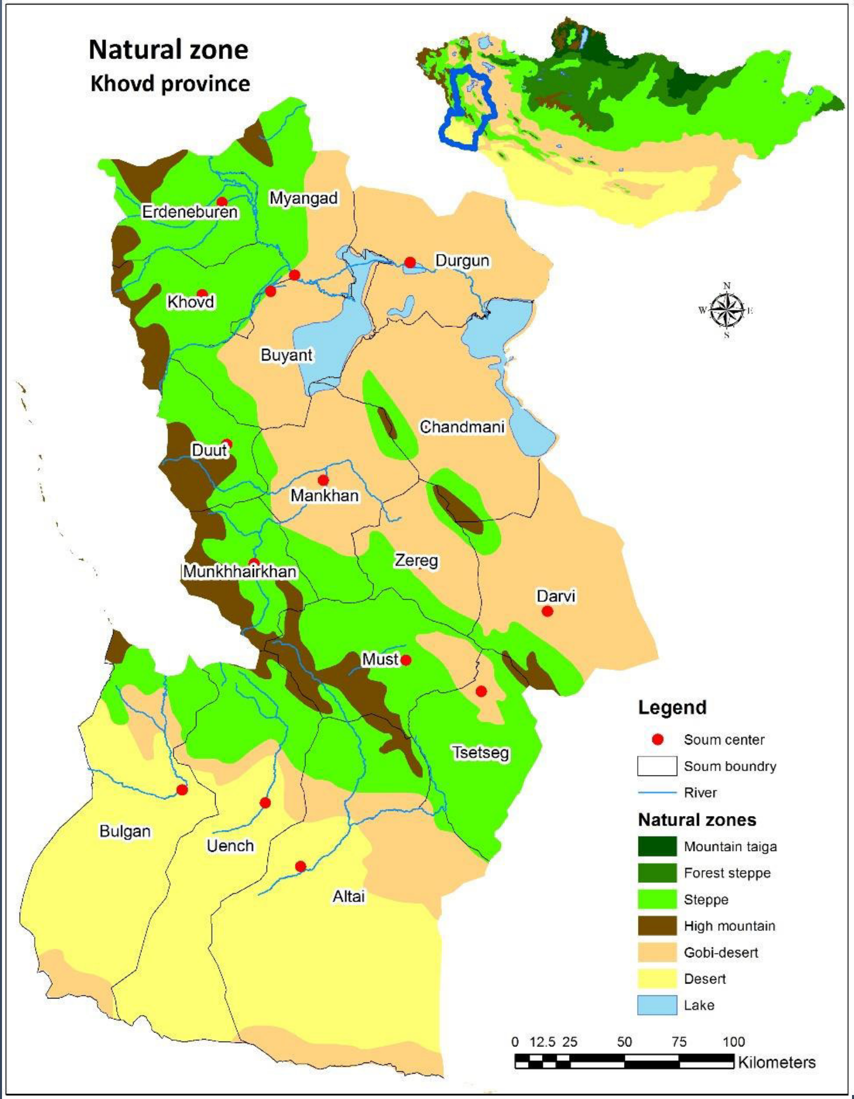
Content

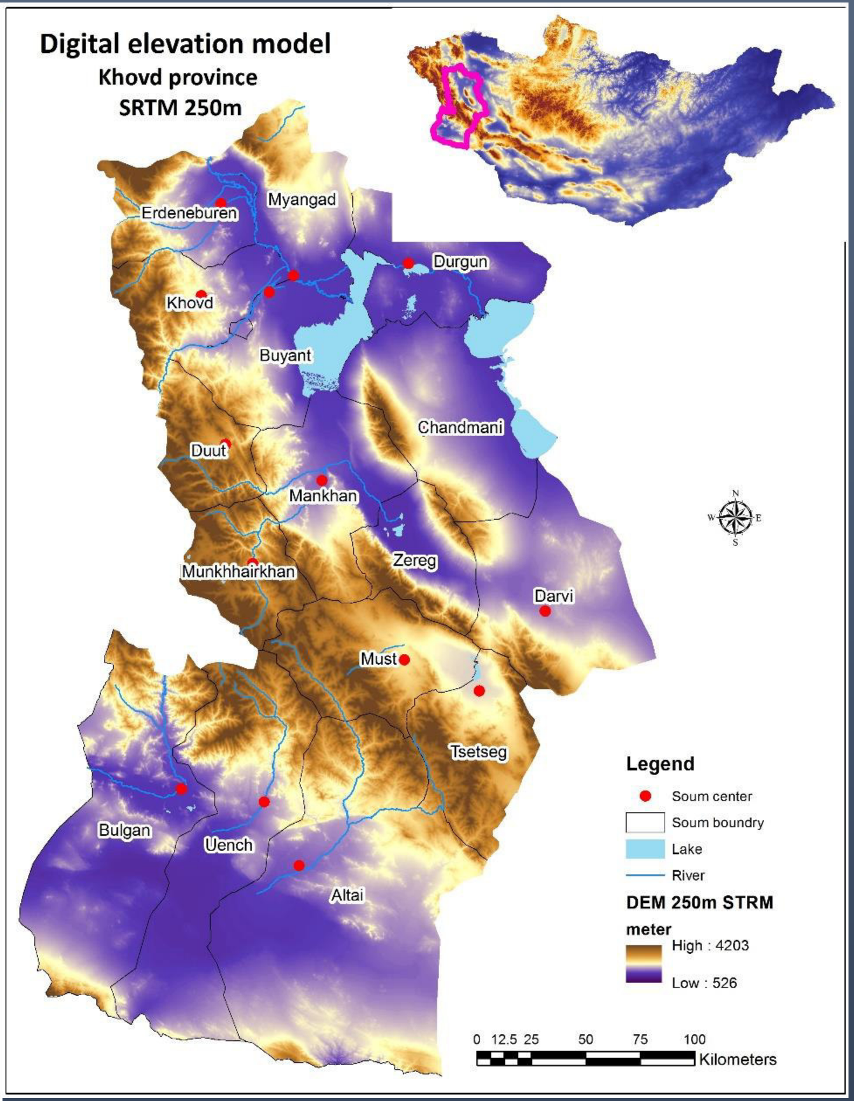
- About Khovd province
  - Natural condition
  - Social and economic condition
- How we choose ecological vulnerability sub-indicators /*Ecological vulnerability index/*
  - Aridity
  - Drought
  - Pasture use
  - Vegetation change
- Integrated ecological vulnerability
- Example result by soum

Content

- About Khovd province
  - Natural condition
  - Socio-economic condition
- How we choose ecological subindicator/*Ecological vulnerability index/*
  - Aridity index
  - Drought
  - Pasture use
  - Vegetation change
- Integrated ecological vulnerability
- Example result by soum

Natural condition





Khovd province:

- Located in the western region of Mongolia
- 17 soums (including province center)
- 6 soums – In mountain steppe zone of Mongolian Altai mountain range
- 7 soum – in Gobi desert zone of Great lakes valley
- 3 soums – in desert zone of Southern Gobi of Mongolian Altai mountain range

Desert zone elevation reaches 530 meters above sea level and 4,000 meters in Mongolian Altai mountain range.

Rivers of Buyant, Khovd (Bulgan and Tsenkheriin), which originate from the snow-capped mountains, flow into Khar-Us Nuur, Khar nuur and Durgun Lake.

Social and economic condition

Social

As of2017,Khovdprovince has 87.3 thousand inhabitants.

34.1% of the totalpopulationlivesinthe provincecenter.

Population decreased by 3.8% compared to 1998.Afterthesequences ofdroughtanddzudof 1998-2002 and the dzud of 2009-2010the population migration intensified.

Economic

As of 2016,Khovdprovince'sGDPreached 304,906.9 million MNT, ofwhich 41.8%was produced byagriculturalsectors,18.1%wasmanufacturingsectorand 40.1%wasservicesector. Per capitaGDPreached 3573.5thous.tugand the province'sGDPincreased 11.2 times compared with that of 2000.

Where is Khovd?

Khovdprovinceconstitutes 2.8%ofMongolia's totalpopulation,5.2 %of the totallivestock and1.2%ofthe totalGDP.Khovd is the pillar, education and health center of the western region.

In2017,34.7% of total households in theprovincewasherder households and 36.9% of theprovinceGDPwasgenerated by the livestock sector alone.Khovdis also home to diverseethnic groups.

Content

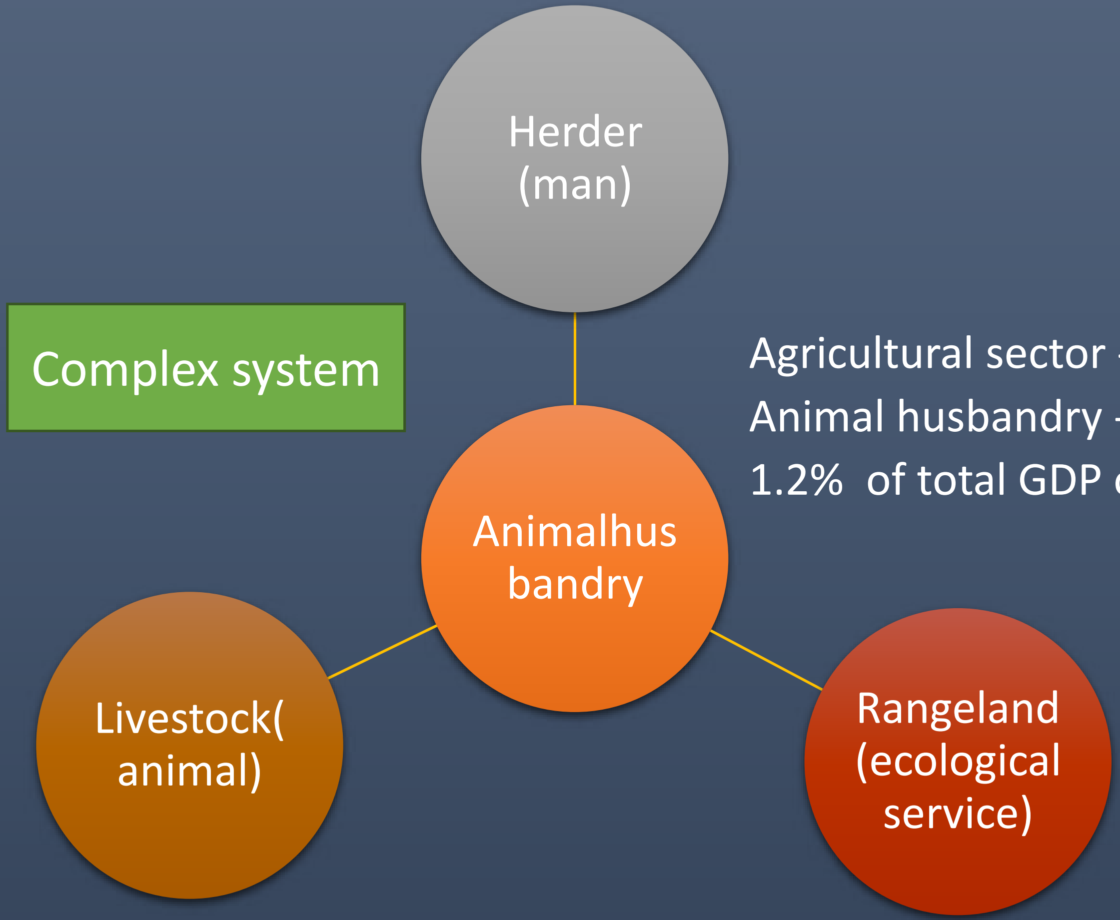
- About Khovd province
- How we choose sub-indicators /*Ecological vulnerability index/*
  - Aridity index
  - Drought
  - Pasture use
  - Vegetation change
- Integrated ecological vulnerability
- Example result by soum

Ecological vulnerability index for Khovd Province

34.7% herder household of total household,
2.8% of total population of Mongolia

Dryland Development Paradigm (DDP) 1: Human–environment systems are coupled, **dynamic and co-adapting, so that their structure, function** and inter-relationships change over time.

DDP 4: Coupled human–environment systems **are hierarchical, nested, and networked across multiple scales** (Reynolds JF etc, 2007)

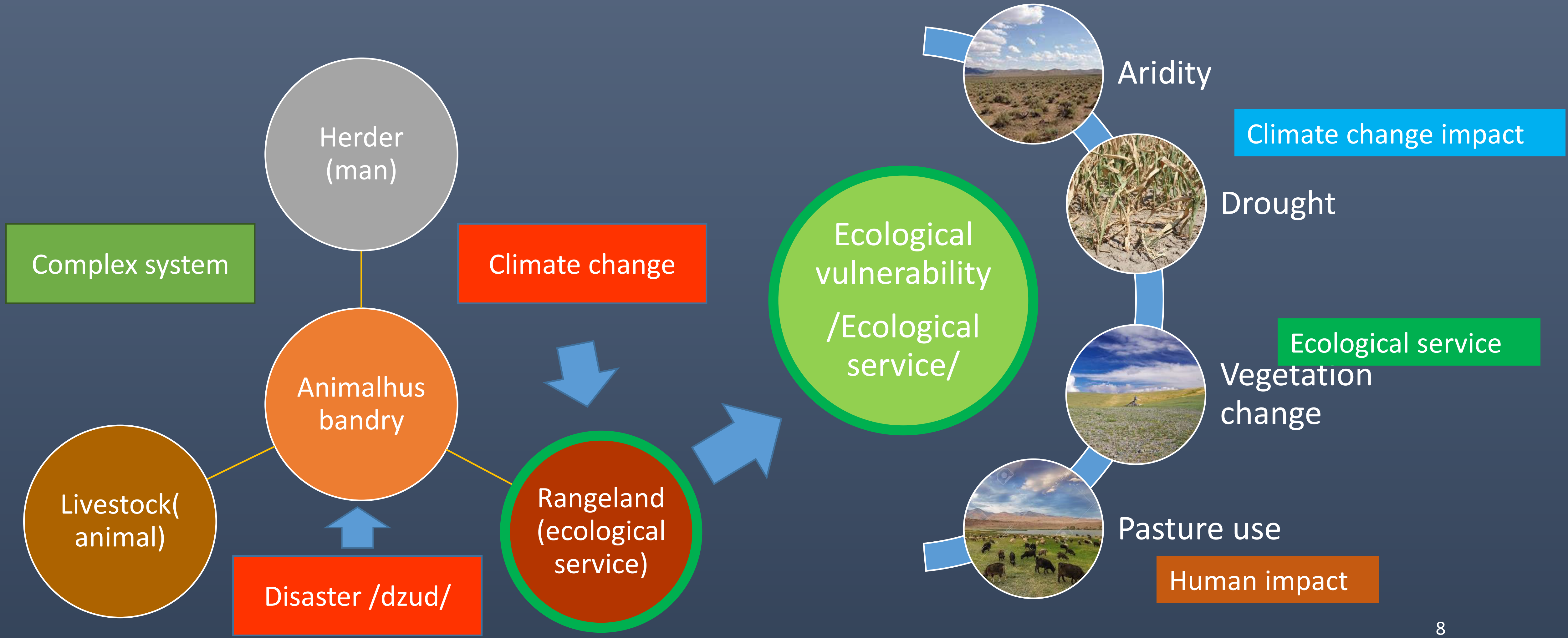


Agricultural sector - 41.8% of GDP
Animal husbandry - 36.9% GDP
1.2% of total GDP of Mongolia

5.2% of amount livestock

4.9 % of total area

Ecological vulnerability index for Khovd Province



Content

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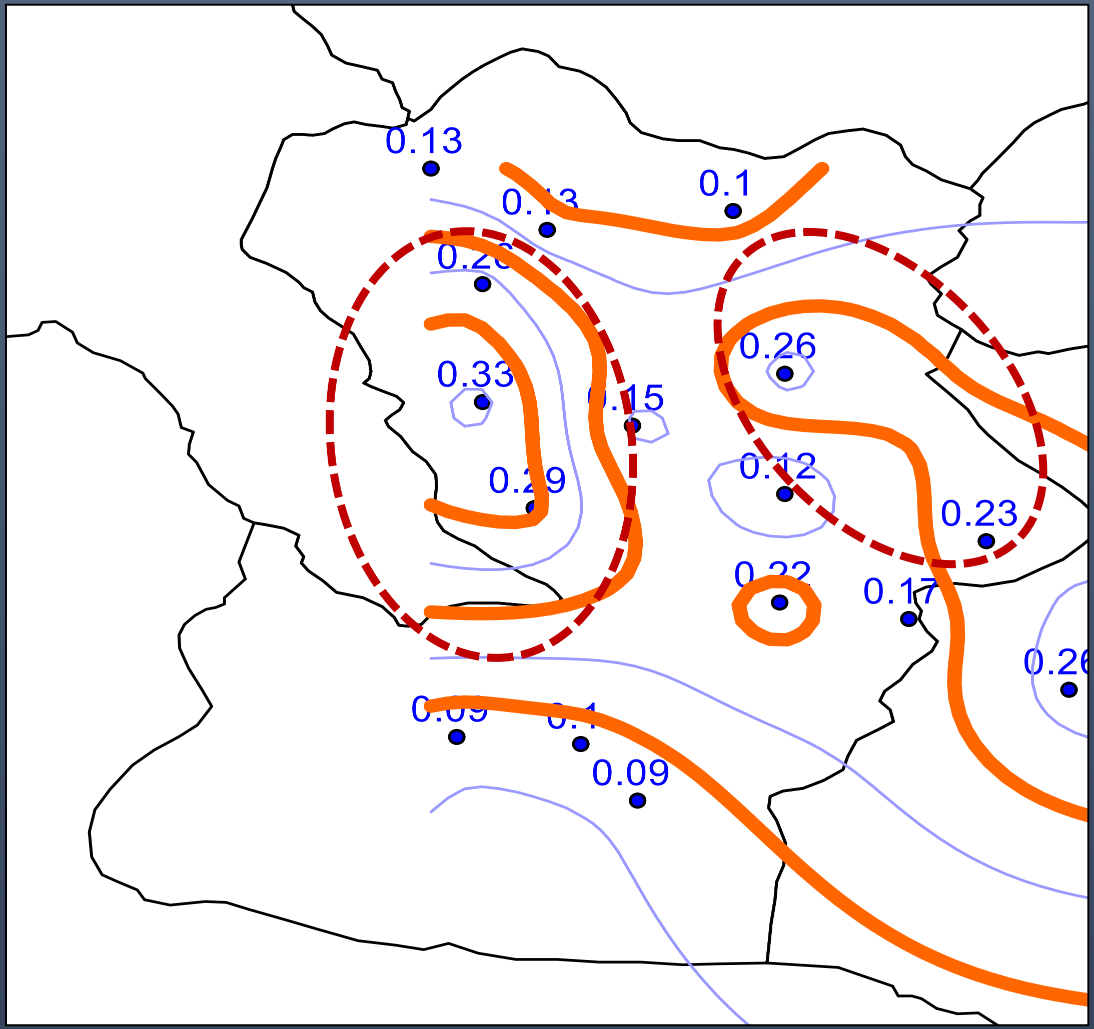
Aridity index



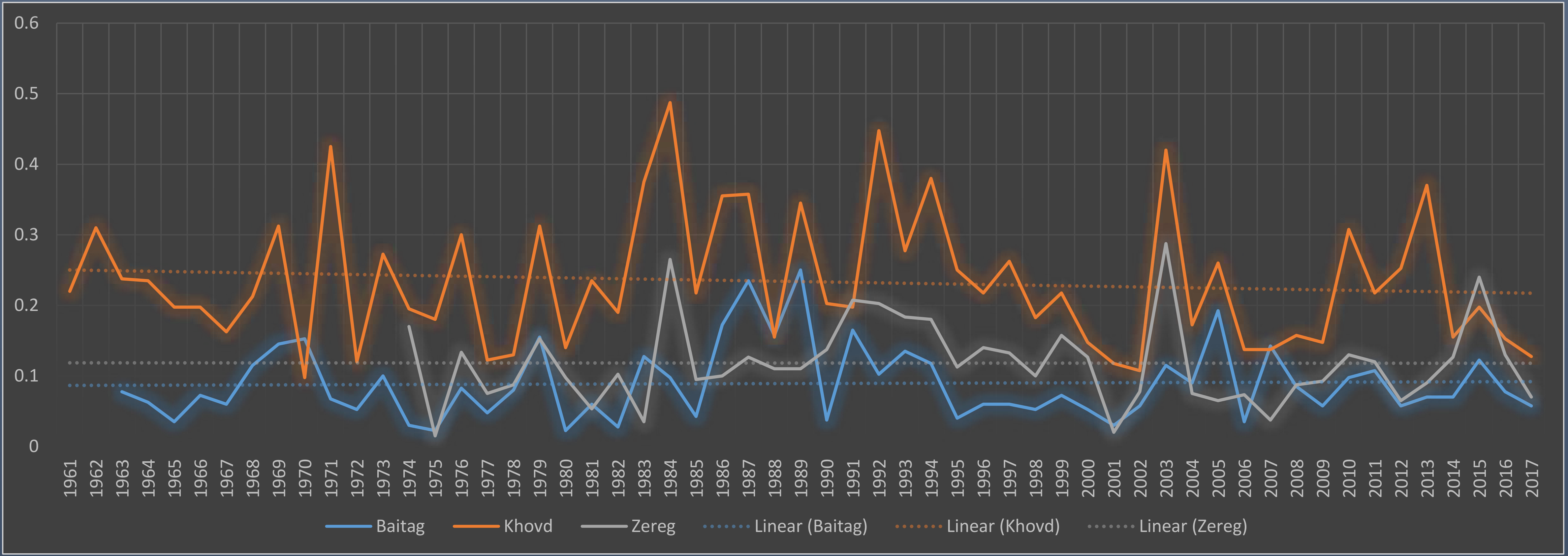
The index is calculated using the methodology developed by the United Nations Environment Program, using the precipitation and potential evaporation ratio as follows:

Aridity index =P/PET, (UNEP, 1992)

№	Region	P/PET by Thornthwaite method
1	Hyper arid	<0.05
2	Arid	0.05-0.20
3	Semi-arid	0.20-0.50
4	Dry subhumid	0.50-0.65
5	Humid	>0.65

In Khovd aimag, the index is between 0.09-0.33, western and eastern parts are in semi-arid zone, others are entirely in the arid zone.

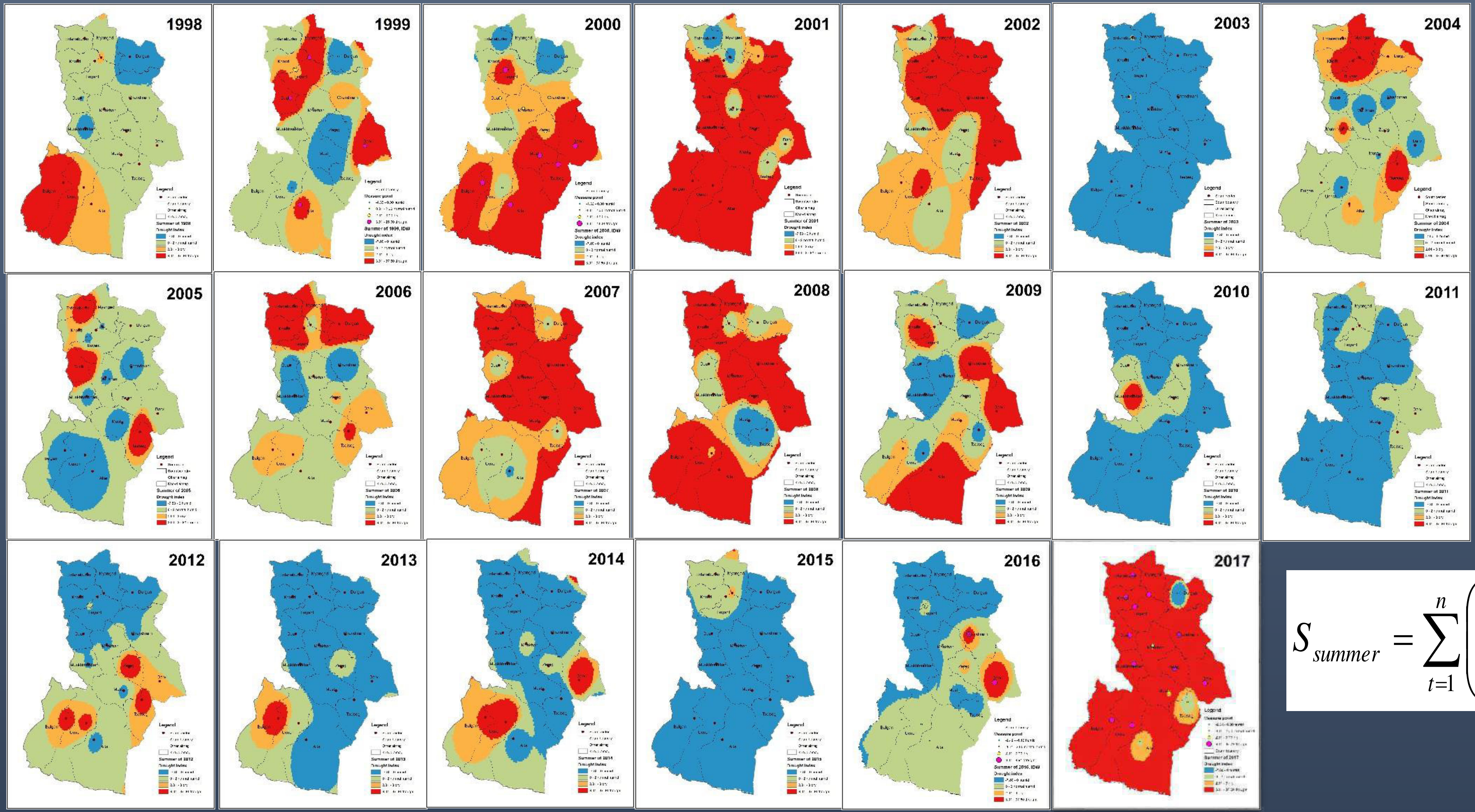
Aridity index



The trend of changes in the aridity index estimated by meteorological stations for a given region over the past 60 years shows:

- Intensifying aridity in the northern part,
- Weakening aridity in the central and southern parts of Khovd province.
- In the vulnerability assessment, average value of long period data was selected as a vulnerability threshold.

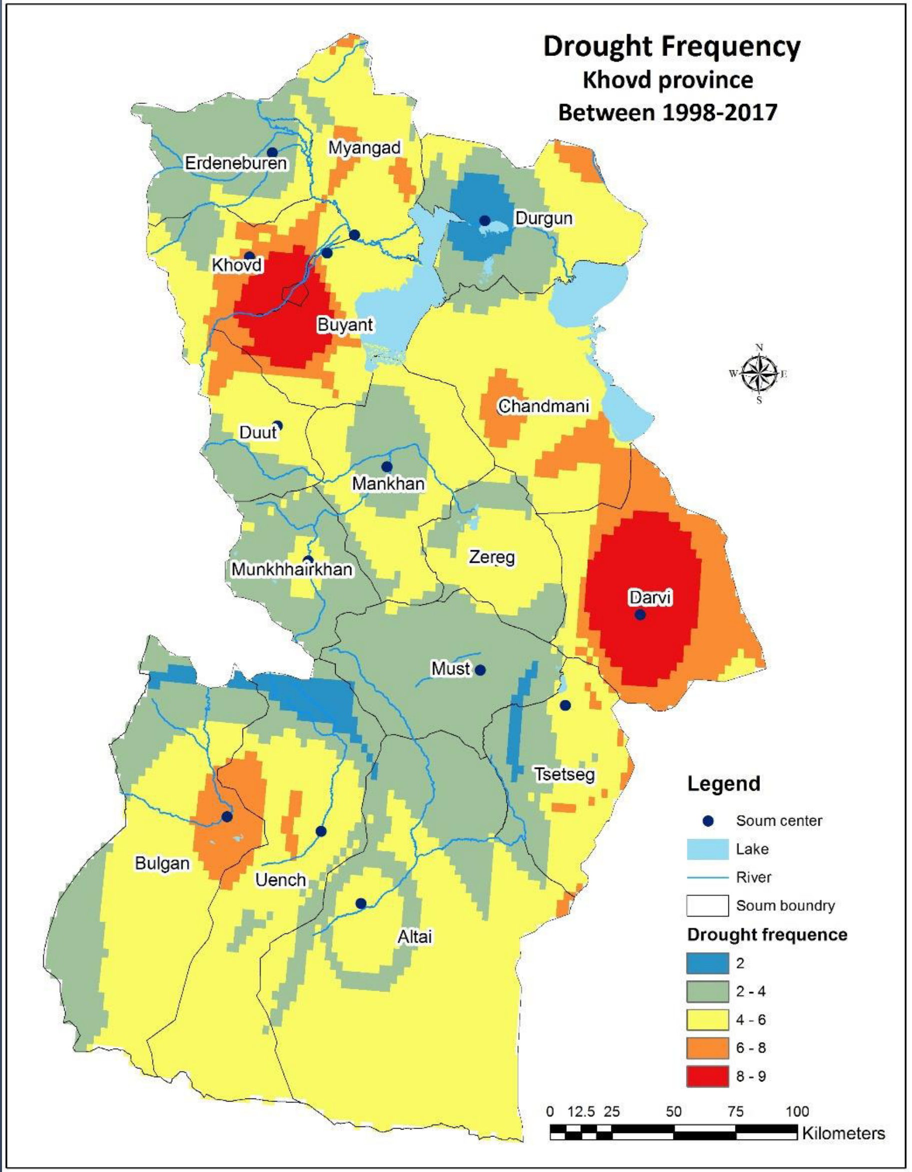
Drought index

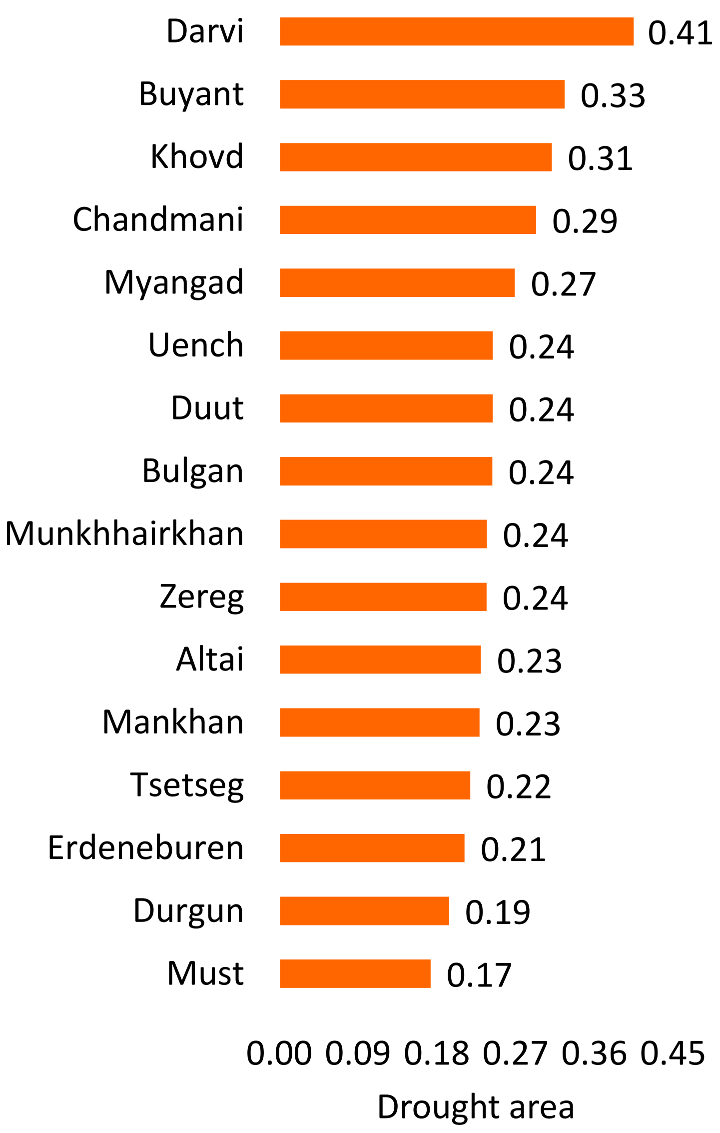


Value of Ped's index:
S>3 intense drought
2<S<3 medium intense drought
S<0 more precipitation
(Natsagdorj.L, 2009)

$$S_{summer} = \sum_{t=1}^{n}\left(\frac{T_j - \overline{T}_j}{\sigma_T}\right) - \sum_{t=1}^{n}\left(\frac{R_j - \overline{R}_j}{\sigma_R}\right)$$

Drought index

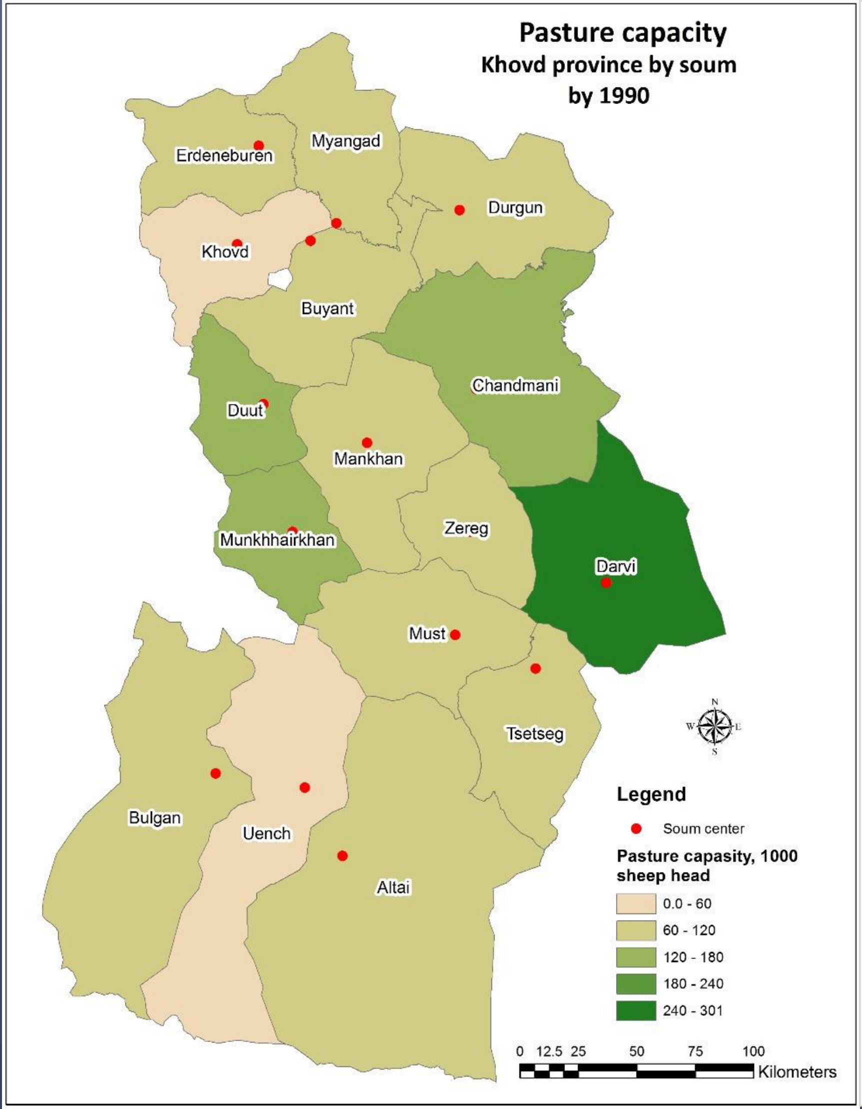


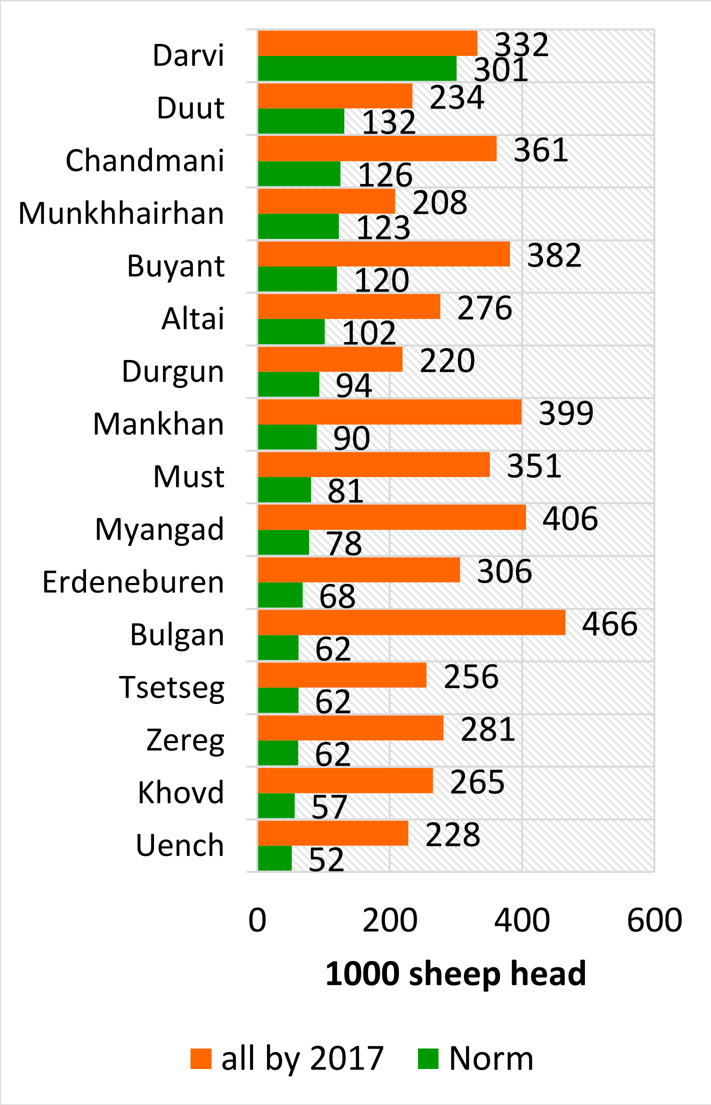


In the last 20 years drought frequency:

- 2-4 times in Erdeneburen, Munkhkhairkhan, Must and Durgun soums,
- 4-6 times in Chandmani, Bulgan, Myangad, Uench, Duut, Altai, Zereg, Mankhan and Tsetseg soums,
- 6-9 times in Khovd, Buyant and Darvi soums.

Pasture use





It is estimated using livestock number from 1998-2017, by performing a normalized comparison between livestock number per unit of a given soum's rangeland (N) (sheep unit/ha) and rangeland capacity (N_0) (National Atlas of Mongolia, 1990).

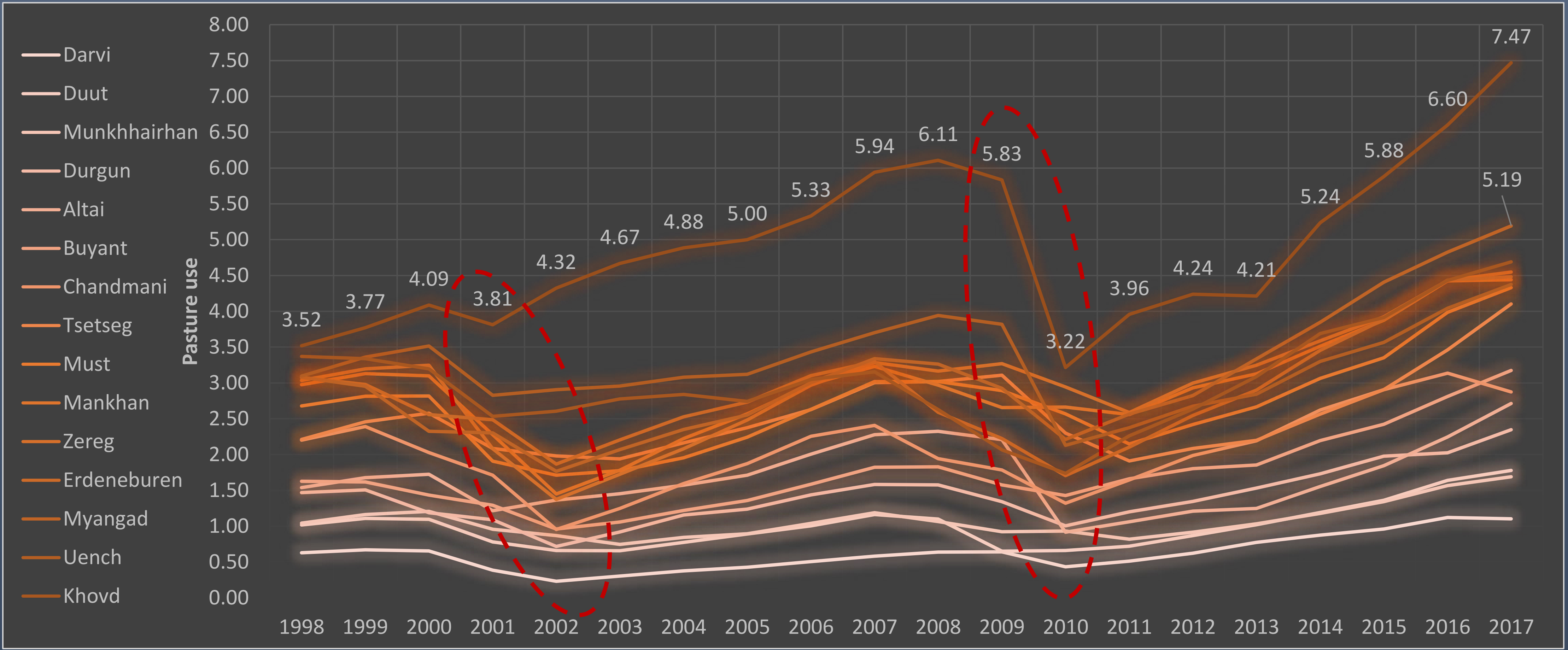
The threshold value of the vulnerability of pasture use was taken as livestock capacity

$$\Delta N = \frac{N}{N_0}$$

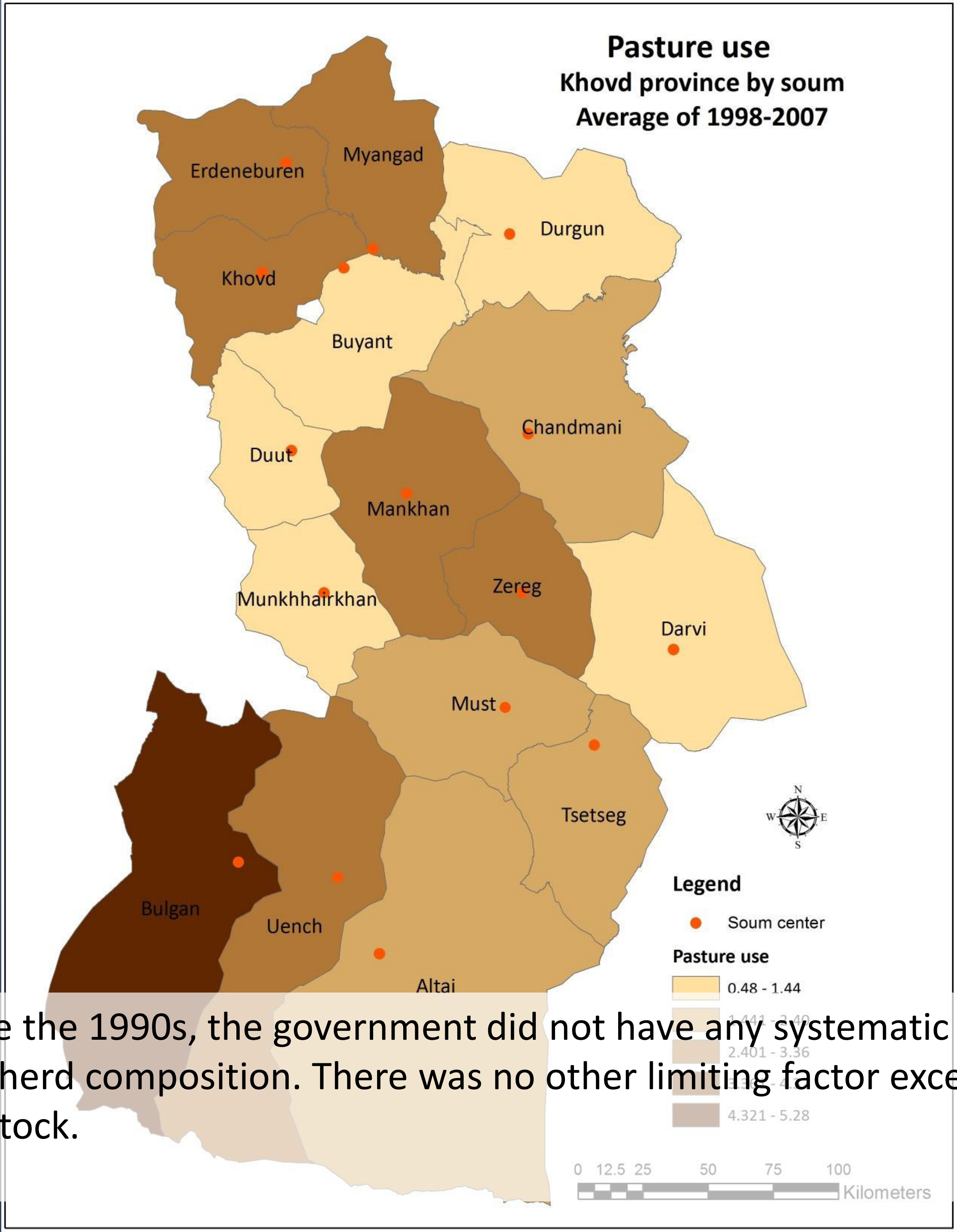
Quotients used for converting number of livestock into sheep unit:

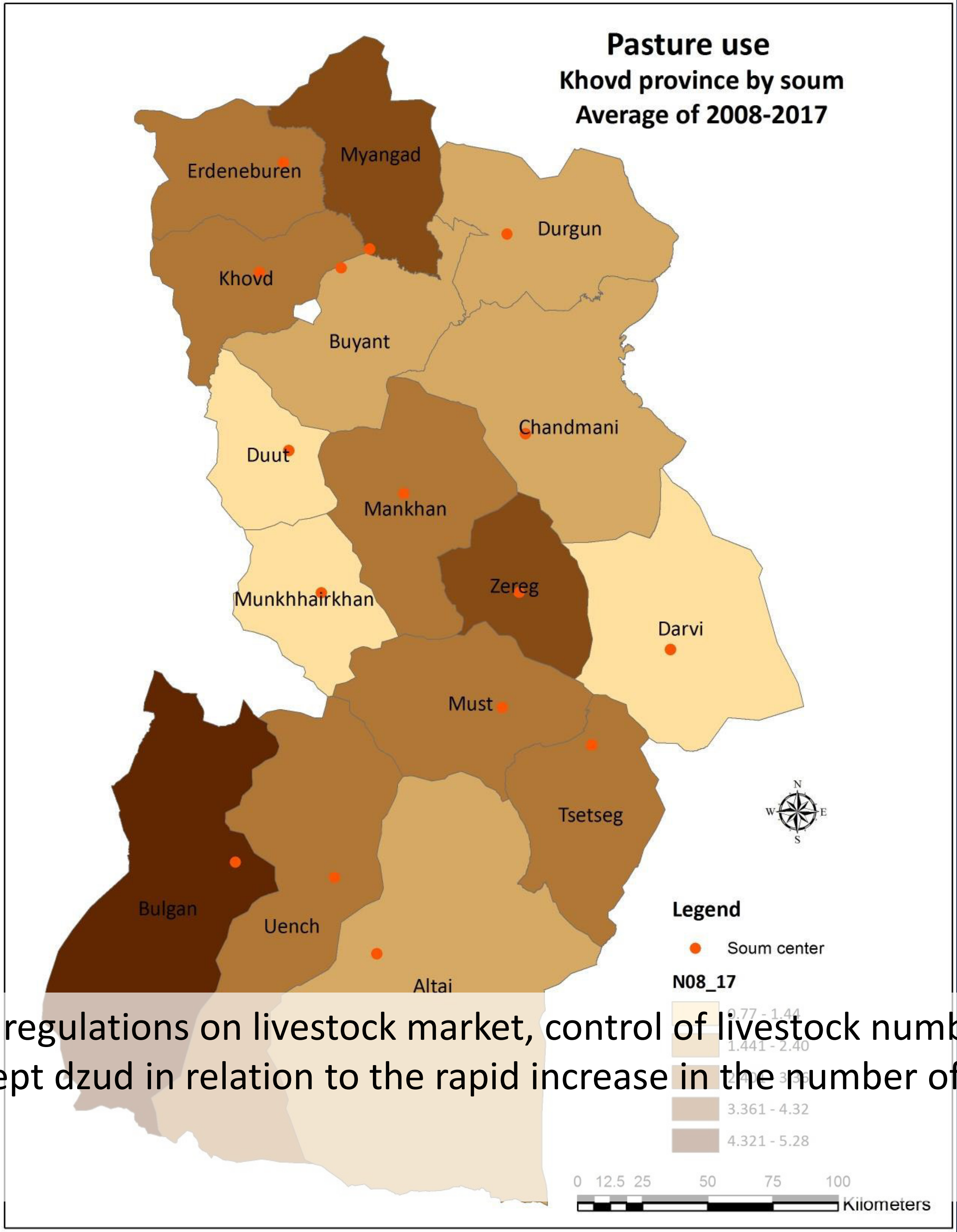
Livestock type	Camel (K_c)	Horse (K_h)	Cattle (K_{ca})	Sheep (K_{sh})	Goat (K_g)
Sheep unit	5	8	7	1	0.9

Pasture use



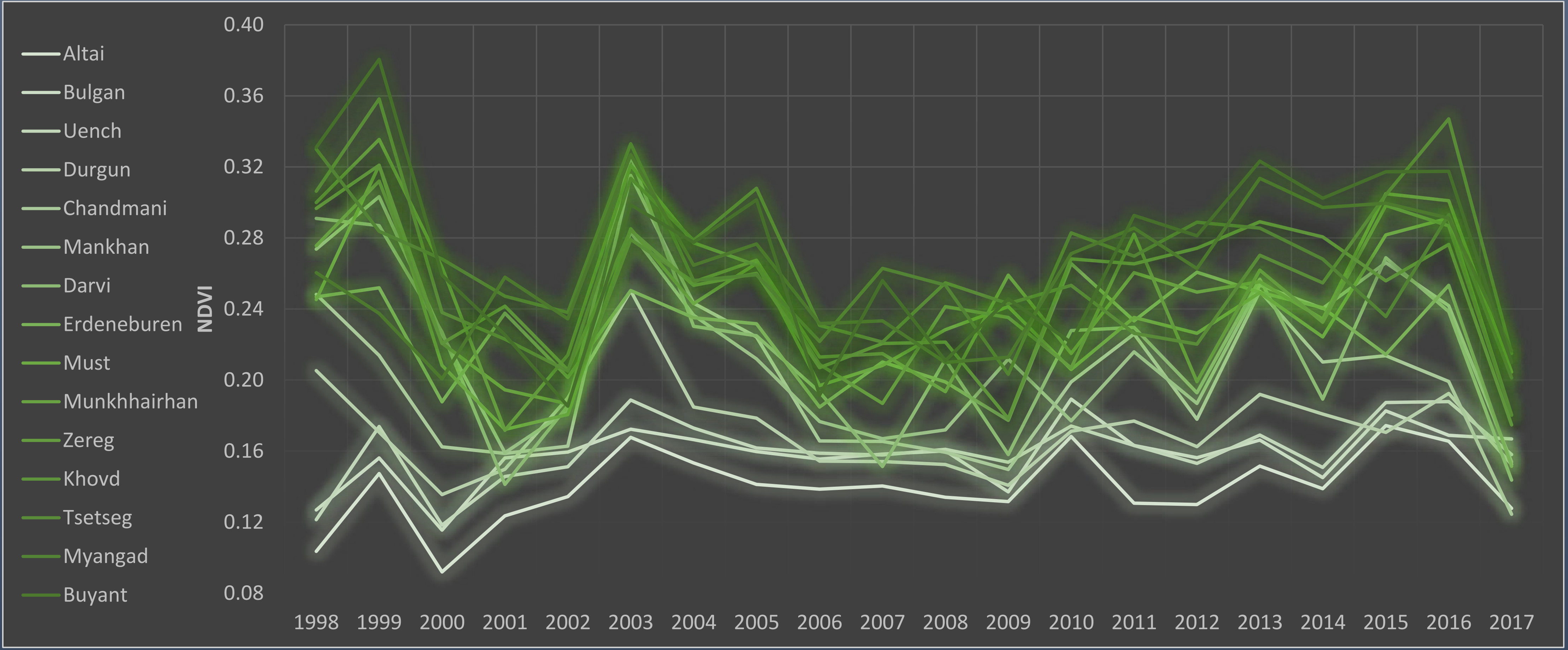
In 2000-2002 and 2009-2010, pasture use decreased in all soums, followed by intensified pasture use over the last 8 years. Pasture use has dramatically increased in Bulgan, Khovd, Myangad, Zereg, Must, Tsetseg, Buyant and Durgun soums. Pasture use trend will continue to grow in all soums





Since the 1990s, the government did not have any systematic regulations on livestock market, control of livestock number and herd composition. There was no other limiting factor except dzud in relation to the rapid increase in the number of livestock.

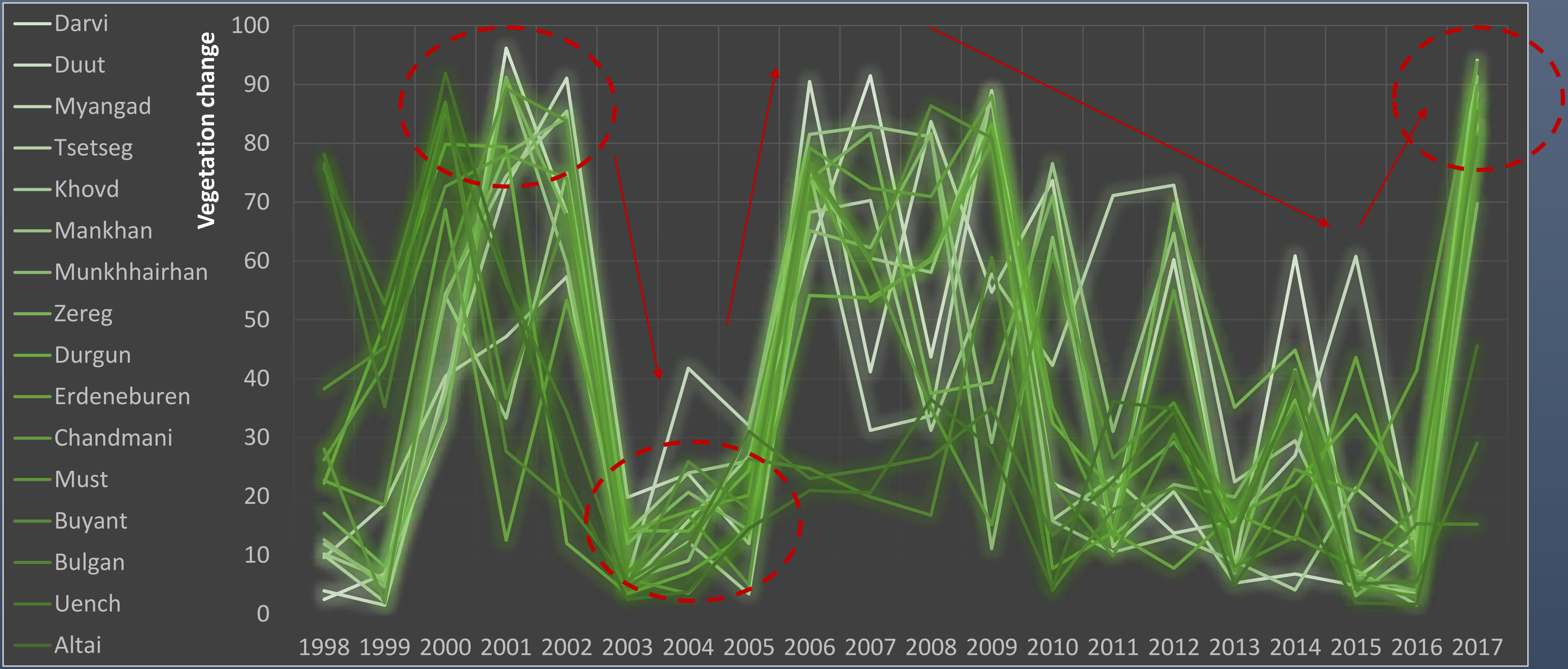
Vegetation/NDVI/



$$\Delta V = \frac{\sum_{i=1}^{n} V_i}{n}$$

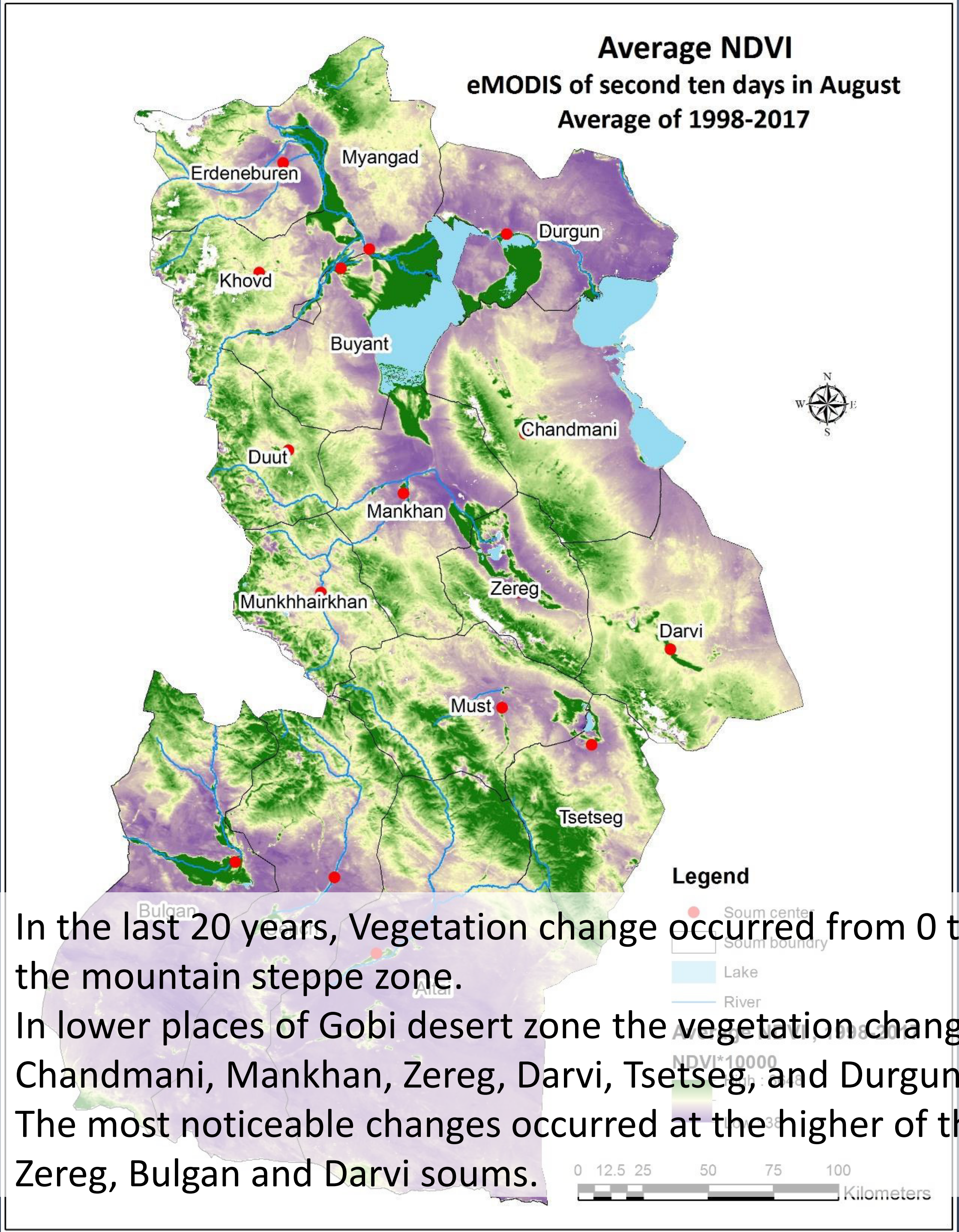
We choose threshold value of vulnerability as the NDVI average value for the last 20 years.

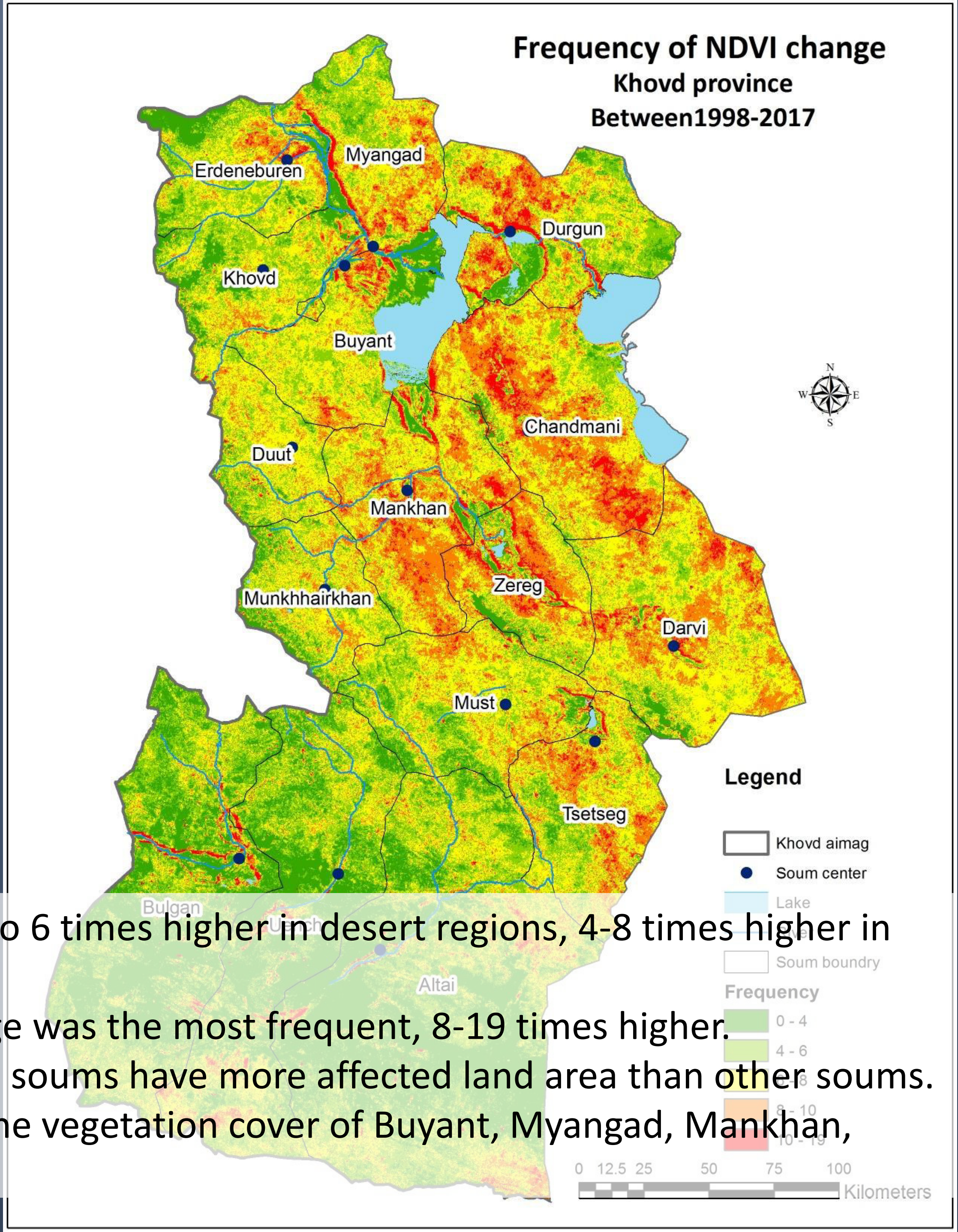
Vegetation/area/ change



$\Delta V=\sum_{i=1}^{n} V_i / n$

Vulnerability assessment is used to estimate how much area of a soum is occupied by vegetation change.





In the last 20 years, Vegetation change occurred from 0 to 6 times higher in desert regions, 4-8 times higher in the mountain steppe zone.

In lower places of Gobi desert zone the vegetation change was the most frequent, 8-19 times higher.

Chandmani, Mankhan, Zereg, Darvi, Tsetseg, and Durgun soums have more affected land area than other soums.

The most noticeable changes occurred at the higher of the vegetation cover of Buyant, Myangad, Mankhan, Zereg, Bulgan and Darvi soums.

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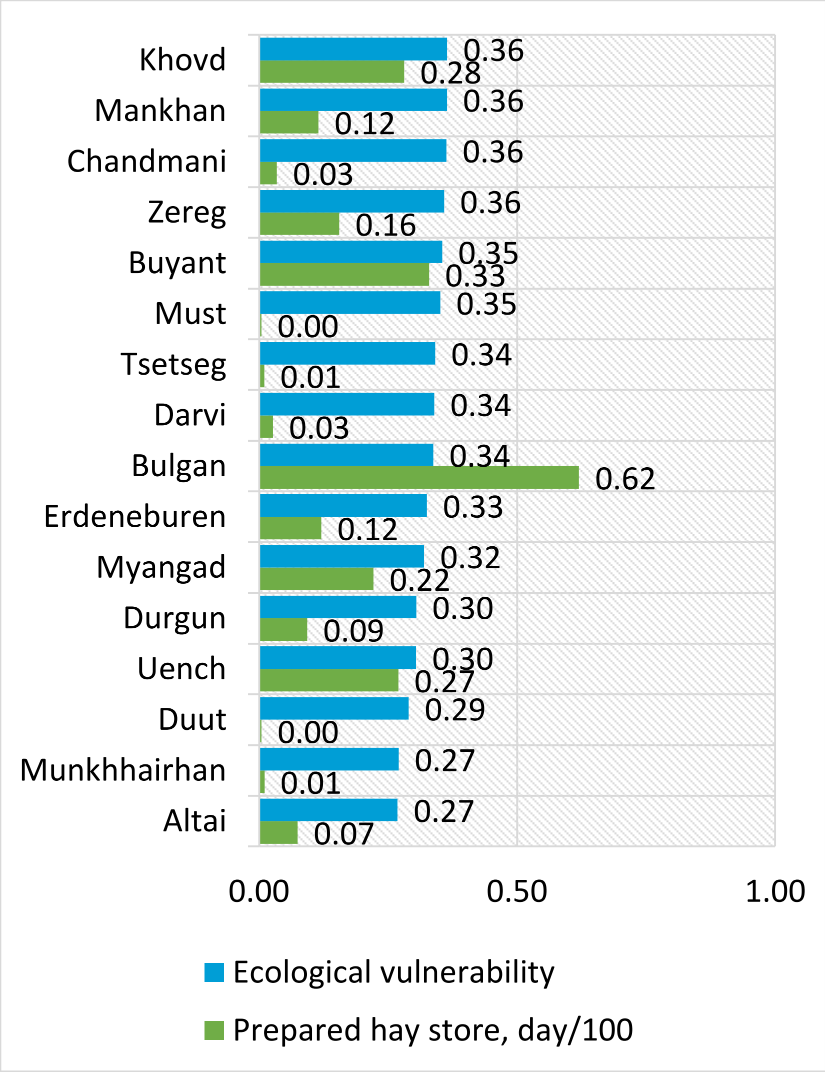
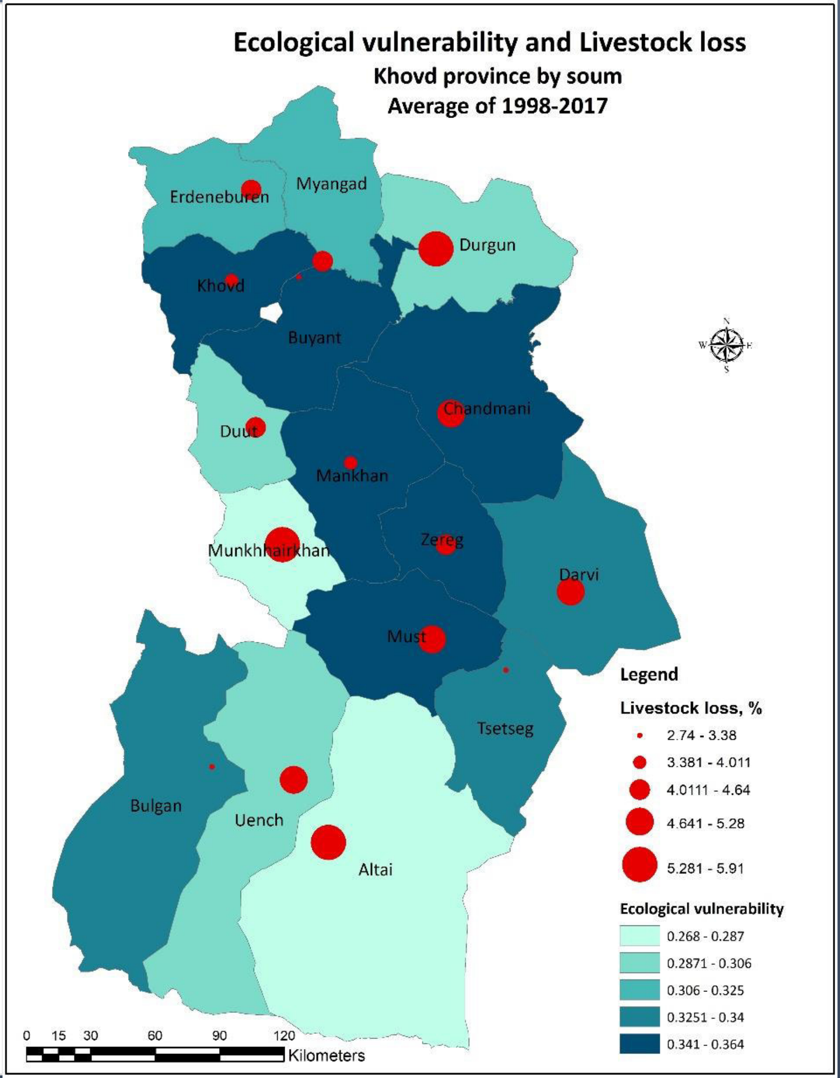
Integrated ecological vulnerability





According to the ecological vulnerability assessment, **Khovd, Mankhan, Zereg, Buyant and Chandmani soums are the most vulnerable.**
From these soums, **Chandmani and Must soums have higher livestock loss**, whereas **Khovd, Mankhan and Buyant, Zereg soums that have well prepared hay have lower livestock loss. Altai and Munkhkhairkhan soums have the lowest risk** of pasture vulnerability and Altai and Munkhkhairkhan soums, which don’t prepare enough hay have the highest number of livestock losses.

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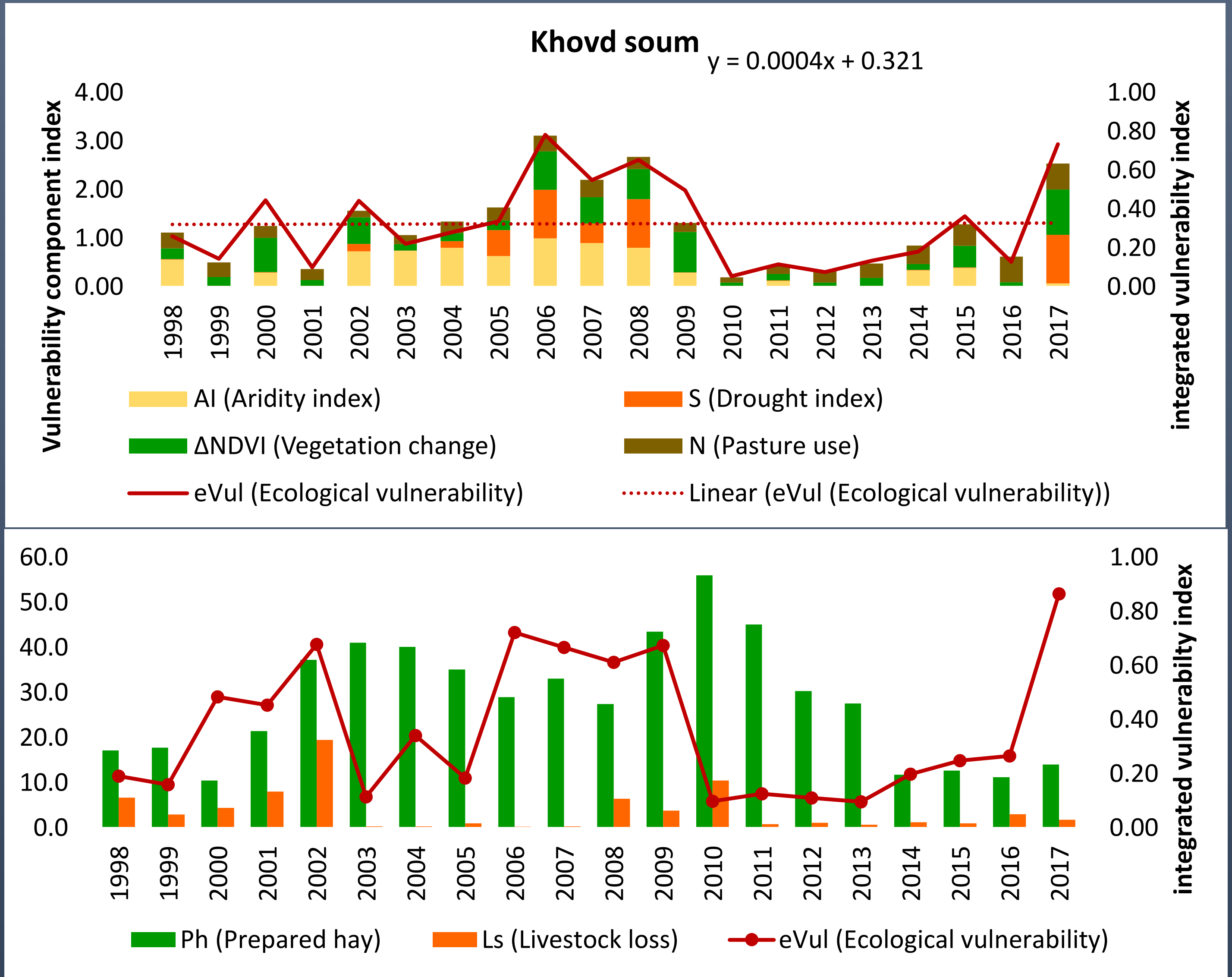
Example result: for Khovd soum



There is a higher risk of ecological vulnerability in the coming years.
In the coming years herders should be prepared enough hay because ecological vulnerability is initial condition to loss of livestock

For Khovd soum, Livestock loss is relatively low due to high level of prepared hay, with 28-day reserve in which is occupied dzud .

Pasture use is predicted to increase depending on the number of livestock and has grown dramatically since 2010.
Therefore, the number of livestock should be adjusted to the carrying capacity, improve pasture management, and take some solution to develop livestock market.

Thank you for your attention

Introduction of Institute of General and Experimental Biology, Mongolian Academy of Sciences (MAS) and research at the Laboratory of Microbiology

Workshop on Ecological vulnerability assessment
Tongliao, Inner Mongolia, China

5-8 July 2018

Kh. Gantuya /MSc/

INSTITUTE OF GENERAL AND EXPERIMENTAL BIOLOGY, MONGOLIAN ACADEMY OF SCIENCES (MAS)

Mission: study of biological resources and biodiversity of Mongolian ecosystems, development of scientific justification for conservation and sustainable use of bioresources and application of research results into practice to achieve the sustainable development of the country

- Set up in 1965
- Publishes "Proceedings of the Institute of General and Experimental Biology"

Botany

Biotechnology

Zoology

Botanical garden

Hydrobiology

Structure

1. Laboratory of mammalian ecology
2. Laboratory of hydrobiology and ichthyology
3. Laboratory of ornithology
4. Laboratory of entomology
5. Laboratory of genetics
6. Laboratory of molecular biology
7. Laboratory of plant biotechnology
8. Laboratory of microbiology
9. Laboratory of microbial synthesis
10. Laboratory of flora and plant systematics
11. Laboratory of forest phytocenology
12. Laboratory of vegetation ecology and plant resources
13. Laboratory of plant anatomy and eco-physiology
14. Laboratory of plant introduction
15. Fish breeding research center
16. Botanical garden

Staff

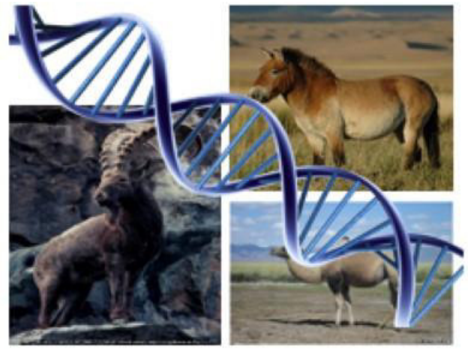
- Total: about 160
- Researchers: about 140, of which
- Honored scientists - 6
- Doctor of Sciences - 3
- PhD - 40

At the end of January of 2015 The Institute of Biology and The Institute of Botany joined as the Institute of General & Experimental Biology, MAS. Staff 160.

DIVISION OF BIOTECHNOLOGY

LABORATORY OF MOLECULER BIOLOGY

LABORATORY OF GENETIC

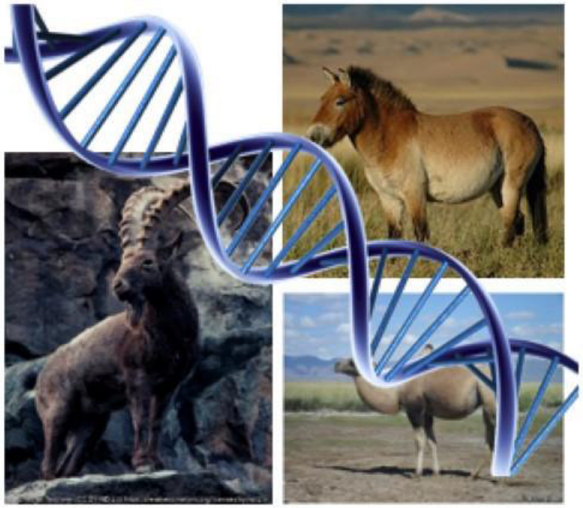


LABORATORY OF MICROBIAL SYNTHESIS

LABORATORY OF PLANT BIOTECHNOLOGY

LABORATORY OF MICROBIOLOGY

LABORATORY OF GENETIC



Laboratory of genetic's research focuses on genetic investigation of polymorphismin in blood protein and enzymes, chromosomal entity, nucleus and mitochondrial DNA sequences to clarify their phylogenic relation and taxonomy of Mongolian livestock and related wild animals, such as argali sheep (*Ovis ammon*), wild goat (*Capra sibirica*), wild camel (*Camelus bactrianus ferus*), wild ass (*Equus hemionus*), and Przewalski's horse (*Equus ferus przewalskii*).

LABORATORY OF MOLECULER BIOLOGY

The aim of this laboratory of moleculer biology research focuses on investigation of various markers, gene/protein expression by comparing cancous and non-cancerous cells of human liver tissue to find out the molecular reason of tumorigenesis.

LABORATORY OF MICROBIAL SYNTHESIS

Our research interests include isolation of industrially important microorganisms for microbiologocal-biotechnological production that can maintain ecological balance, improve soil fertility, and reduce environmental pollution. Moreover, we will be able to provide necessary valuable microbial cultures to the research, educational, and industrial organizations in our country, which could create opportunities for commercializing innovative products in the future.

LABORATORY OF PLANT BIOTECHNOLOGY

Currently this laboratory is conducting research aimed at conservating and increasing plant genetic resources, and micro propagation of particular endangered and rare Mongolian medicinal plants by using cell and tissue culture to determine useful target genes and to obtain transgenic plants.

LABORATORY OF MICROBIOLOGY

- Established in 1985 as Laboratory of Microbial Physiology and Biochemistry.
- Changed in 1997 as Laboratory of Microbiology

Head of Laboratory,
Doctor J. Enkh-Amgalan

Mission:
Research and generation of new knowledge on Mongolian microbial biodiversity and their genetic resources. *Ex-situ* conservation of microbial biodiversity.

Vision:
Wide application of microorganisms in different branches of national economy and environmental protection for benefits of the present and future generations.

Members of Laboratory

Staff
- Total 12
- ScD – 1
- PhD - 3
- Msc – 5
- Bsc - 3

RESEARCH ACTIVITIES

- **Ecology and diversity of microorganisms** in Mongolian natural environments and milk products.
- **Genetic resources of microorganisms** (antimicrobials, enzymes, resistant heavy-metal and biosynthetic genes).
- **Plant-microbe interactions**:
  - -nitrogen-fixing bacteria;
  - - rhizosphere actinomycetes and bacteria.
  - - streptomycetes causing potato scab and their biological control agents.
- **Endophytic microorganisms of Mongolian plants** and their bio-active compounds;
- Charactization and Identification of **probiotic strains** from traditional food and plant
- Isolation, ***ex-situ* conservation** and taxonomic identification of microorganisms

CULTURE COLLECTION

Preservation of isolates at -80^0C

The Laboratory of Microbiology maintains about **8,000** strains of actinobacteria, bacteria, microscopic fungi, yeast and archaea that represent more than 200 microbial genera collected from Mongolia.

2006-2016: PA on "**Taxonomic and Ecological Studies of Microorganisms in Mongolia and the Utilization**". NITE, Chiba, Japan.

- ❖ It is the largest in Mongolia culture collection. We isolate and preserve indigenous microbial cultures for *ex-situ* conservation and future distribution for R&D in biotechnology and environmental protection.
- ❖ At the moment we are not a service collection but we hope to receive this status in future.
- ❖ Approximately 5500 strains were identified by modern genetic methods. 358 genera
- ❖ Novel **1** genera and **8** species were detected and published in *International Journal of Systematic and Evolutionary Microbiology*.

- ❑ **Fungi: 4 Phylum, 9 Classes, 34 Orders, 178 genera**
- ❑ **Yeasts: 2 Phylum, 4 Classes, 5 Orders, 10 Families, 22 genera**
- ❑ **Chromista: 2 Phylum, 2 Classes, 4 Orders, 4 Families, 6 genera**
- ❑ **Class Actinobacteria: 2 Orders, 25 Families, 66 genera**
- ❑ **Bacteria: 5 Classes, 16 Orders, 34 Families 81 genera,**
- ❑ **Archaea: 1 Class, 1 Order, 1 Family, 5 genera**

RESULT OF RESEARCH

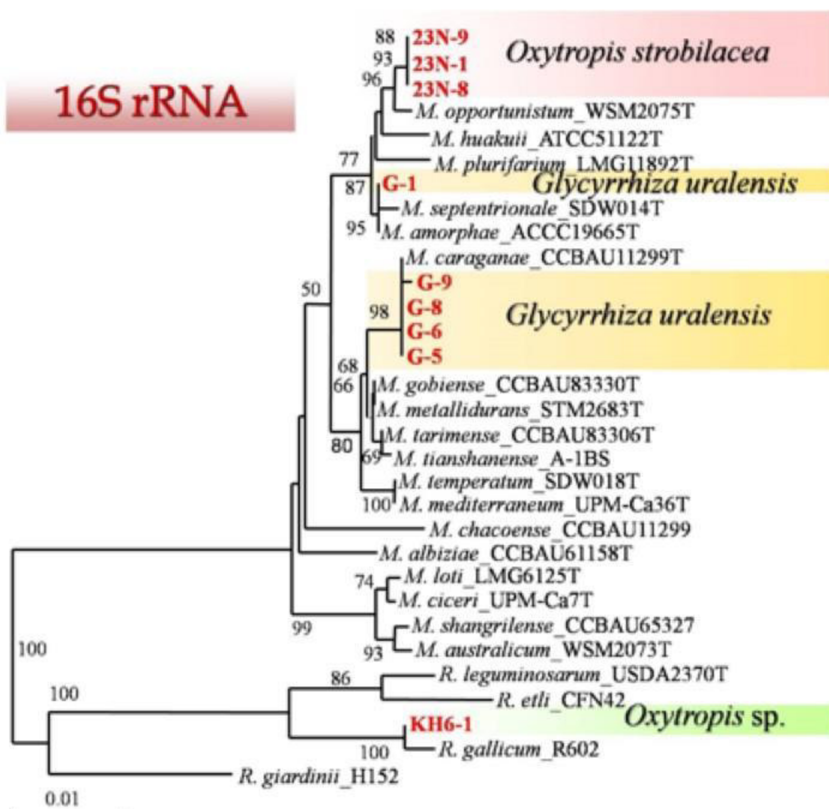
Diversity of Mongolian rhizobia and their *nifH* and *nodC* genes

Rhizobial associations with wild legumes are important in natural ecosystems, providing a fundamental source of N input, especially in semi-arid ecosystems.

Fabaceae → Isolated 137 strains → Identified 62 strains → Selected 50 strains

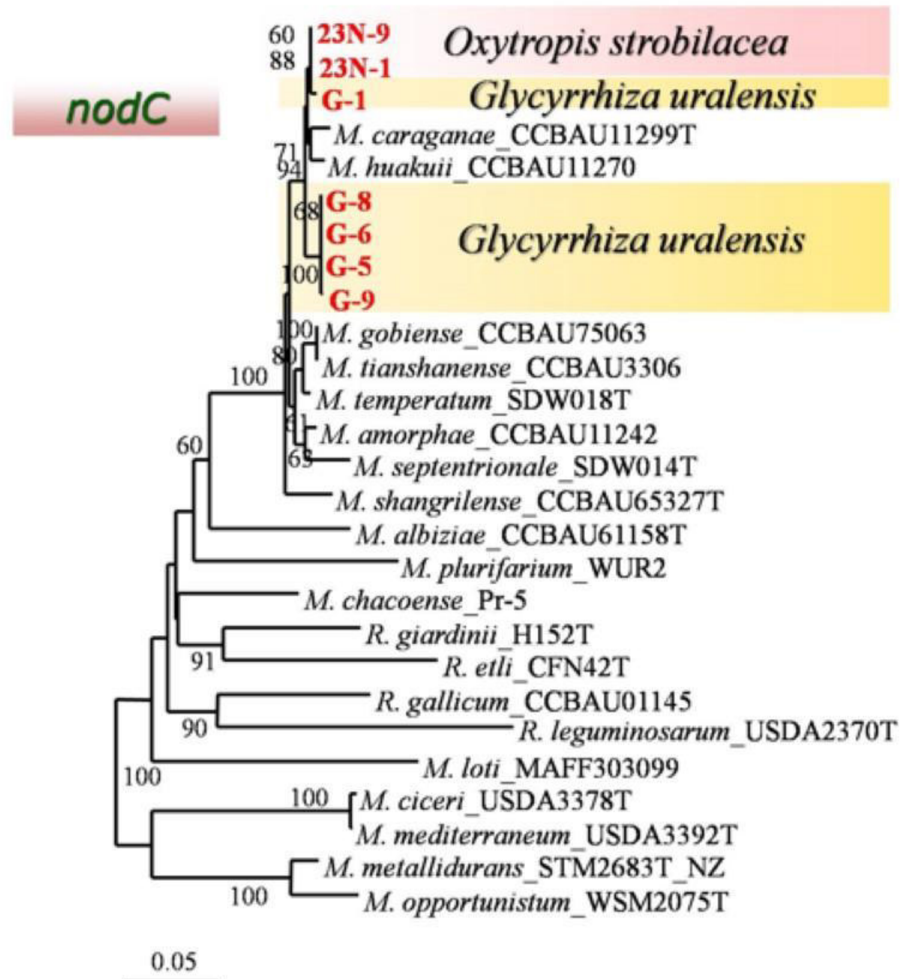
16S rDNA sequences

PCR detection of *nifH* and *nodC* genes



According to the 16S rDNA sequences, our strains belonged to several genera: ***Rhizobium*** (22 strains), ***Mesorhizobium*** (9 strains), ***Pseudomonas*** (6 strains), ***Phyllobacterium*** (4 strains), ***Bacillus*** (4 strains), ***Burkholderia*** (1 strain), ***Luteibacter*** (1 strain), ***Variovorax*** (1 strain), ***Bosea*** (1 strain), and ***Sinorhizobium*** (1 strain).

- Strains of *Oxytropis strobilacea*, 23N-1, 23N-8, 23N-9, presented almost identical *nifH* sequences, and related (97%) to that of the type strain of *Mesorhizobium temperatum* and *M. septentrionale*.
- One strain of the *Glycyrrhiza uralensis* root nodule, G-1, represented a different *nifH* sequence from other four strains, G-5, G-6, G-8, G-9.
- *nodC* gene sequences were conserved in significant degree among Mongolian strains nodulating different plants.



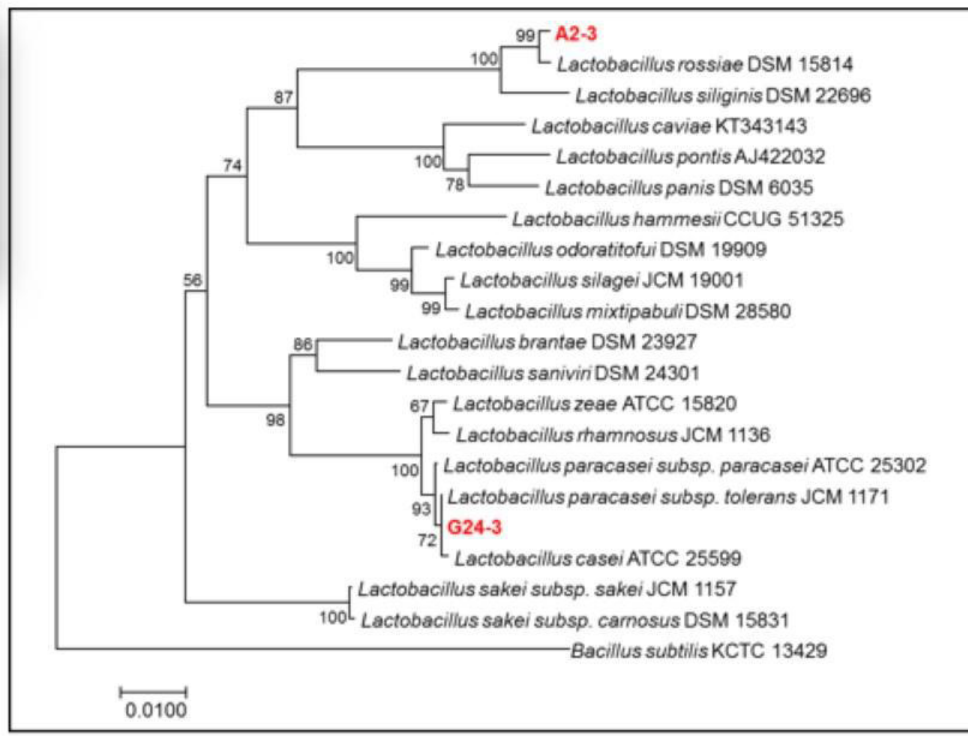
(*Enkh-Amgalan Jigjiddorj and Kazuhito Fujiyama, 2017*)

Identification and plant growth promoting properties of bacteria isolated from nodules of some Leguminous plants of Mongolia

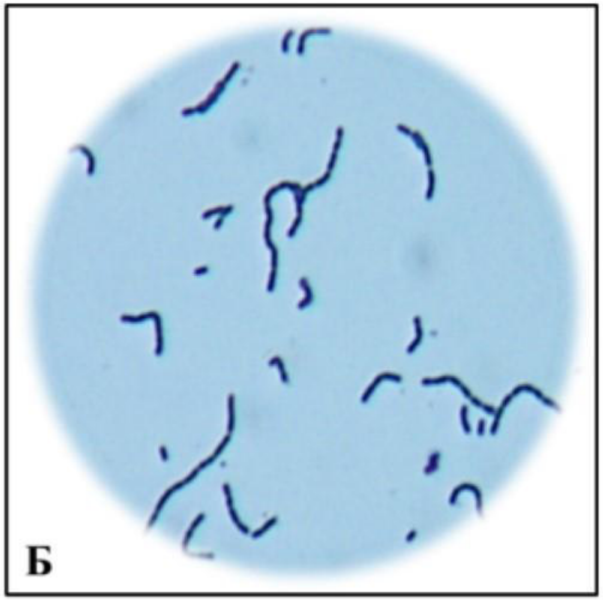
- Total 13 isolates were subjected to the study of their plant growth promoting properties.
- Out of them 13 strains, 6 strains showed a capability of producing siderophores. It means that they can assist plant in acquiring useable iron.
- Strains 30N-3, 40N-5b, and strain 23N-3 were able to solubilize /convert to a form that plant can absorb/ organic and inorganic phosphates, respectively.
- Strain 40N-1 was positive for IAA production. It is known that bacterial IAA increases root surface area and length, and thereby provides the plant greater access to soil nutrients.
- These results confirm the potential of the mentioned strains as plant growth-promoting bacteria.

Identification and characterization of lactic acid bacteria isolated from plant surface

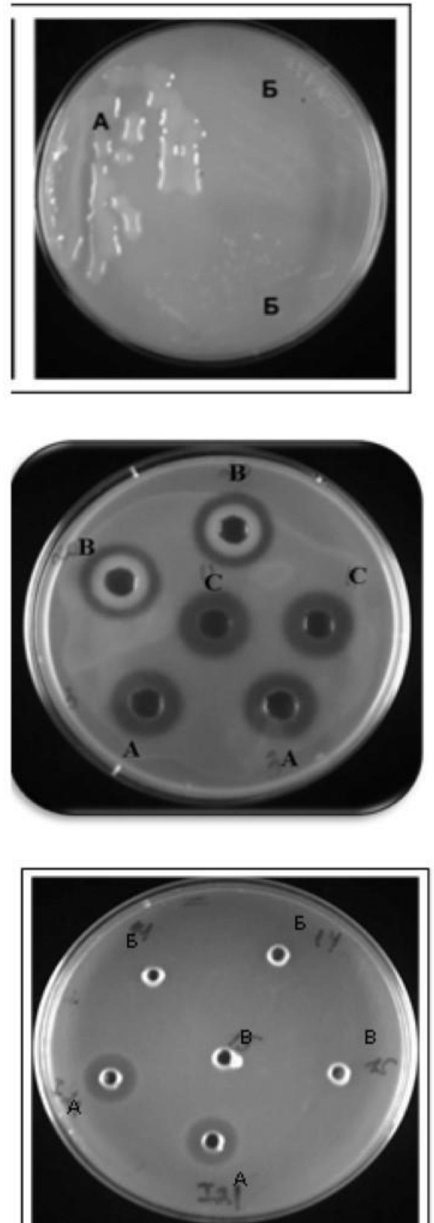
Lactic acid bacteria are widely used in numerous industrial applications, ranging from starter cultures in the fermented food industry to probiotics in dietary supplements, and as bioconversion agents. The natural habitat of LAB is represented by nutritionally rich environments such as various food products and plant materials. They can be found in soil, water, manure, sewage, and silage and can ferment or spoil food.



Identification



Lactobacillus, Leuconostoc, Pediococcus, Lactococcus and *Streptococcus, Enterococcus*



Biological activity starter culture

THANK YOU FOR ATTENTION

Workshop on Ecological vulnerability assessment
Tongliao, Inner Mongolia, China

5-8 July 2018

www.Igeb.ac.mn

Kh. Gantuya (MSc)

Establishment of Regional Grassland Ecological Security Pattern Based on The Positive and Negative Assessment Indicators

-A Case Study on BayinXil Pasture

Untee
Institute of Grassland Survey and Planning
Inner Mongolia
2018-07-04

Content

1.Introduction

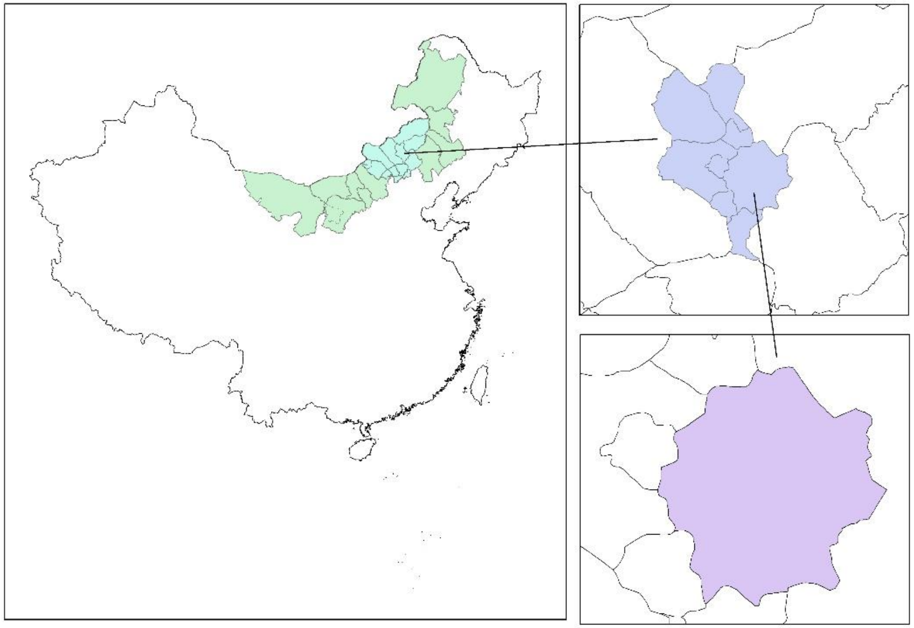
2.Data and Methods

3.Analysis and Result

4.Discussion

1.Introduction-Study area

- BayinXil Pasture is a typical arid and semi-arid steppe, located in Xilinhot, Inner Mongolia.



It's vegetation type and climate condition is much similar to that of Northwestern part of TongLiao.

1.Introduction-What's the Ecological Security Pattern?

The concept of ecological security has two meanings:

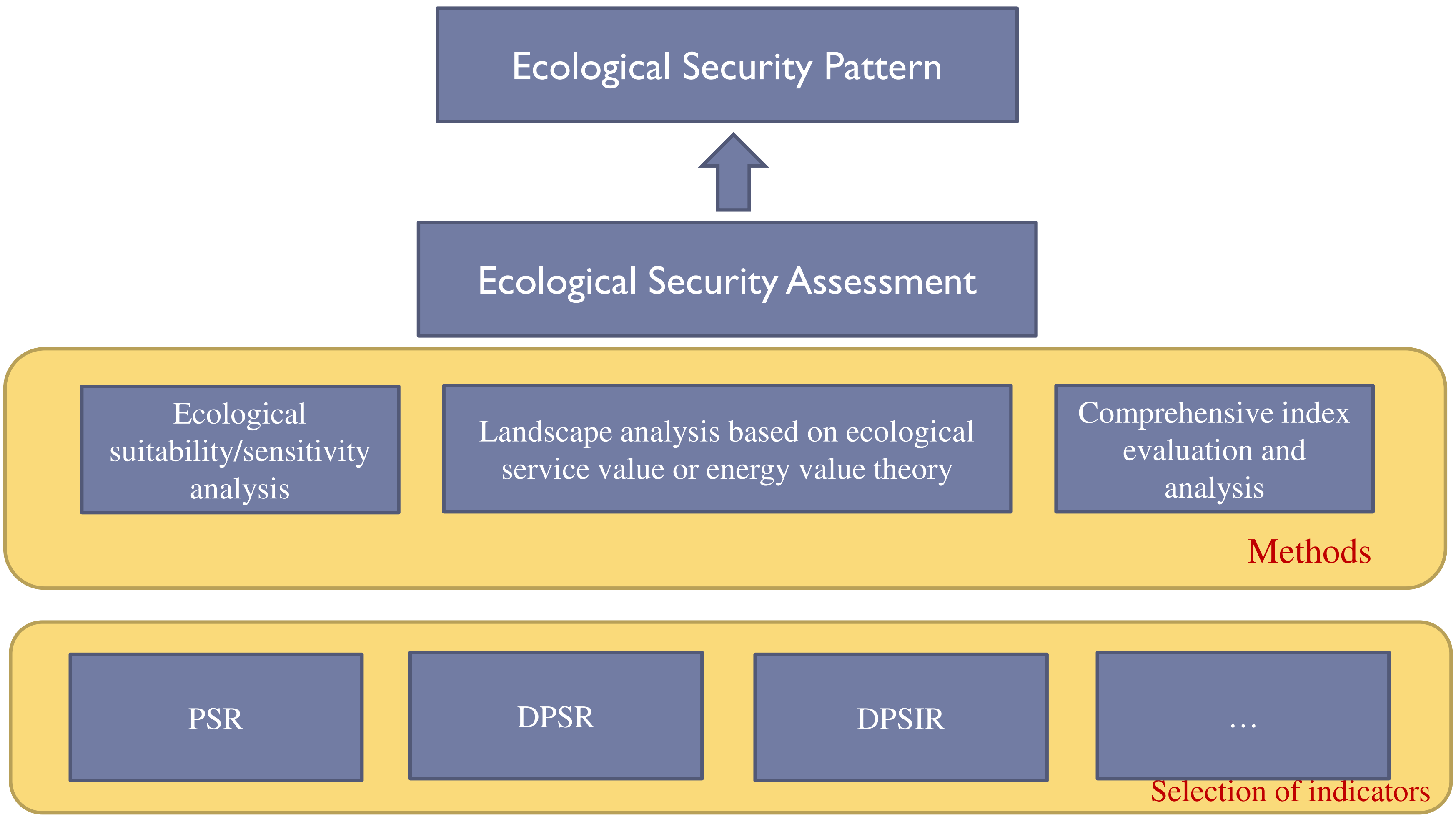
1-The security of the ecosystem itself, the ability to develop sustainably.

2-The ability to provide the material and cultural needs of human beings and to serve the development of human economy.

So, how to build or optimize the ecological security pattern plays a vital role in ecological sustainability.

The construction of the ecological security pattern is the ways and methods to improve regional ecological security on the basis of maintaining the sustainable development of the original environment.

1.Introduction-Significance of the Current Study

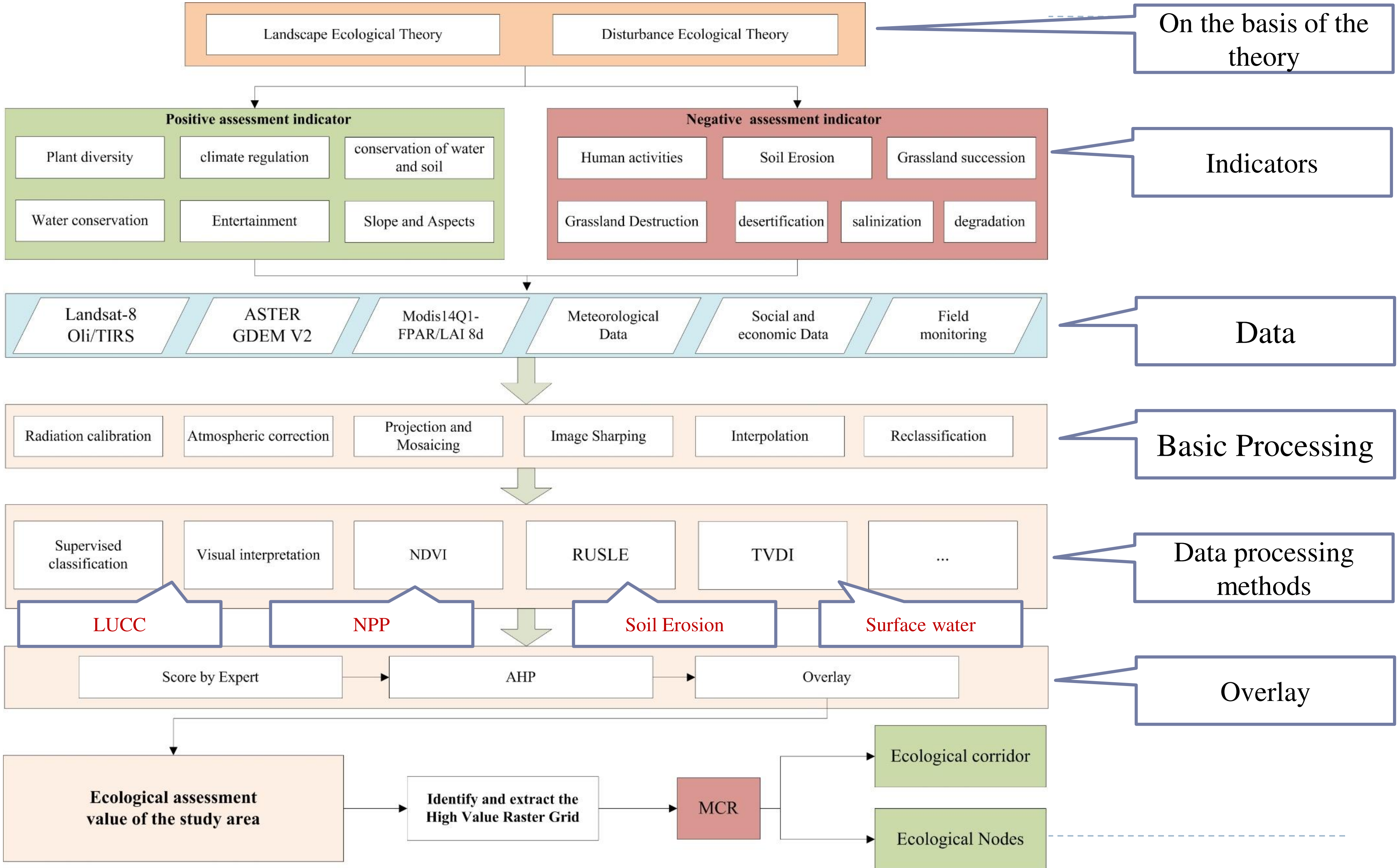


1.Introduction-Significance of the Current Study

- At present, as for the research on ecological security pattern, most studies focused on the city or urban areas, the grassland ecosystem being less involved.
- Besides, on the selection of evaluation index, positive evaluation was given priority to, and the studies rarely involved the evaluation index which highlights the factors destroying the original ecological environment, making it difficult to properly evaluate some man-made landscape elements and ecological degradation process.

Combining the theory of disturbance ecology, this study aims to evaluate the positive and negative direction of regional landscape elements in grassland ecosystem services from the landscape ecology perspective, and to evaluate the service ability and obstructive ability of various landscape elements in natural grassland.

2.Data and Methods-Structure



2.Data and Methods-Indicators

Landscape Ecological Theory

Disturbance Theory

Positive

Negative

2.Data and Methods-Indicators

Hierarchical standardization

	Indicator Type	Assessment Indicator	Calculate method	Classify	Score
Positive assessment indicator	Ecosystem function	Plant diversity	The Simpson index was used to calculate the plant diversity of different regions	Highest	5
				High	4
				Medium	3
				Low	2
				Lowest	1
	Environmental protection	Climate regulation	Due to the positive correlation between vegetation biomass and its carbon cycle and climate regulation capacity, this study used NPP and LAI data to indirectly evaluate vegetation climate regulation capacity	Highest	5
				High	4
				Medium	3
				Low	2
				Lowest	1
		Soil and water conservation	According to the soil and water conservation of vegetation, the ability of grassland soil and water conservation was evaluated based on biomass and root canopy ratio	High	5
				Medium	3
				Low	1
		Water conservation	Based on TVDI index	Highest	5
				High	4
				Medium	3
				Low	1
				Lowest	0
	Culture service	Entertainment	According to the distribution density of tourist spots (mujialu) in the study area	High	5
				Medium	1
				Low	0
	Terrain conditions	Aspect factor	Based on the relevant research results of the research group in the west wuzhu mu qin grassland and the results of the chang xueli et al. in the hulunbuir meadow grassland	N	5
				W	4
				E	3
				Flat	2
				S	1
		Slope factor		15°~25°	5
				8°~15°	4
				5°~8°	3
				<5°	2
				>25°	1

2.Data and Methods-Indicators

Hierarchical standardization

	Indicator Type	Assessment Indicator	Calculate method	Classify	Score
Negative assessment indicator	Human activity	Human activity frequency		>1000	-5
				1000~500	-3
				500~100	-1
				<100	0
	Natural change	Soil Erosion	The distribution of soil and water loss intensity in the study area was obtained based on RUSLE model	Highest	-5
				High	-4
				Medium	-3
				Low	-1
	Grassland succession	Desertification	Compared with the species of grassland community, the degree of grassland desertification and salinization in 2010	Severe	-5
				Moderate	-3
				Mild	-1
		Salinization		Severe	-5
				Moderate	-3
				Mild	-1
		Degradation		Severe	-5
				Moderate	-3
				Mild	-1
	Destruction	Destruction of grassland	The extent to which the original natural landscape was destroyed	Completely destroyed	-5
				Highly disruptive	-4
				General disruptive	-2
				No destruction	0

2.Data and Methods-NPP

- In this study, field monitoring output P and NDVI's statistical model method was used to calculate NPP. The previous research has shown that the predictive results of this method can perfectly reflect the NPP on regional scale spatial. Therefore, the results of the study has the repeatability and the accuracy depends on the resolution of the remote sensing data.

$$NDVI = \frac{\rho_{Nir} - \rho_{Red}}{\rho_{Nir} + \rho_{Red}}$$

2.Data and Methods-Soil Erosion

RUSLE Model:

$$A = R \cdot K \cdot LS \cdot C \cdot P$$

- A: Annual soil erosion(t/Km2·year)
- R: Rainfall erosivity factor
- K: Soil erosivity factor
- LS: Slope length and slope factor
- C: Vegetation coverage
- P: Soil and water conservation measures factor

2.Data and Methods-Surface water

TDVI:

$$TVDI = \frac{T_s - T_{Smin}}{T_{Smax} - T_{Smin}}$$

Tsmax、Tsmin were obtained by linear fitting of vegetation index and surface temperature according to dry edge and wet edge respectively

$$T_{Smax} = a_1 + b_1 \cdot NDVI$$

$$T_{Smin} = a_2 + b_2 \cdot NDVI$$

a1、b1: Linear fitting coefficient of dry edge
a2、b2: Linear fitting coefficient of wet edge

2.Data and Methods-Surface water

Landsat-8 TIRS

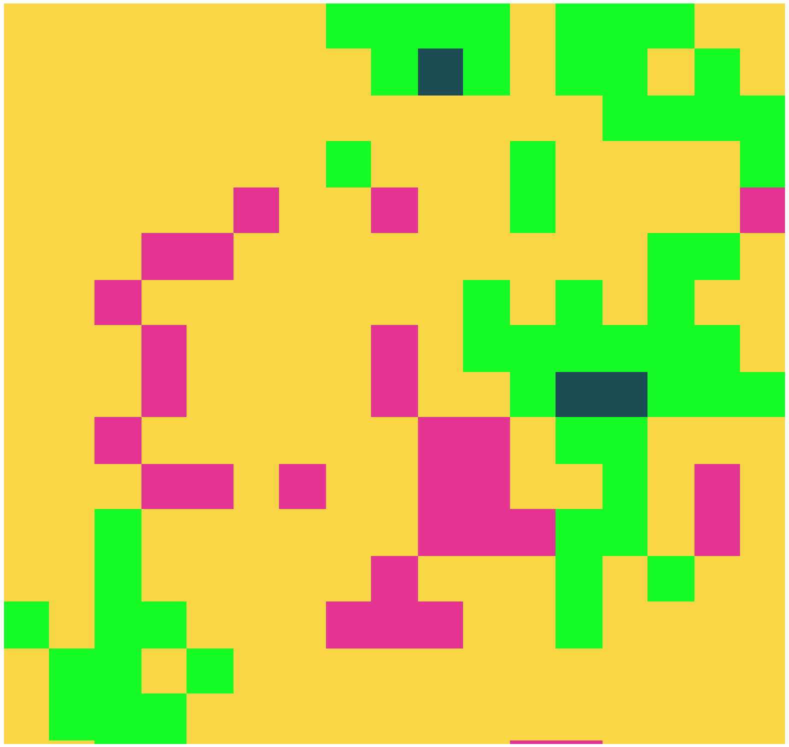
$$T_{10} = K_2 / \ln\left(\frac{K_1}{L(\alpha)} + 1\right)$$

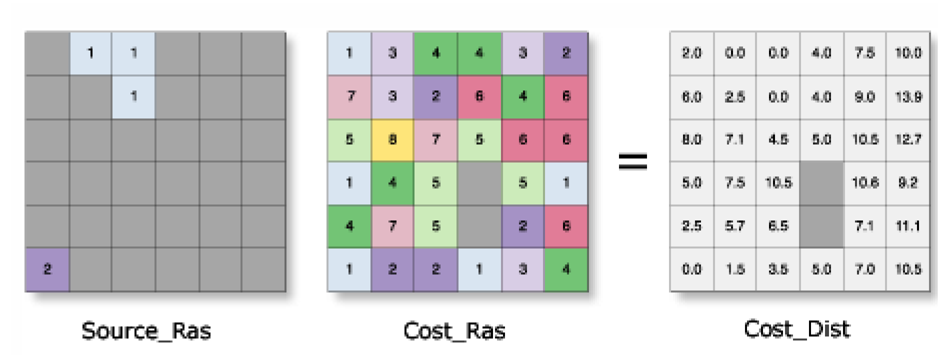
K1 and K2 are nominal constants; L is the thermal infrared radiation

$$L(\alpha) = [\varepsilon_\alpha b_\alpha(T_s) + (1 - \varepsilon_\alpha)L_{\downarrow\alpha}]\tau_\alpha + L_{\uparrow\alpha}$$

$$\varepsilon_\alpha = \varepsilon_{grass} VC + \varepsilon_{building} (1 - VC) + 4(d\varepsilon)VC(1 - VC)$$

2.Data and Method-MCR





$$MCR = f\min \sum_{j=n}^{i=m} D_{ij} \cdot R_i \cdot P_j$$

MCR is the minimum cumulative resistance value;
Fmin represents the positive correlation between minimum cumulative resistance and ecological processes;
Dij is the distance of landscape flow from source pixel j to landscape element I;
Ri is the resistance coefficient of landscape elements to landscape flow;
Pj represents the ecological energy value of the ecological source area;

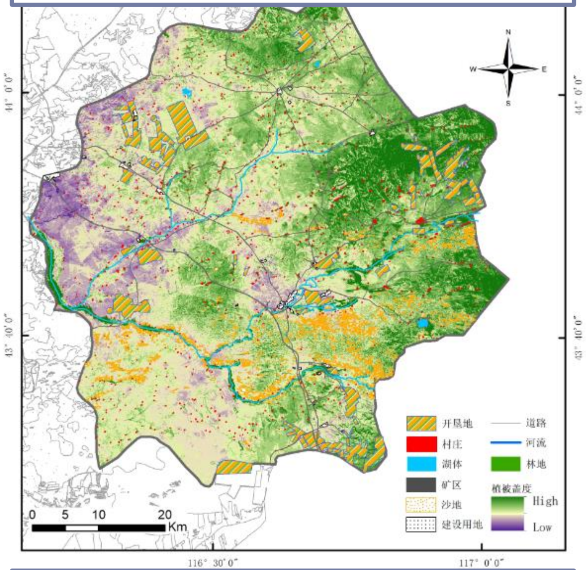
3.Analysis and Result

Score by Experts + AHP

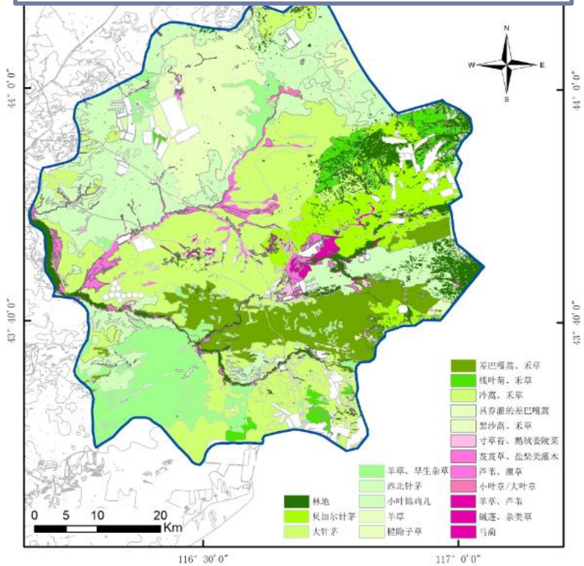
Indicator Type	Assessment Indicator	Weight	Rank
Ecosystem function	Plant diversity	0.0834	4
	Climate regulation	0.1045	1
Environmental protection	Soil and water conservation	0.0853	3
	Water conservation	0.088	2
Culture service	Entertainment	0.045	13
Terrain conditions	Aspect factor	0.0731	9
	Slope factor	0.0696	11
Human activity	Human activity frequency	0.0683	12
Natural change	Soil Erosion	0.079	6
	Desertification	0.0795	5
Grassland succession	Salinization	0.0752	8
	Degradation	0.0765	7
Destruction	Destruction of grassland	0.0726	10

3.Analysis and Result

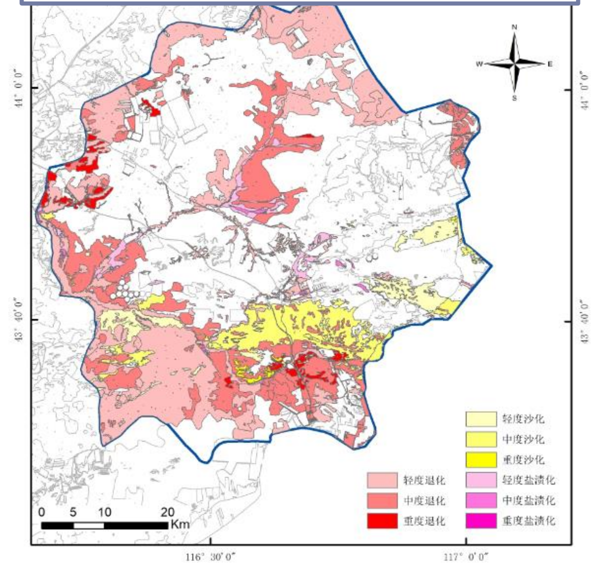
LUCC



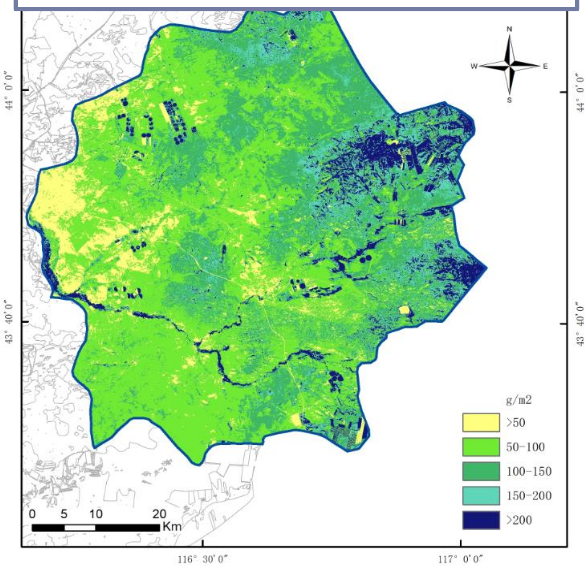
Vegetation types



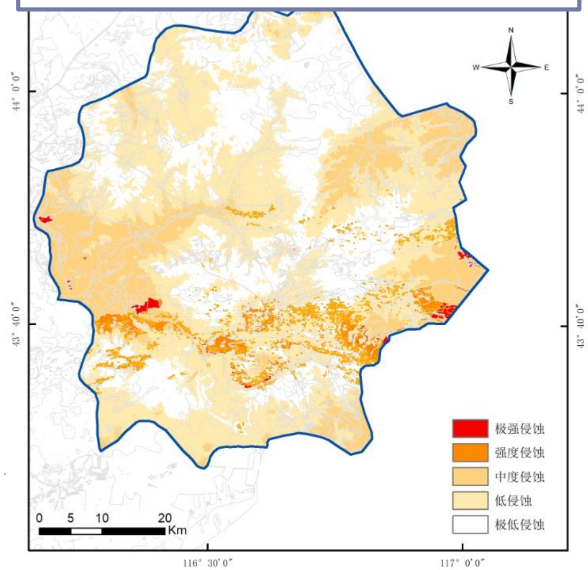
Degradation of Vegetation



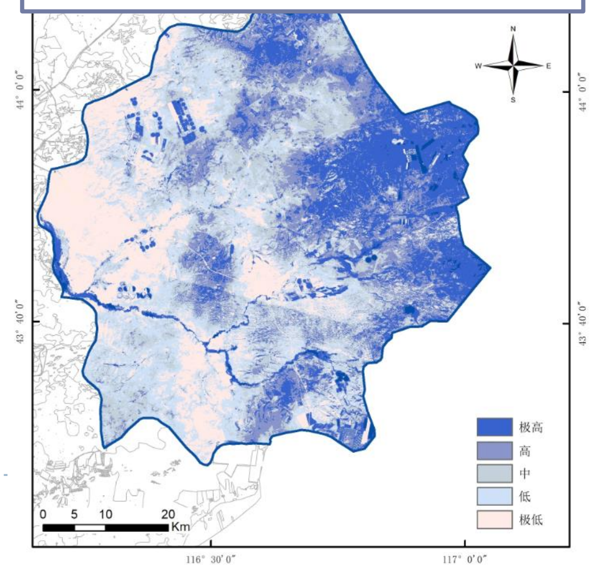
NPP



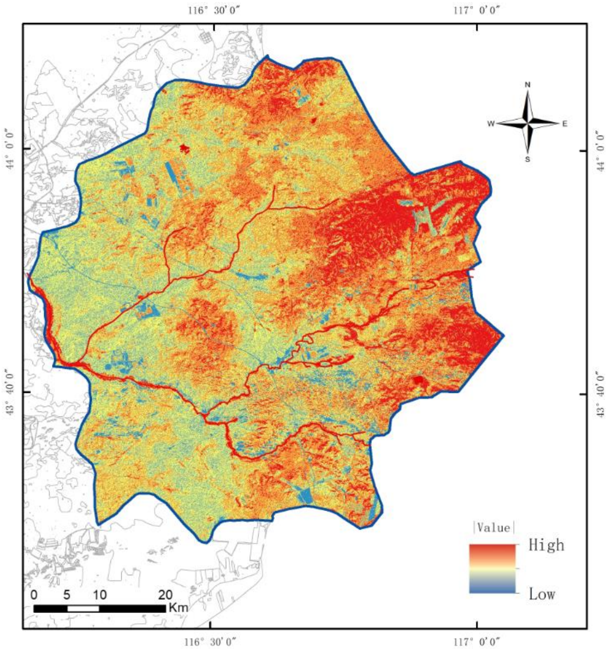
Soil Erosion

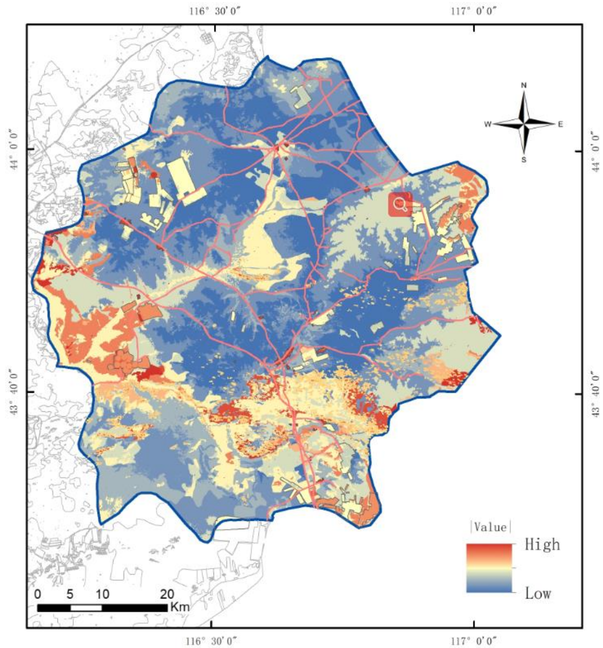


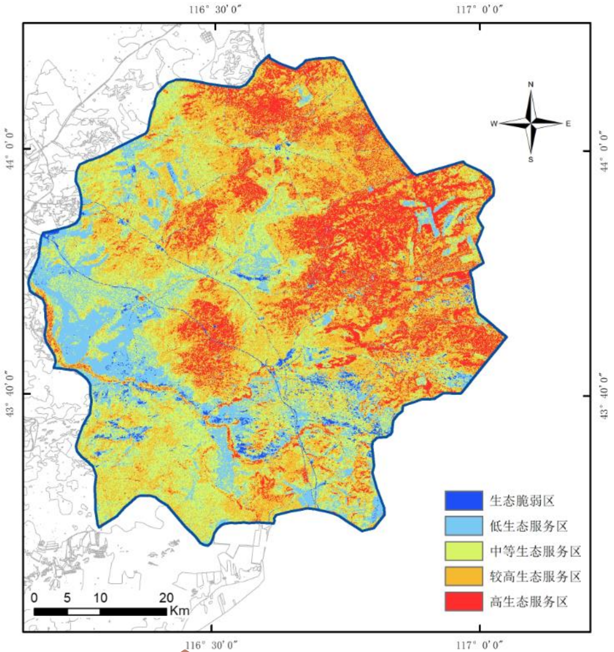
Surface Water



3.Analysis and Result





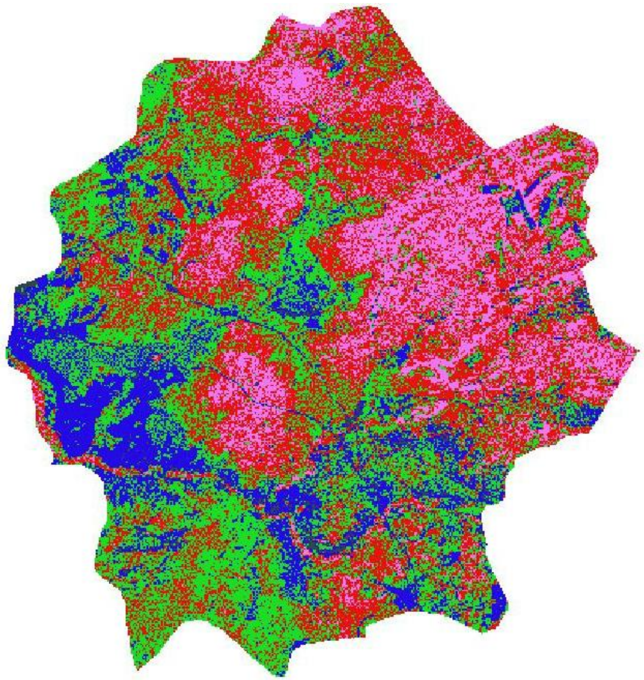


Positive+

Negative -

Ecological assessment

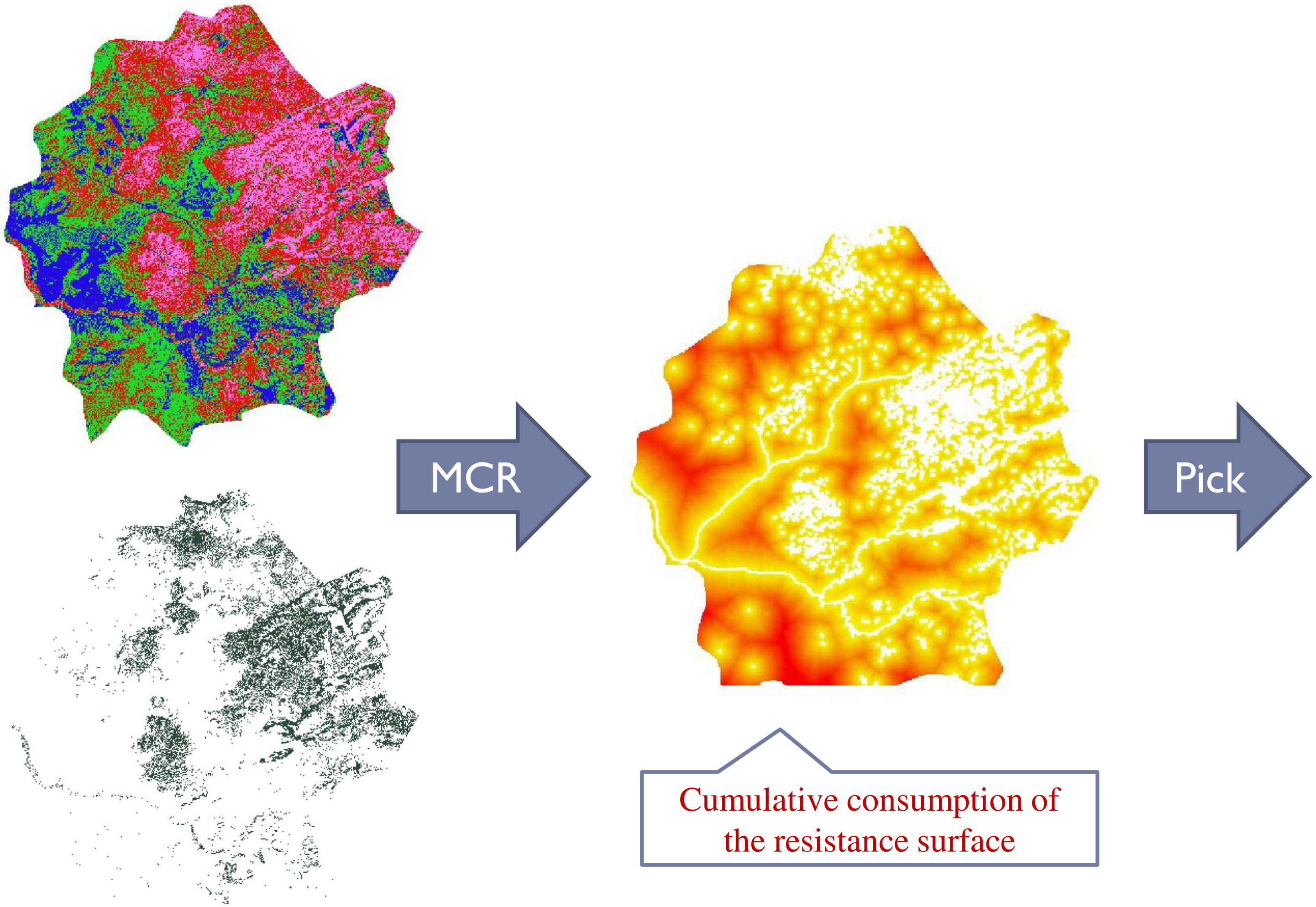
3.Analysis and Result



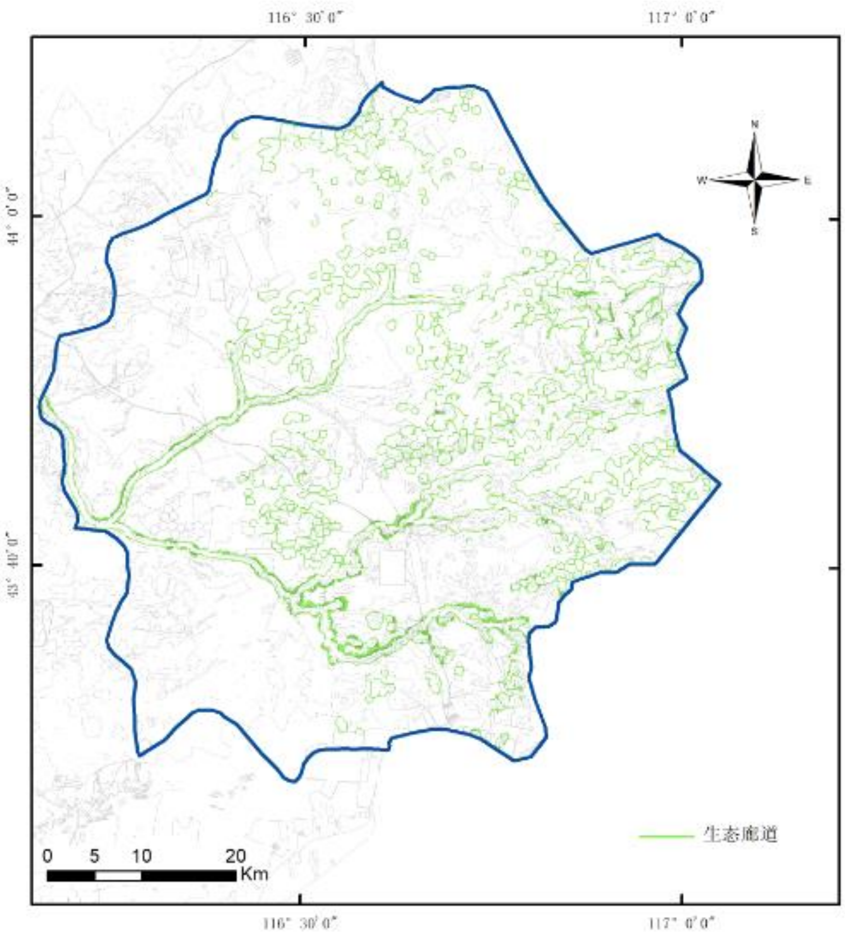
Reclassify=Resistance

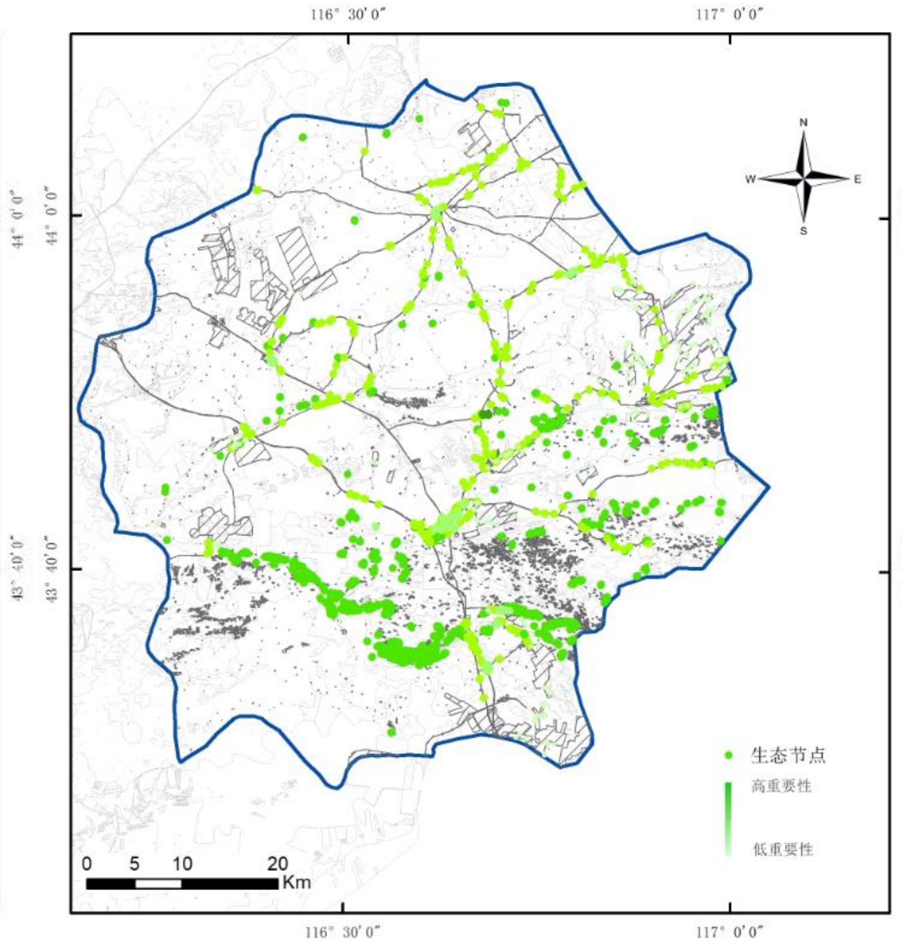
High Ecological Service
Grid=Source

3.Analysis and Result



3.Analysis and Result

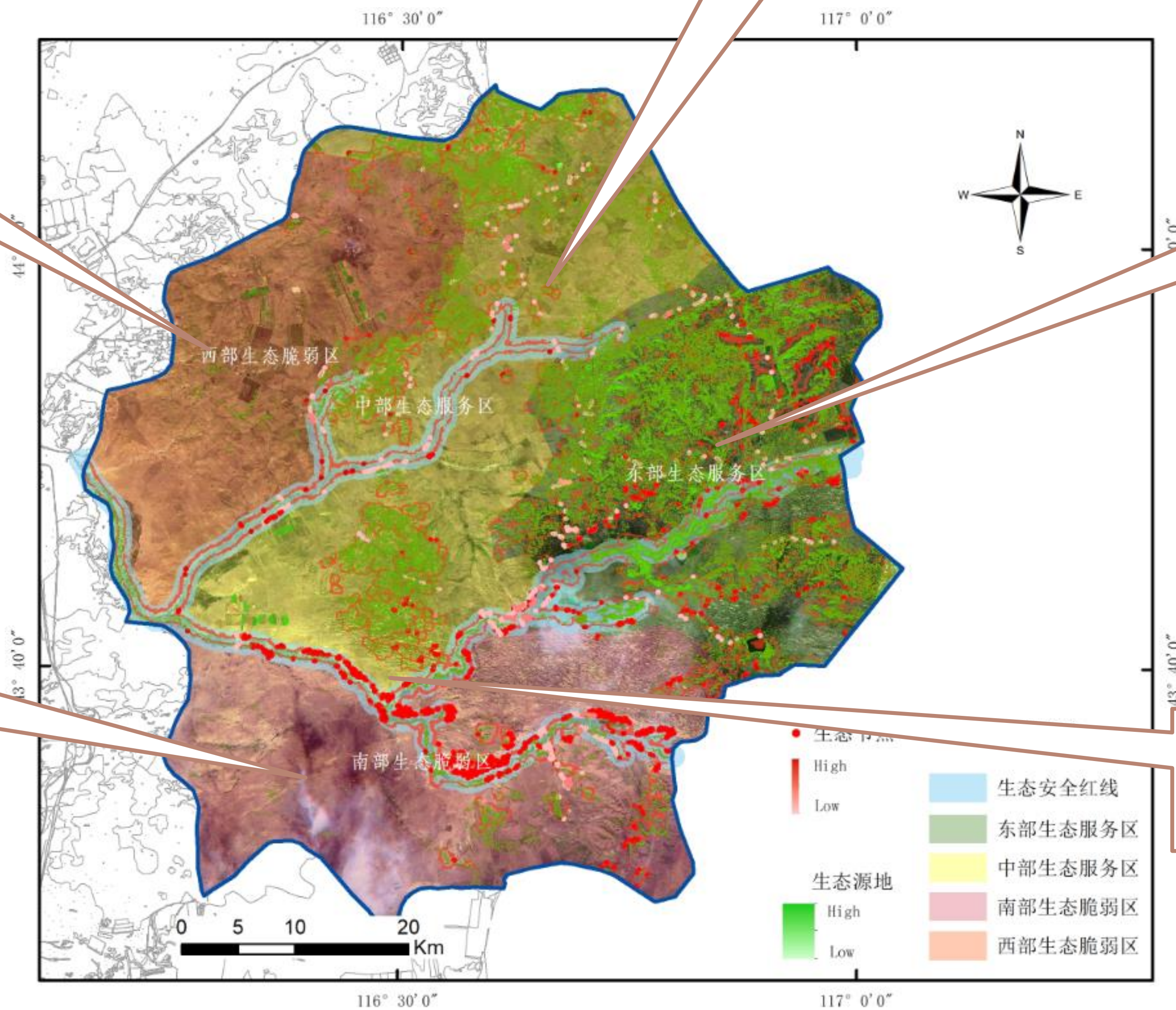




Ecological Corridor

Ecological Nodes

3.Analysis and Result



4.Discussion

- Based on the landscape ecology theory, this study combining the disturbance ecology theory, tries to establish a positive and negative directive evaluation system for the grassland ecological system. It highlights the factors which have obstructive impact on the landscape flow and ecological flow.
- Besides, with the help of analytic hierarchy process, the study sets the weight value of each index. Then, by means of overlaying the grids, the comprehensive assessment graph of the study area is found. In addition, by extracting and accusing the pixel value, and with the MCR model, the ecological security pattern of the Bayinxil pasture is established. Furthermore, the functional classification of the present pattern is also made in this study.

1. The assessment indicators is whether fully evaluate the current situation of study area.
2. Is it too subjective to select the evaluation indicators?


Thank you

Social-ecological impacts of a payment for ecosystem services scheme in the Horqin Sandy Land

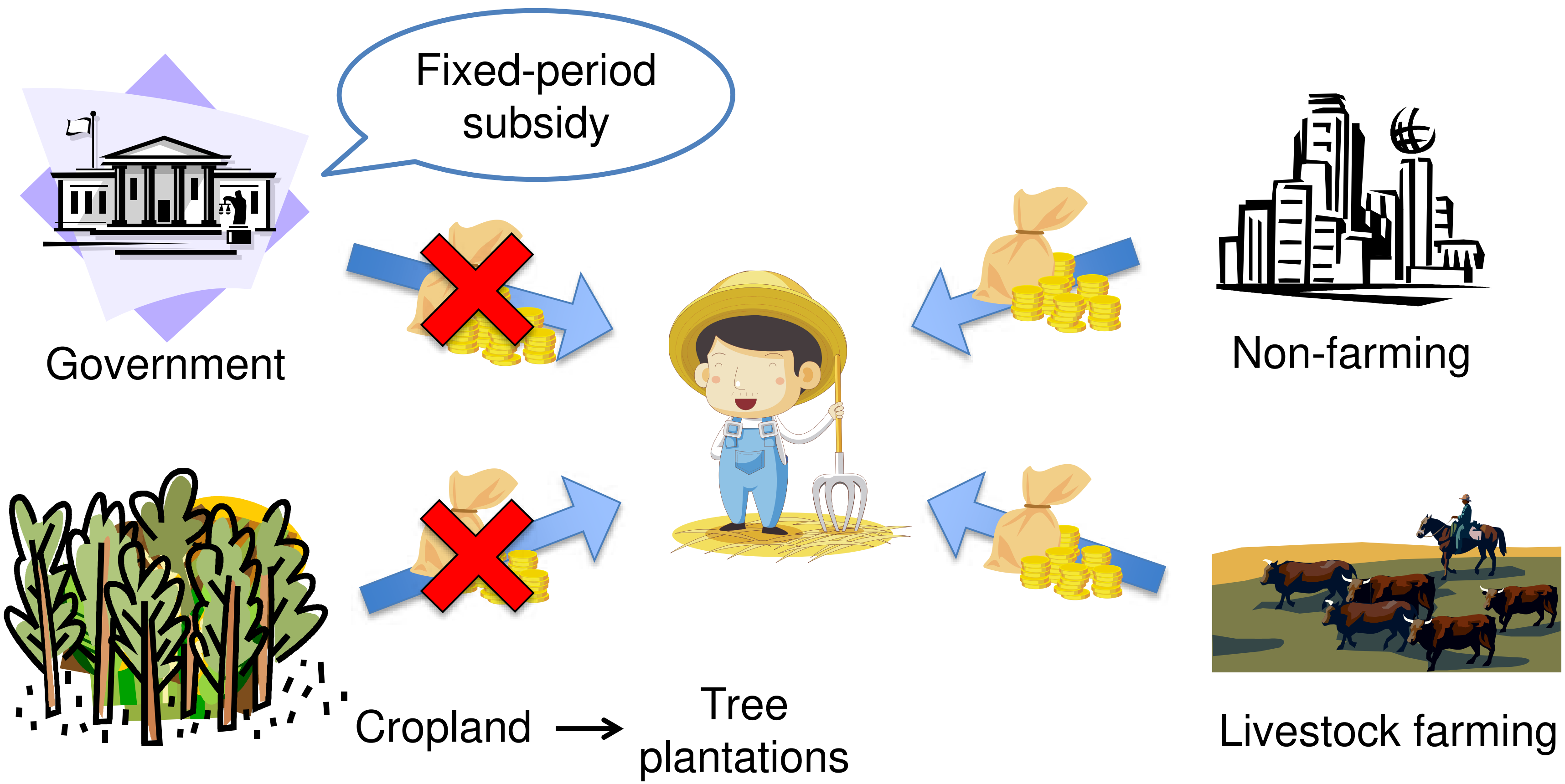
Takafumi Miyasaka
Nagoya University

Table of contents

Sloping Land Conversion Program (SLCP) in Inner Mongolia

Aims

- Environmental restoration and poverty alleviation
- Livelihood change from agriculture to non-agriculture

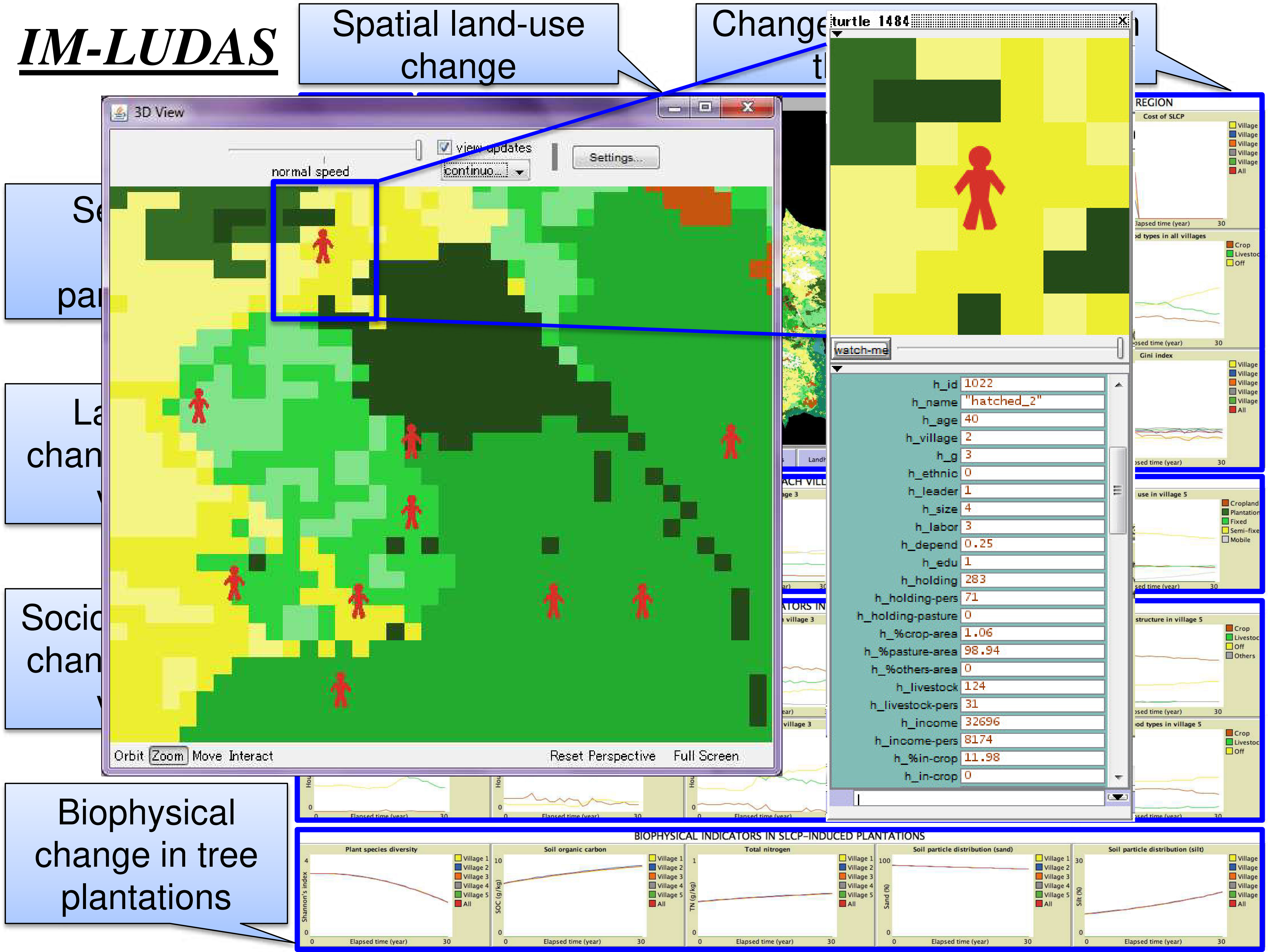


Research question

Major issues in SLCP

- Lack of targeting strategies
- Feasibility of facilitating the livelihood change

"Can the SLCP better achieve its multiple goals, including economic structural shift, if targeting strategies based on social and ecological heterogeneity are incorporated into it?"


IM-LUDAS
Spatial land-use change
Biophysical change in tree plantations
3D View
view updates
normal speed
continuo...
Settings...
Orbit Zoom Move Interact
Reset Perspective Full Screen
turtle 1484
watch-me
h_id 1022
h_name "hatched_2"
h_age 40
h_village 2
h_g 3
h_ethnic 0
h_leader 1
h_size 4
h_labor 3
h_depend 0.25
h_edu 1
h_holding 283
h_holding-pers 71
h_holding-pasture 0
h_%crop-area 1.06
h_%pasture-area 98.94
h_%others-area 0
h_livestock 124
h_livestock-pers 31
h_income 32696
h_income-pers 8174
h_%in-crop 11.98
h_in-crop 0
REGION
Cost of SLCP
Gini index
BIOPHYSICAL INDICATORS IN SLCP-INDUCED PLANTATIONS
Plant species diversity
Soil organic carbon
Total nitrogen
Soil particle distribution (sand)
Soil particle distribution (silt)
Elapsed time (year)
Village 1
Village 2
Village 3
Village 4
Village 5
All

Scenario assessment

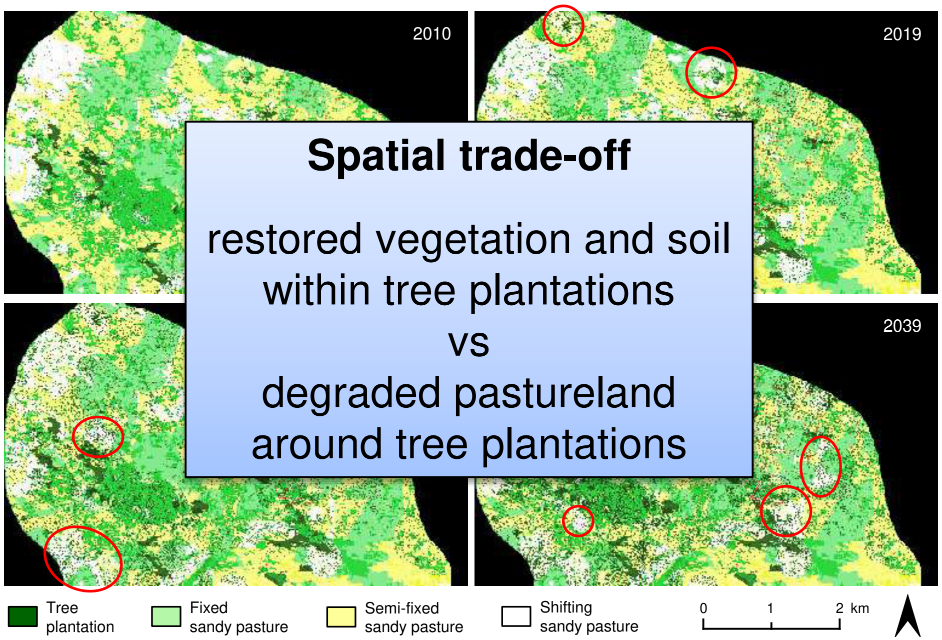
- Baseline scenario
  - Maintains the current tree plantations without expanding implementation area

- Targeting scenario
  - Converts all degraded, unprofitable cropland to tree plantations

Environmental impacts

Change in the area of shifting sandy land

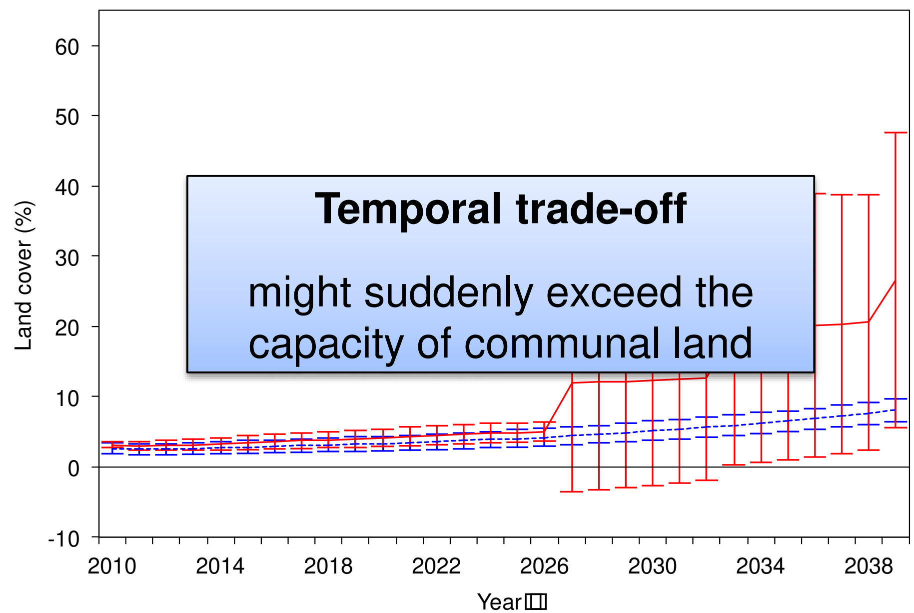
Household scale



Spatial trade-off

restored vegetation and soil within tree plantations
vs
degraded pastureland around tree plantations

Village scale



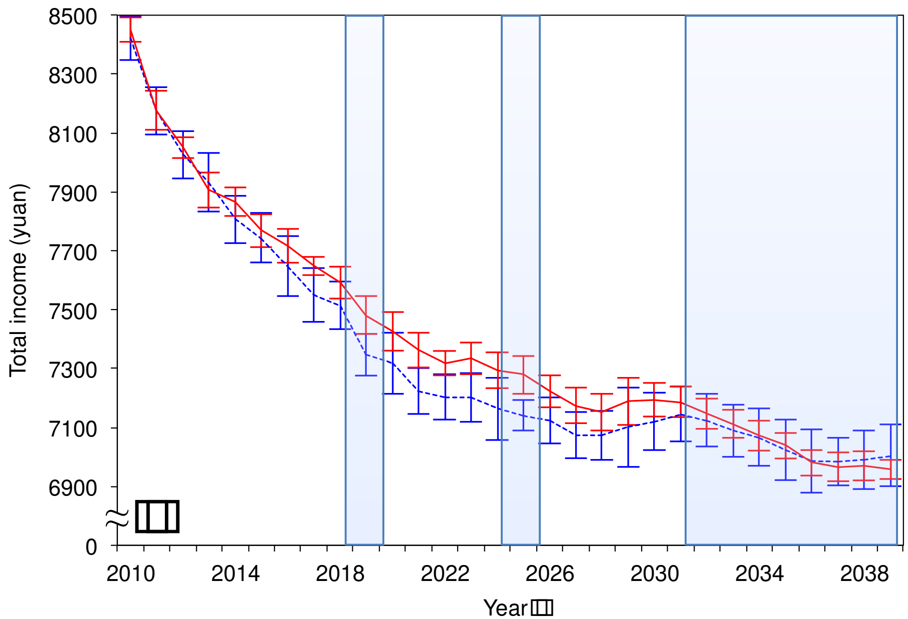
Temporal trade-off

might suddenly exceed the capacity of communal land

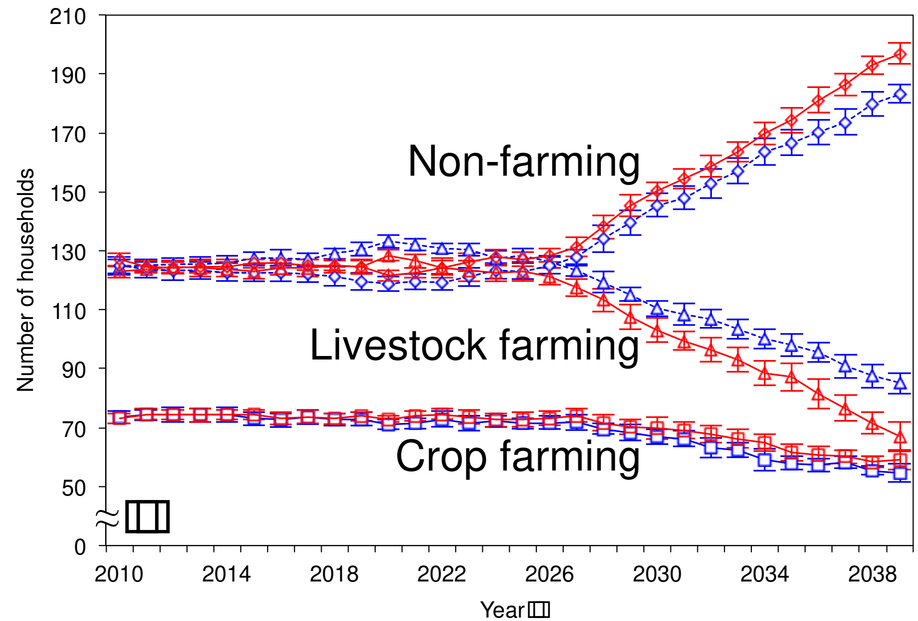
Baseline scenario Targeting scenario

Poverty alleviation & Livelihood change

Total income change



Livelihood change
(change in the number of households for different livelihood types)



crop income decrease >
off-farm income increase + subsidy

Primary factor: generational change
Secondary factor: targeting strategy

Baseline scenario   Targeting scenario

Summary

Spatial and temporal trade-offs

○ Expansion of tree plantations with facilitating land restoration

× Further pasture loss and degradation outside the tree plantations

Social trade-offs

○ Household change toward off-farm livelihoods with slight income rise

× Income deterioration by the afforestation-induced reduction in cropland

Conclusions

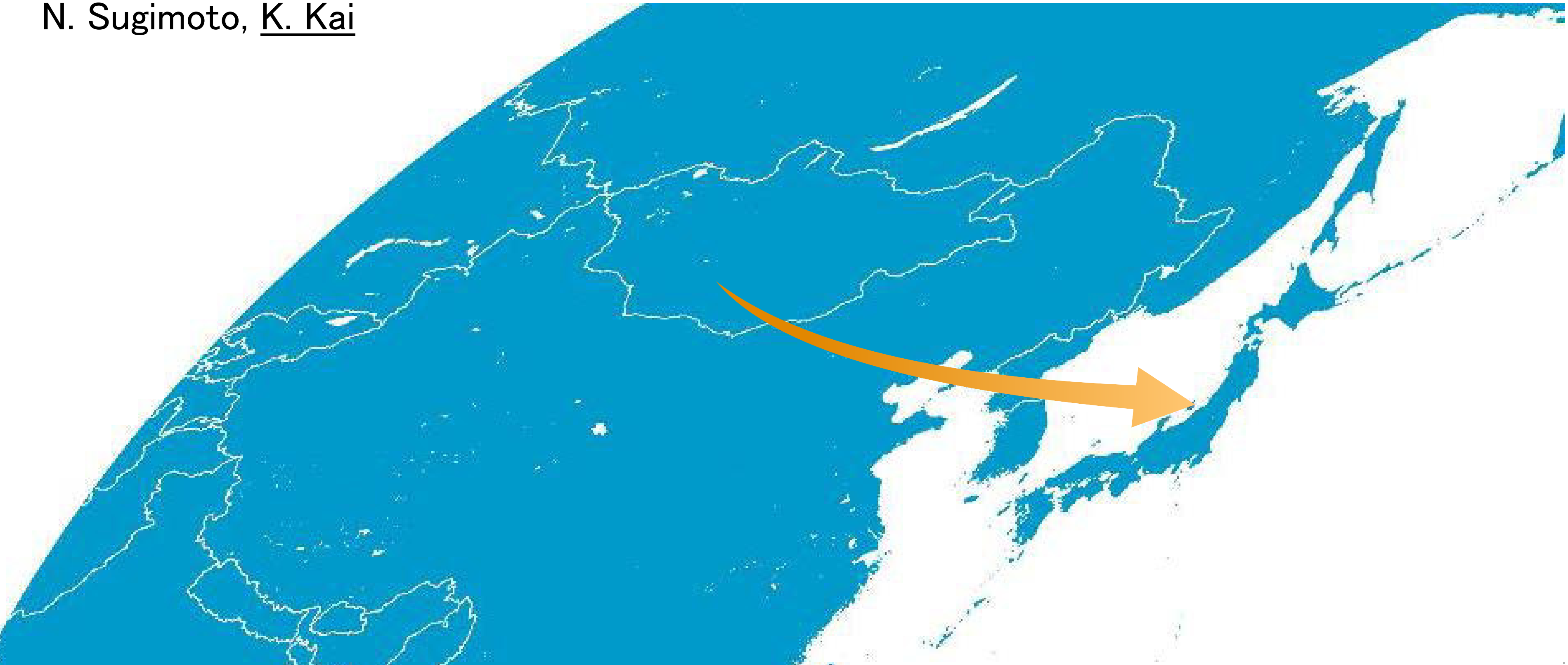
The targeting strategy examined do not always improve achievement of the environmental or economic goals of the policy

- ❖ SLCP could potentially result in multi-dimensional trade-offs in its social-ecological impacts
- ❖ IM-LUDAS proved itself to be an advanced empirical model that can represent complex social-ecological systems

Large-Scale Dust Event in East Asia in May 2017: Dust Emission and Transport from Multiple Source Regions

Kenji KAI *Designated Professor of Ibaraki University / Emeritus Professor of Nagoya University*

My presentation is published in Minamoto et al. (2018): SOLA, Vol.14, p.33–39.
URL: https://www.jstage.jst.go.jp/article/sola/14/0/14_2018-006/_article/-char/en
Authors: Y. Minamoto, K. Nakamura, M. Wang, K. Kawai, K. Ohara, Jun Noda, E. Davaanyam, N. Sugimoto, K. Kai

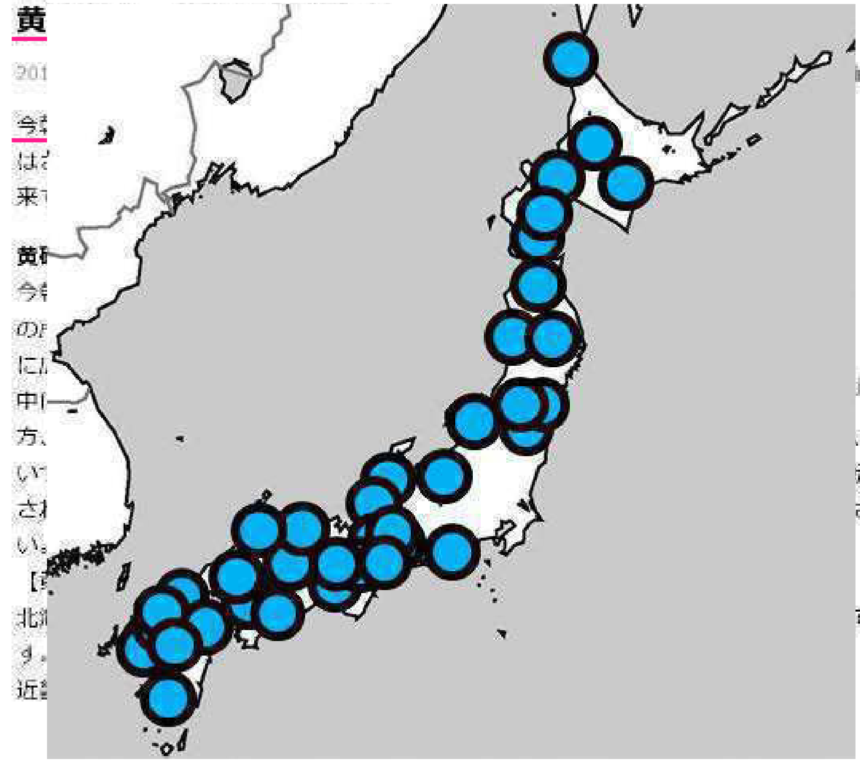


Big dust event

Dust event in Osaka on 7 May 2017

http://www.otonarisoku.com/archives/50004525.html

09:00 UTC 07 May 2017



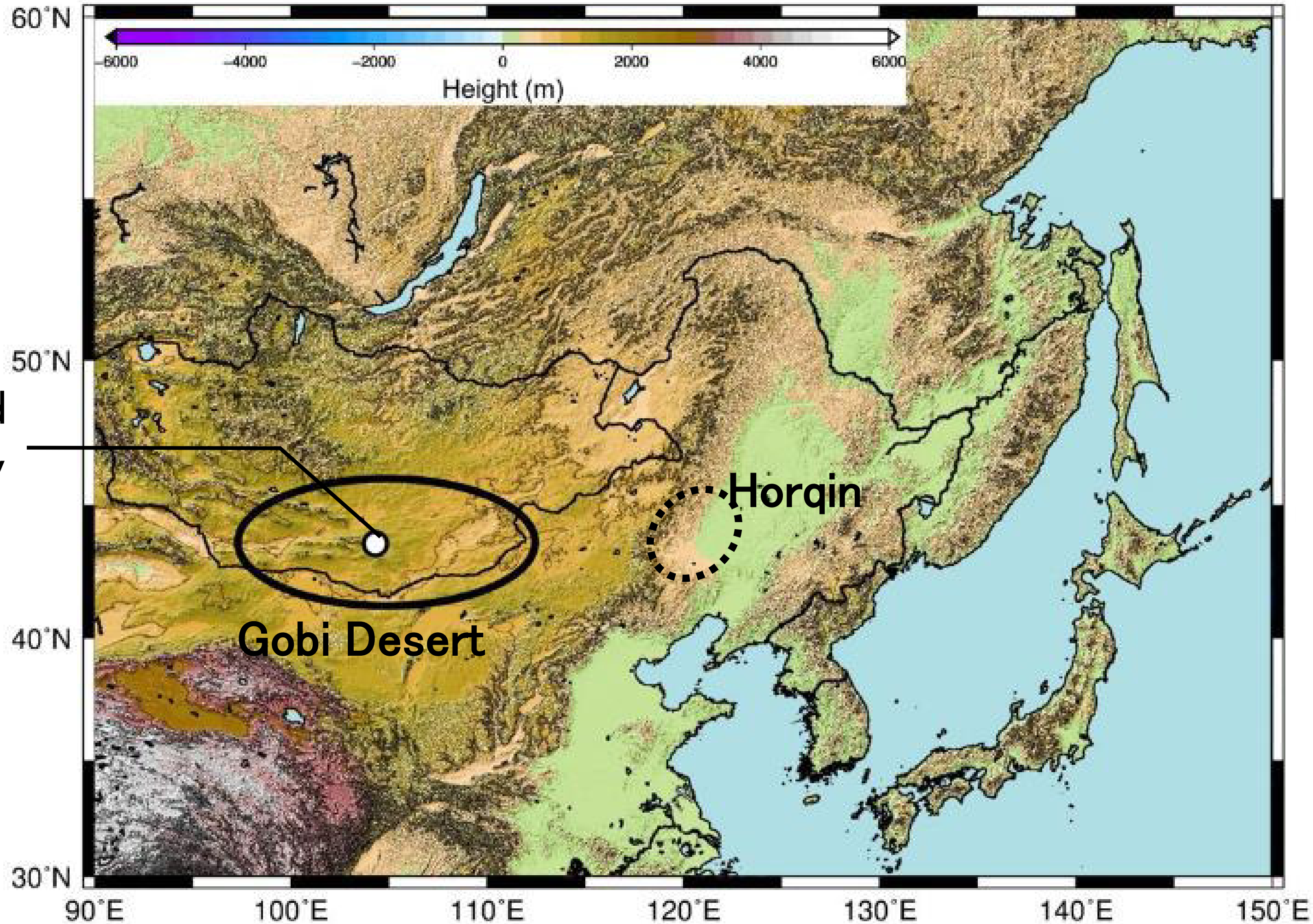
Dust reports (Japan Meteorological Agency)

- Dust events were reported at 46 meteorological statins in Japan on 7 May 2017.
- This dust event covered the whole of Japan.

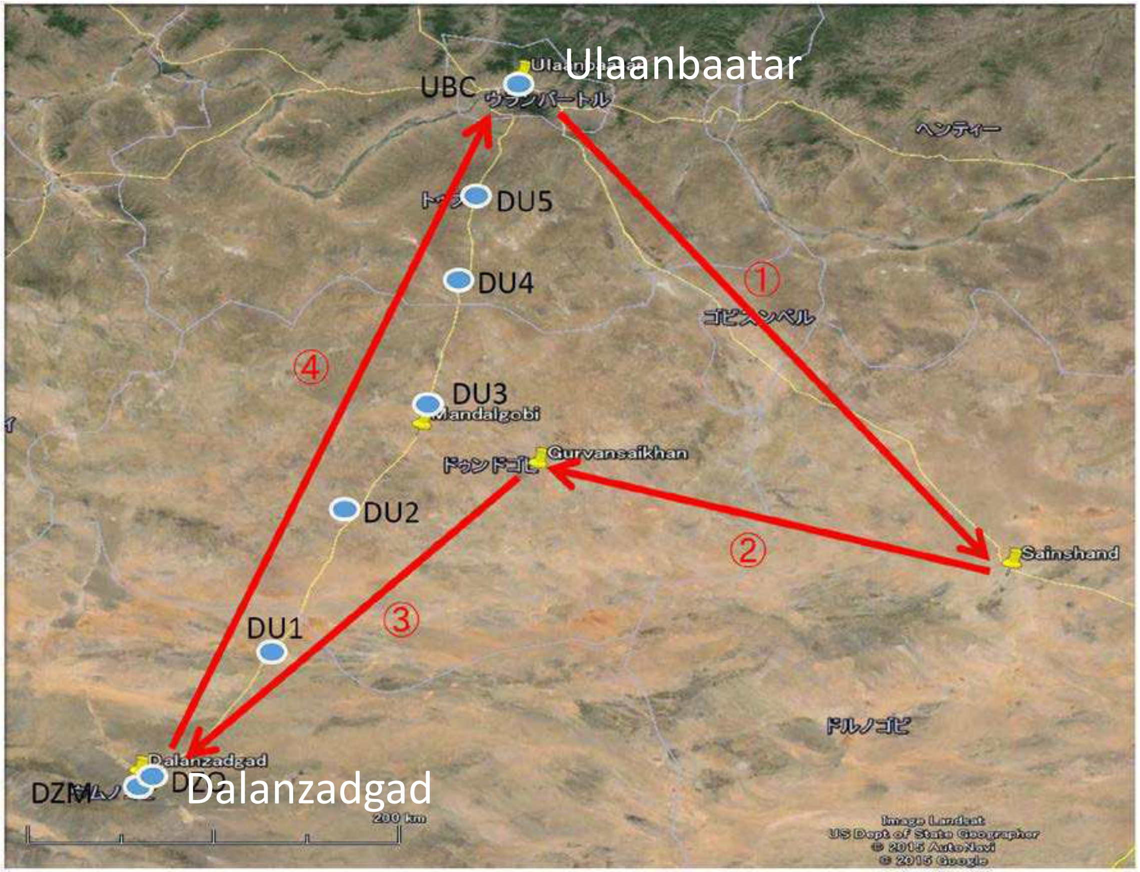
Observation at Gobi Desert

- Observation period: 1–3 May 2017

Dalanzadgad
Observatory
Mongolia



Moving observation of Asian dust in JSPS program



Instrument:

OPC, Sunphotometer, Bioaerosol sampler, Meteorological insturments

The car stops at each observation point **every 100km** between Ulaanbaatar and Dalanzadgad.

Observations at Dalanzadgad

Bioaerosol sampling

Main building and V-SAT, which is used for CL51 data transfer

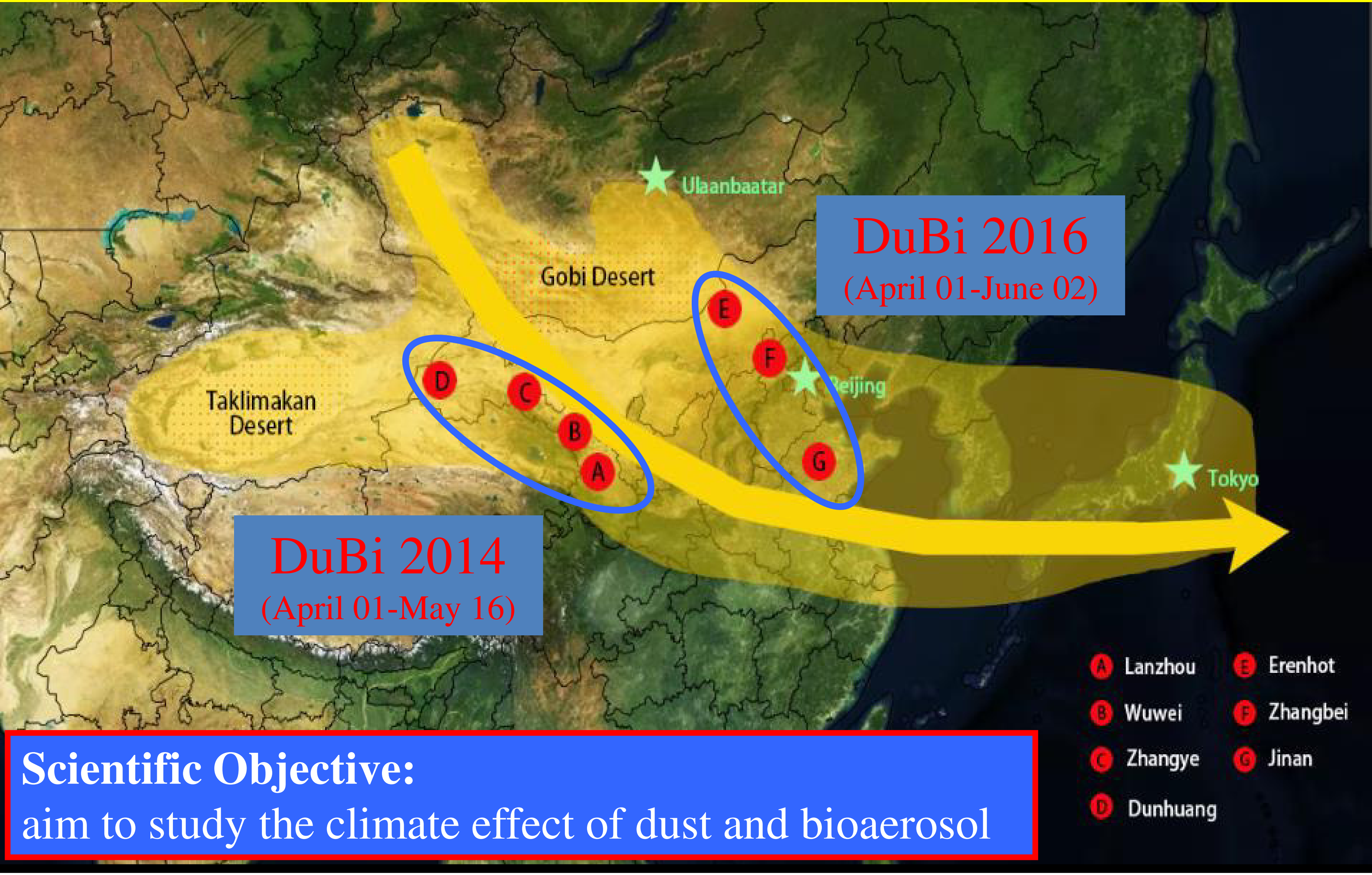
Radiosonde observation. H_2 gas is used.

Ceilometer

NASA sunphotometer

Dalanzadgad observatory is located in the Gobi Desert. Installed are radiosonde by China, a ceilometer by Nagoya University, a sunphotometer by NASA, a bioaerosol sampler by Kanazawa University.

Overview of Dust-Bioaerosol (DuBi) Campaign



Scientific Objective:
aim to study the climate effect of dust and bioaerosol

DuBi: Lanzhou University's research plan

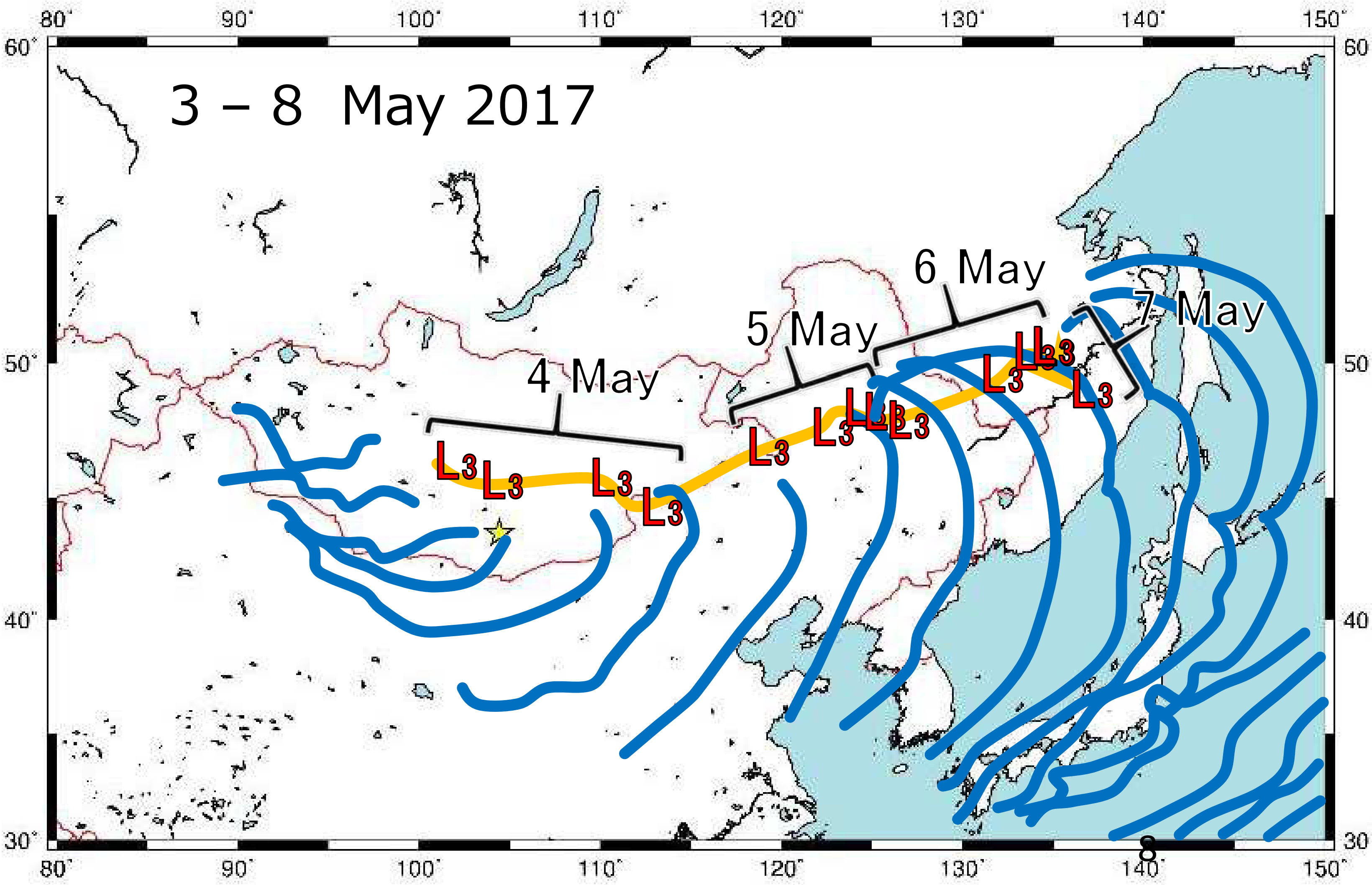
Results

Cold fronts and low pressure system

OPC and ceilometer observations

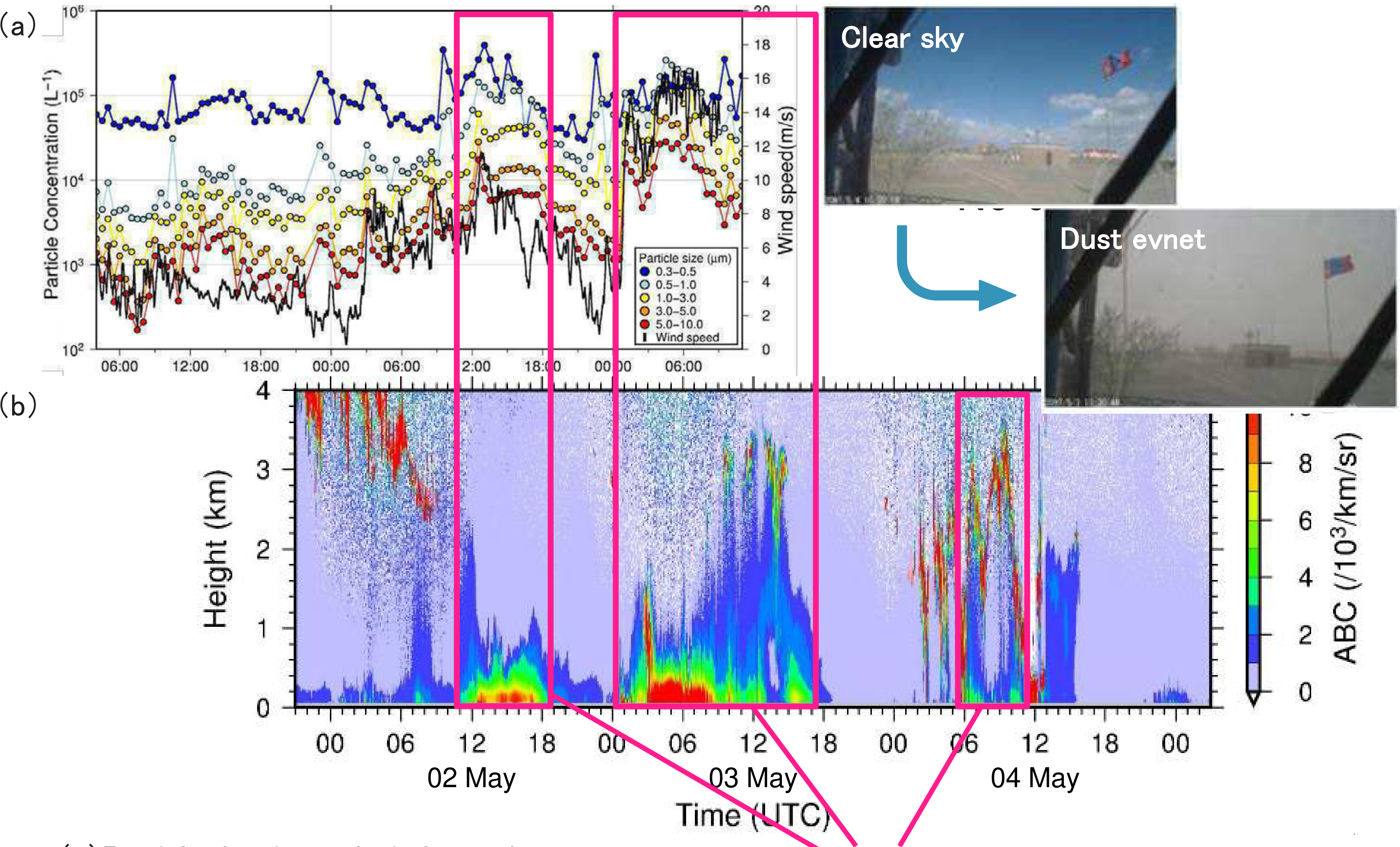
Himawari-8 DUST RGB

Low pressure systems



Low pressure systems caused the dust events and transported the dust on the lee.
The dust event covered the whole of Japan on 7 May.

Dust event at DZ in May 2017



(a) Particle density and wind speed
(b) Backscattering coefficient

Transport of dust

●NCEP Data assimilation system

700hPa height・vertical p velocity・dew point、850hPa wind ・Equivalent potential temperature、surface pressure ・wind

→Analysis of cold front and trough

●Himawari-8 (band 11, 13, 15)

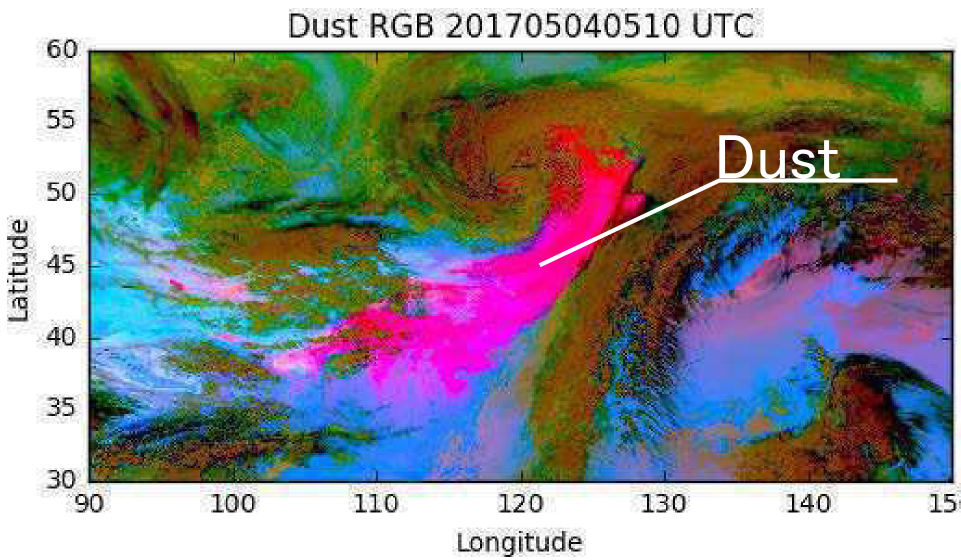
- Dust RGB composite image

●NOAA surface data

- Present weather (dust)

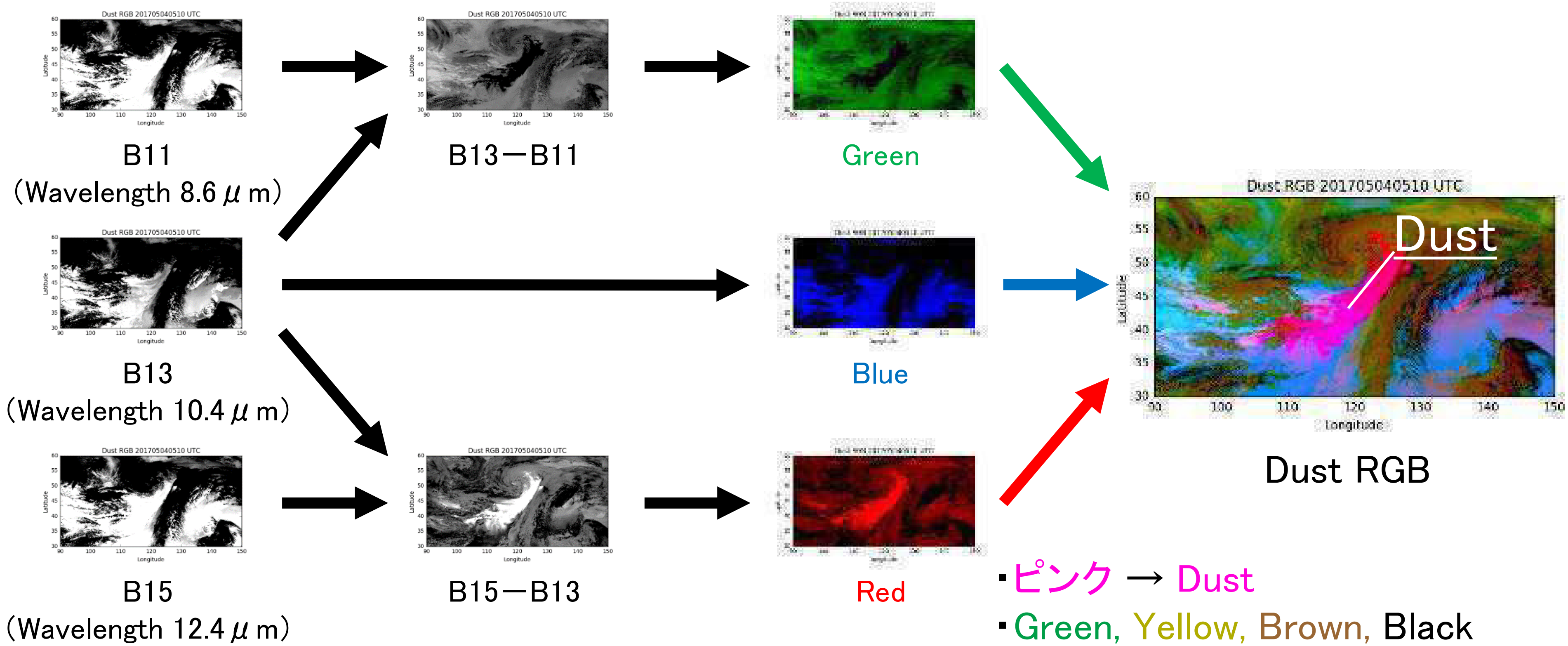
ww=09,30−35,98 → dust storm
ww=07,08 → blowing dust
ww=06 → floating dust

→Surface reports of dust



Pink → dust
Green, yellow, brown, black → cloud

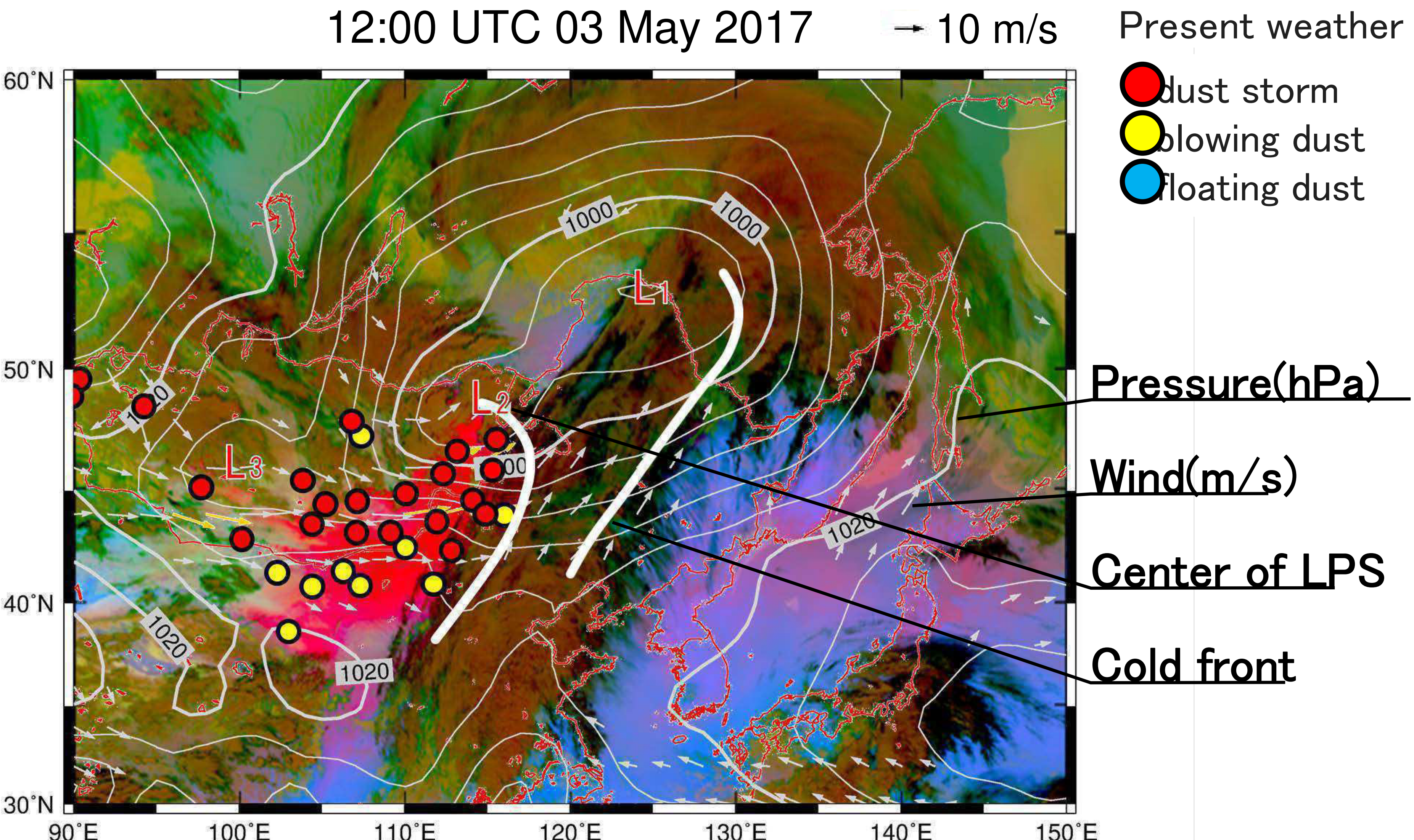
■Dust RGB composite image



・ピンク → Dust
・Green, Yellow, Brown, Black
→ Cloud
・Observation is possible in day and night.

JMA (2015)

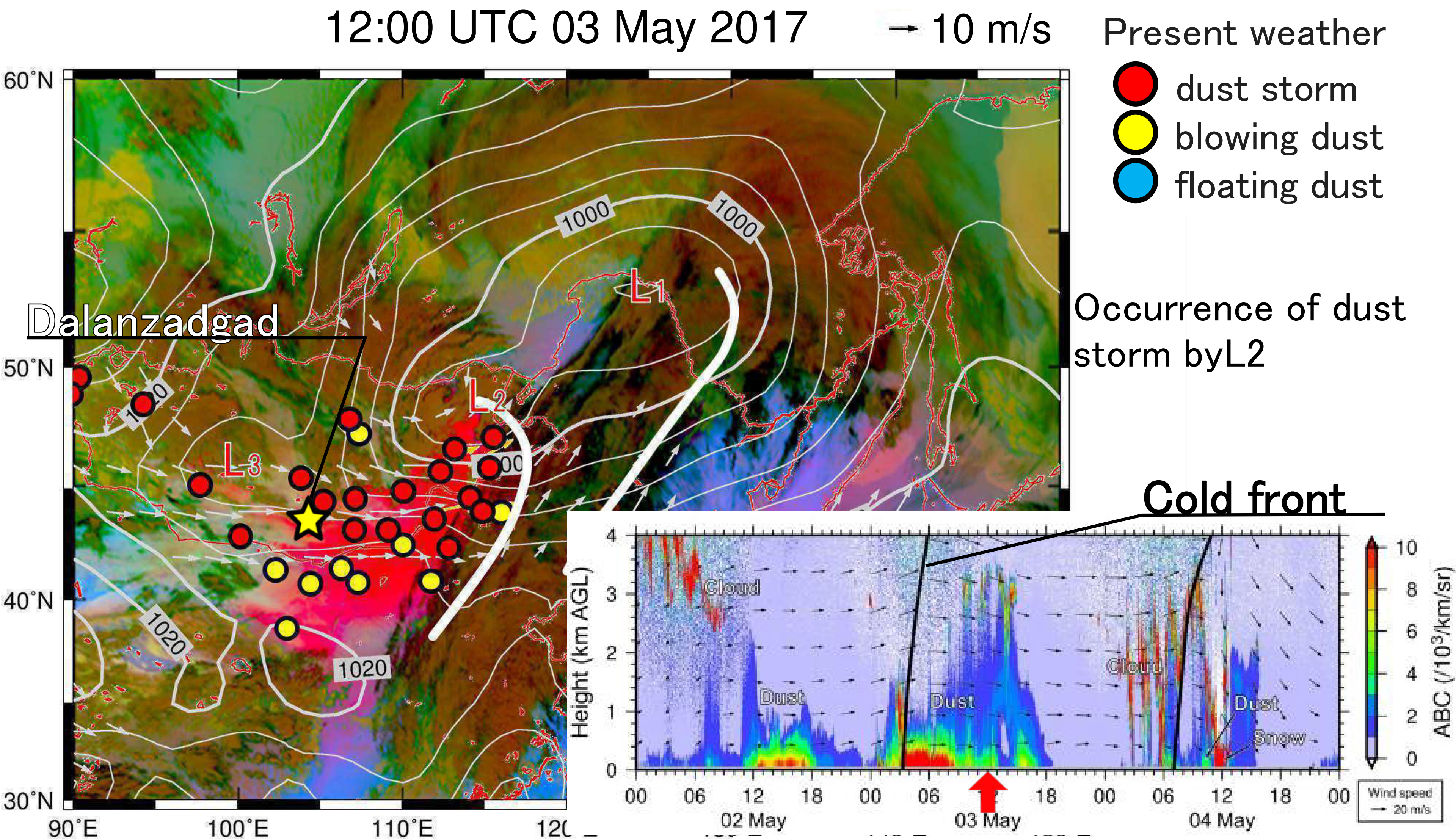
Dust occurrence and transport



Pink → dust

Green, yellow, brown, black → cloud

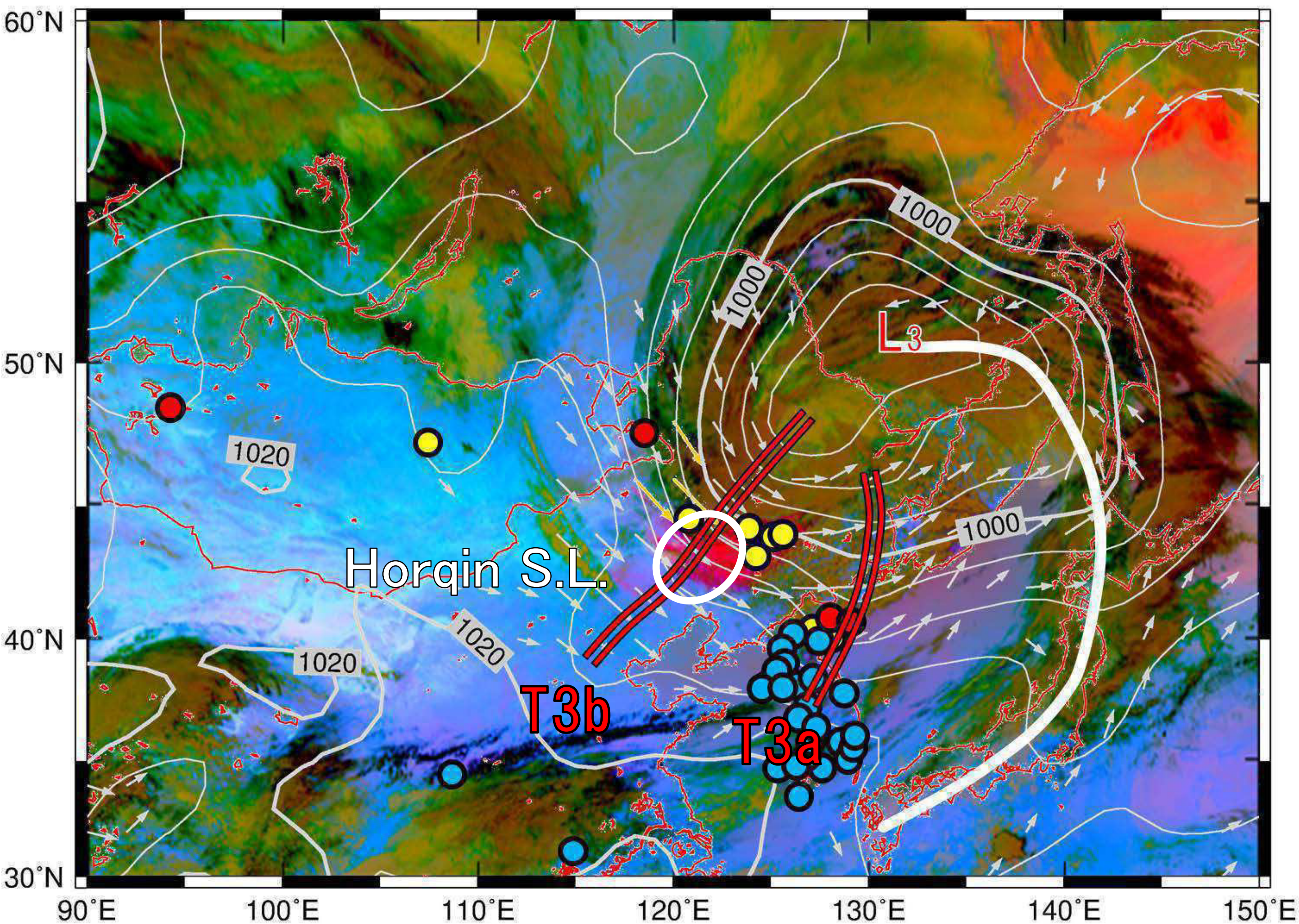
Dust occurrence and transport



Backscattering coefficient at DZ

Dust occurrence and transport

03:00 UTC 06 May 2017 → 10 m/s



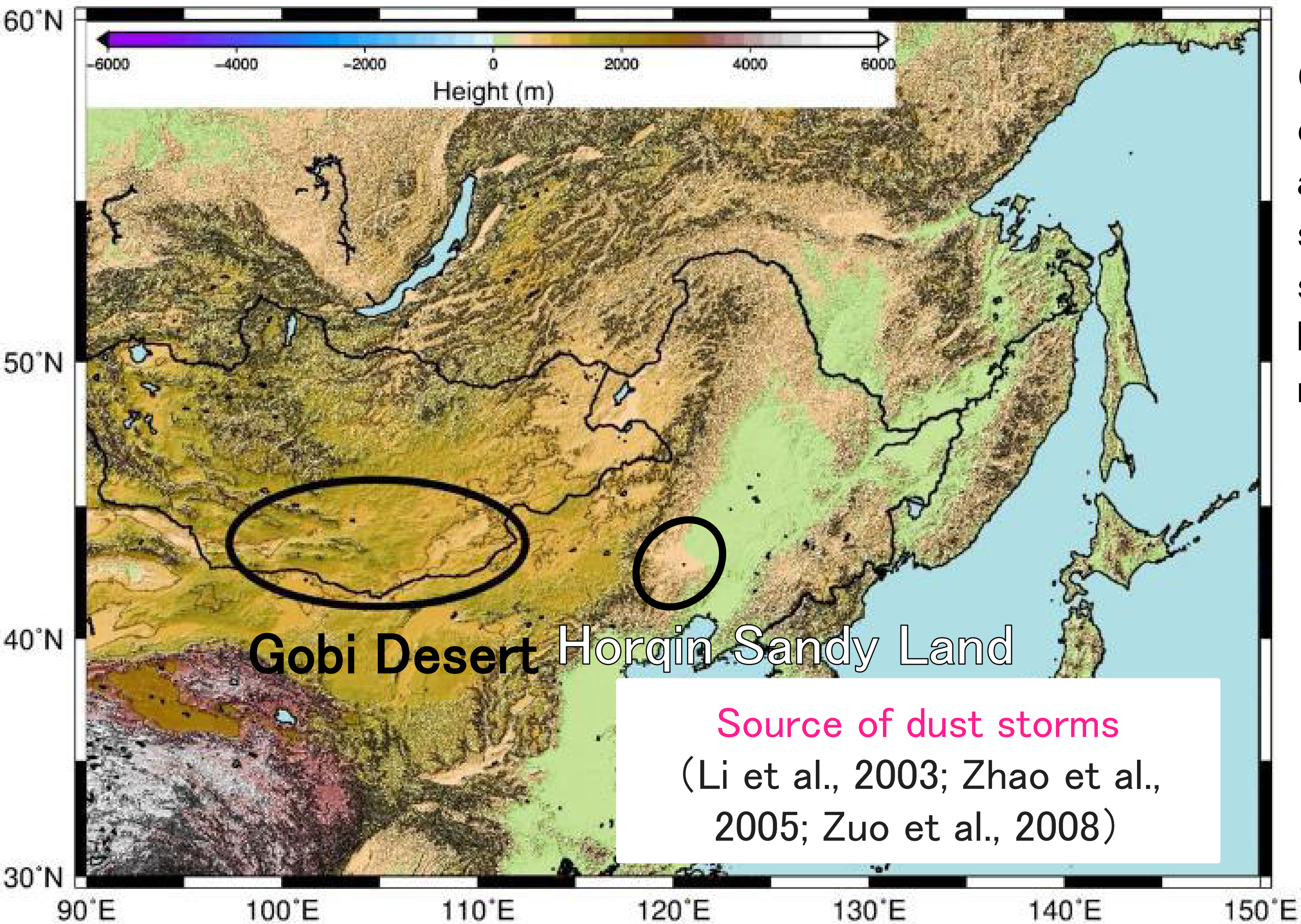
Present weather
- dust storm
- blowing dust
- floating dust

Dust storm by T3b

Pink → dust

Green, yellow, brown, black → cloud

Dust occurrence and transport



Gobi and Taklimakan deserts are well known as the source of dust storms, but the Horqin sandy land has not been internationally recognized.

Summary

- A large-scale dust event occurred in East Asia in early May 2017, and the dust was transported all over Japan. we performed an overall analysis of the whole dust event, based on Dust RGB imagery obtained from Himawari-8, in conjunction with lidar measurements and multiple meteorological data.
- Three extratropical low pressures passed the inland of East Asia consecutively, and dust storms occurred when the low pressures passed across the source regions. The dust generated by the third low pressure system was transported to Japan.
- Remarkably, the RGB imagery shows both the moving traces of the three low pressures and the process of the transporting of dust. Moreover, it detected a dust outbreak in the Horqin Sandy Land and its transport to Japan, showing that the Horqin Sandy Land was one of the source regions of this dust event.

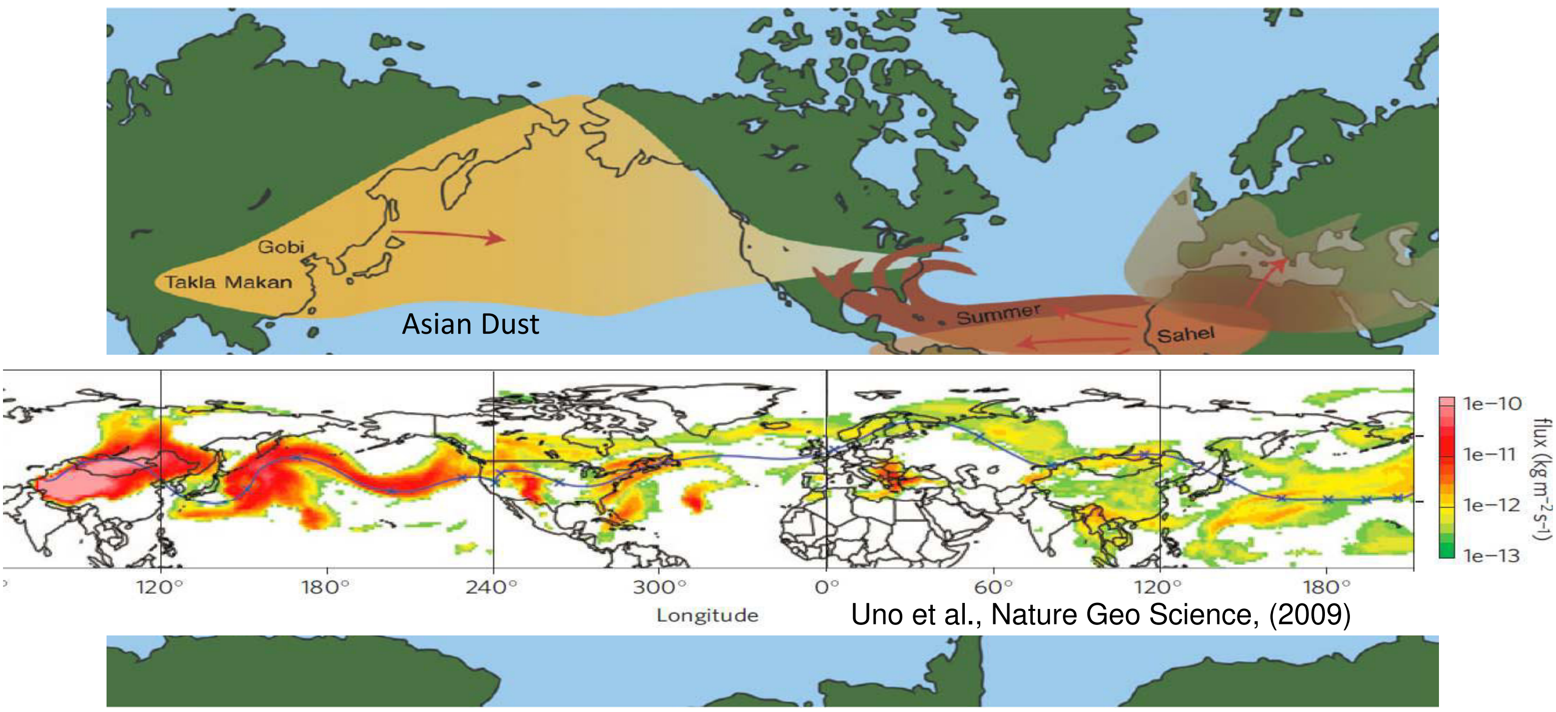
My questions

- Did the Horqin-2018 dust event occur during the cultivation season of spring?
- Do dust events frequently occur in spring in Horqin?
- Is the Horqin dust an anthropogenic dust?

Overview of the Workshop on Asian Dust, Bioaerosols and Environmental Regime

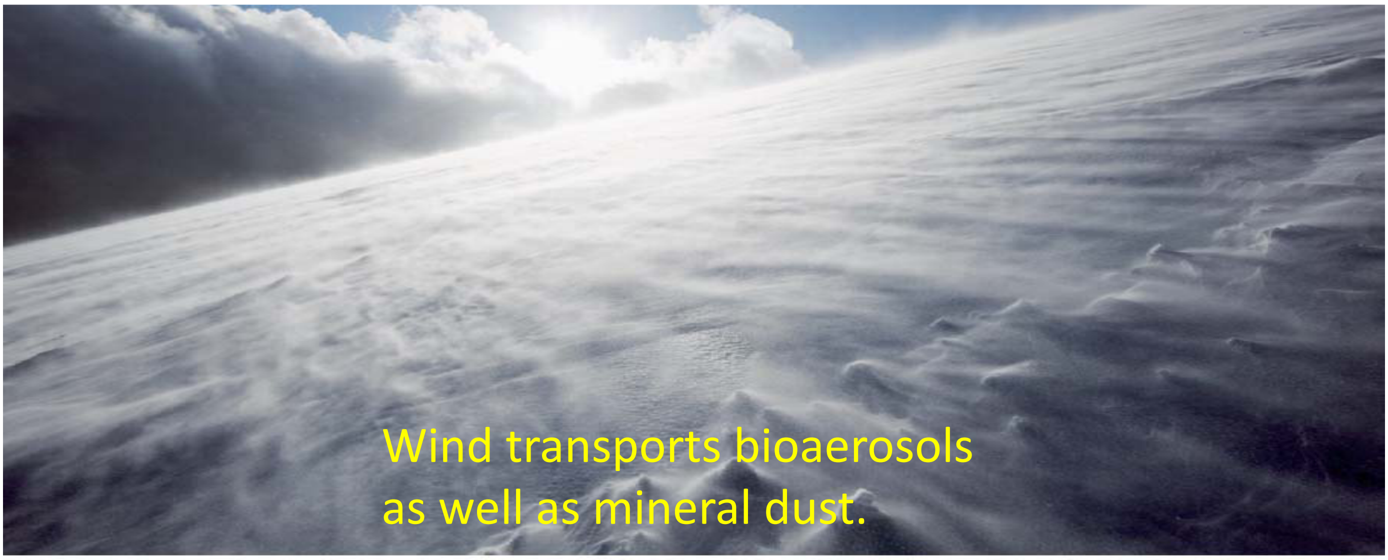
Kenji KAI
Professor of GSES, Nagoya University, Japan
Chair of the Local Organizing Committee

Global dust transport



Uno et al., Nature Geo Science, (2009)

Kellogg and Griffin, Trends in Ecology and Evolution, (2006)



BLOWING IN THE WIND

The mysterious Kawasaki disease might cross the Pacific on air currents high in the atmosphere.

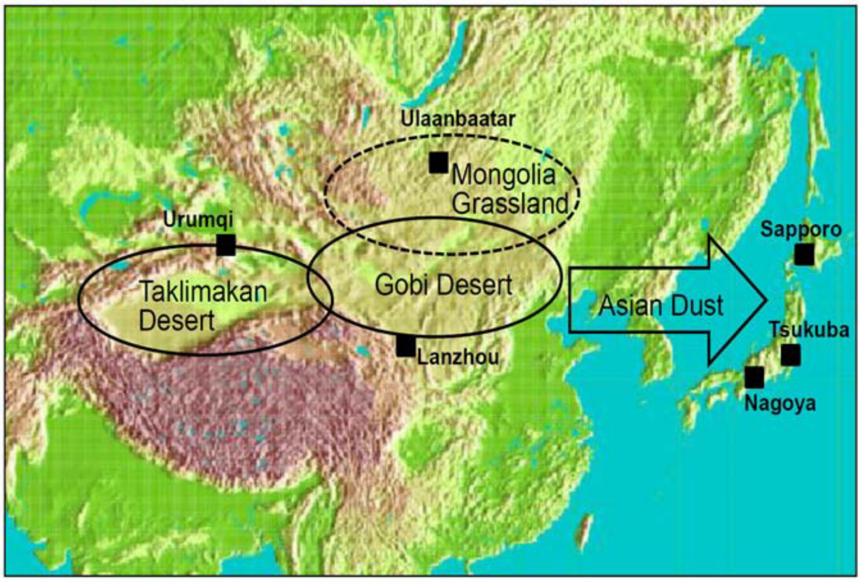
BY JENNIFER FRAZER

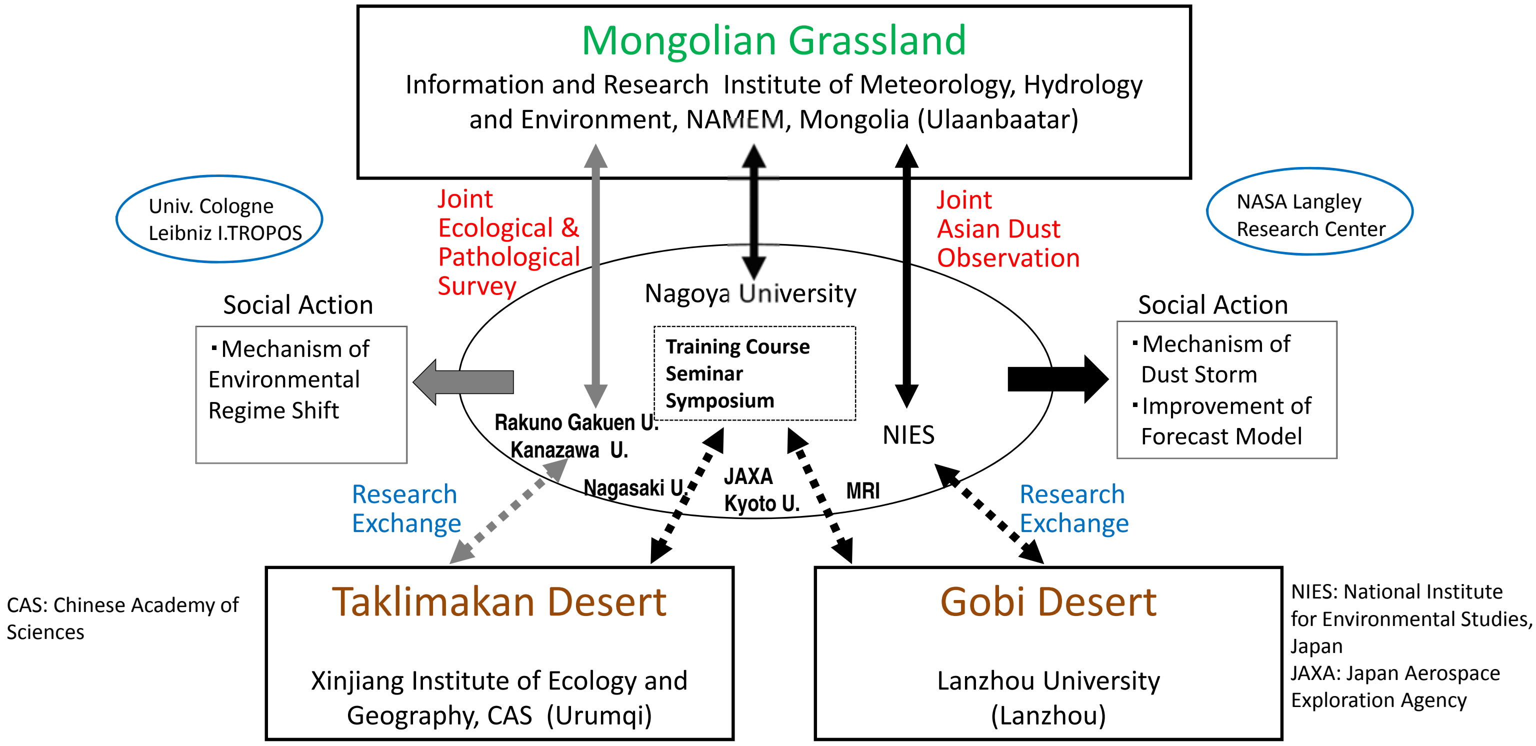
Nature, News Feature, April 2012

Collaborative Research between Mongolia, China and Japan on Outbreaks of Asian Dust and Environmental Regime Shift

JSPS Core-to-Core Program B. Asia-Africa Science Platforms 2014 - 2016

Coordinator: Kenji KAI





Research System of the JSPS Core-to-Core Program

JSPS Seminars

① Nagoya University 2014

② Lanzhou University 2015

③ IRIMHE, Mongolia 2016

Media interview of the Third JSPS Seminar in Ulaanbaatar 2016

TV names (11) interviewed:
D.Jugder, K.Kenji, J.Noda, Kh. Bukhuu and J.Batbayar interviewed in following TVs:
C1 TV, TM, Eagle TV, Star TV, VTV, TV5, TV9, World TV, SBN TV, ETV, UBS TV record

Newspapers (4):
Unuudur sonin (Today newspaper)
Unen sonin (True or right newspaper)
Mongolian Voice newspaper
Ugluunii sonin (Daily Newspaper)

Radio
MONTSAME

Daily News — ӨДРИЙН СОНИН — 2016.08.09 — 7

БАРИМТ, ҮЙЛ ЯВДАЛ

Аврагчид Туул голын дагуу явж иргэдэд сэрэмжлүүлэг хүргэж байна

Шороон шуурга хүн амын эрүүл мэндэд ч нөлөөлөх тохиолдол бий

Logo and tree key words of the JSPS Core-to-Core Program

1 **Sustainability** of Mongolian grassland
2 Asian dust as **bioaerosols** with genetic information
3 **Environmental regime shift**

Asian dust

Regime shift

Gobi Desert

Mongolian grassland

Sustainability of Mongolian grassland

Mongolian grasslands with a rich ecosystem act as a natural barrier to prevent the desertification.

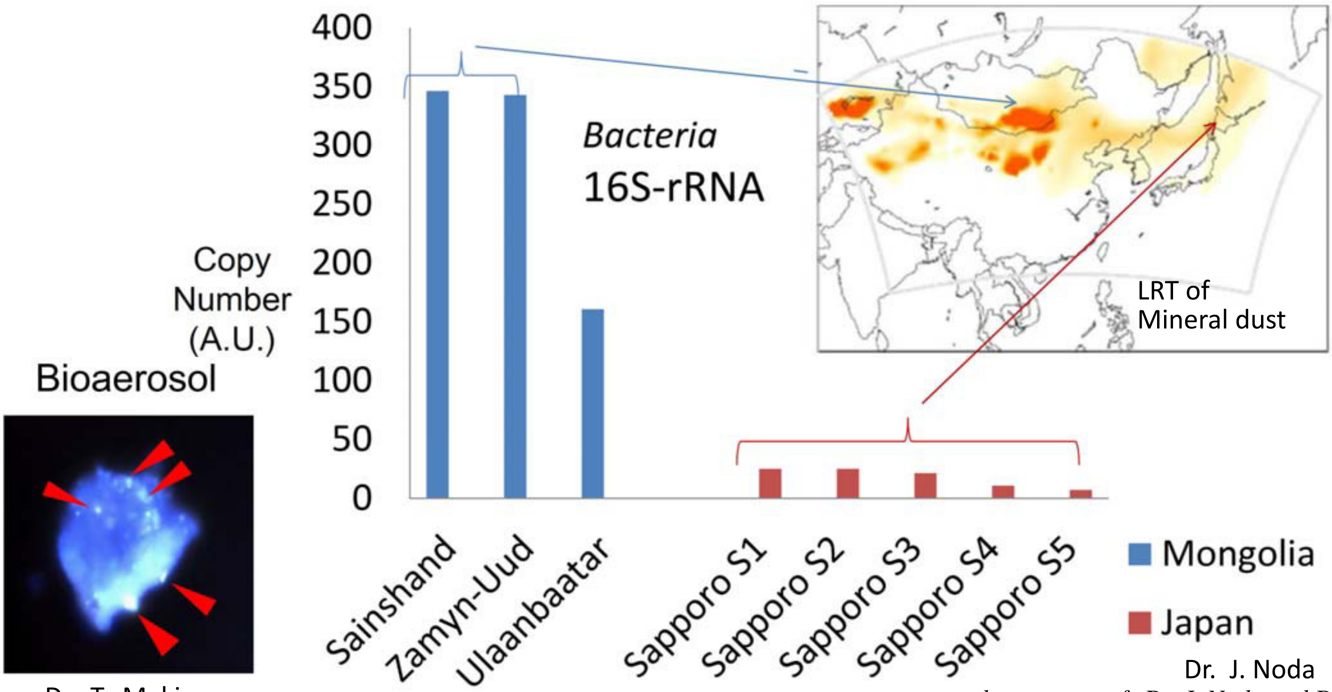
Mongolian wild horses (Takhi; Przewalski's Wild Horse) in the Hustai National Park

Global warming and surface mining in Mongolia

©National Geographic

Surface mining at Oyu Tolgoi, Mongolia © The Wall Street Journal

Asian dust as **bioaerosols** with genetic information
- Long range transport of bioaerosols -

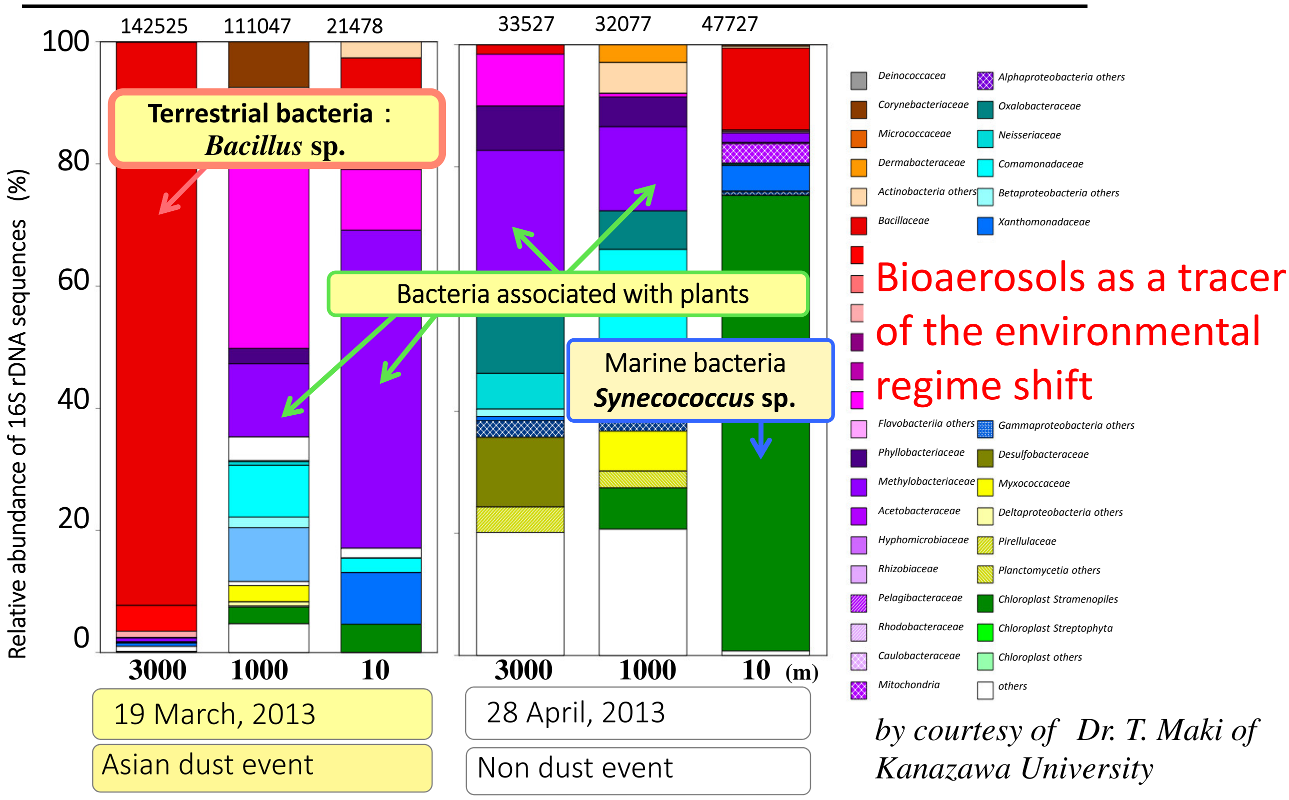


Dr. T. Maki

Dr. J. Noda

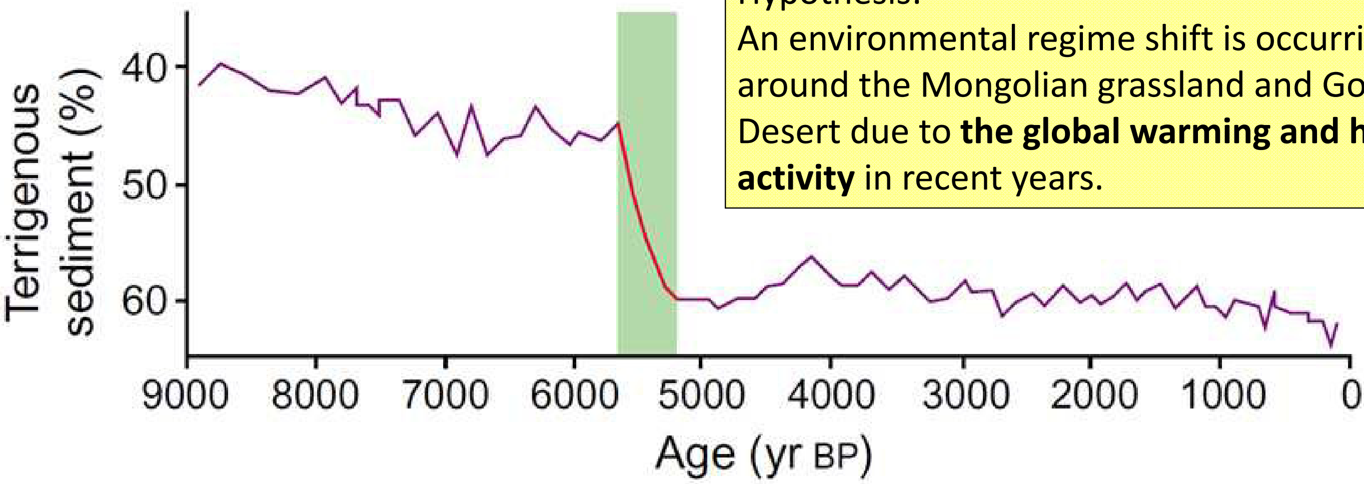
by courtesy of Dr. J. Noda and Dr. T. Maki

Bacterial community structures in bioaerosols < Airborne Observation

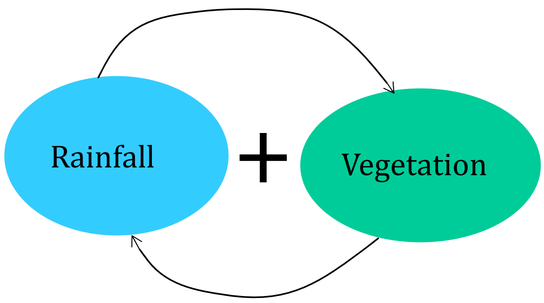


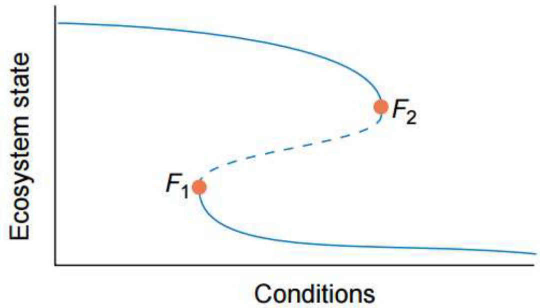
by courtesy of Dr. T. Maki of Kanazawa University

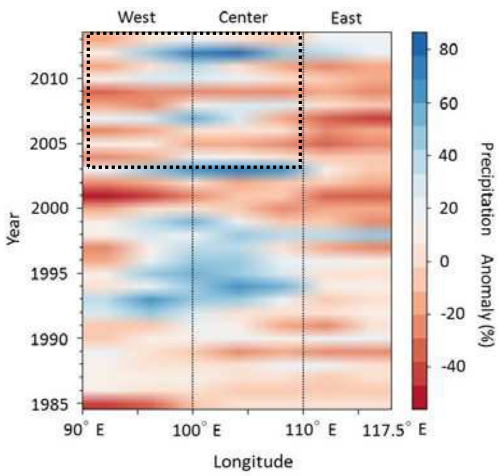
Collapse of Sahara vegetation between 5000 and 6000 years ago (Scheffer *et al.*, 2003)

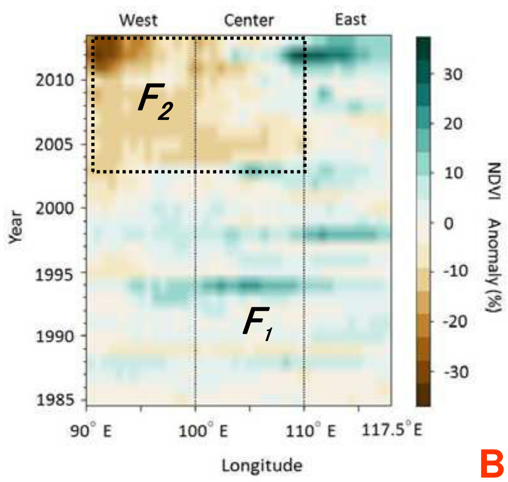


Hypothesis:
An environmental regime shift is occurring around the Mongolian grassland and Gobi Desert due to **the global warming and human activity** in recent years.









B. Hoshino

Setup of a ceilometer at Mandalgobi Observatory on 21 April 2017

Lidar-Ceilometer Network in Mongolia

Yellow point: CHM15k, CL-51; Blue point: AD-Net lidar

JSPS Core-to-Core Program

FY2014 - 2016

In recent years, international environmental problems occur due to the Asian dust, which is potentially affected by different air pollutants and microorganisms, to be transported long distances. A new approach to investigate the Asian dust as bioaerosols is a necessary step to assess health risk and some other environmental problems.

KAKENHI: Grants-in-Aid for Scientific Research (A)

Overseas Academic Research (16H02703)

FY2016 - 2018

A New Approach of Ecological Restoration in Degraded Sandy Land Restoration —using microbial organic compound

Dr. Shaokun Wang

Northwest Institute of Eco-Environment and Resources, Chinese Academy of Sciences

2018-07-08 Ganqika Tongliao

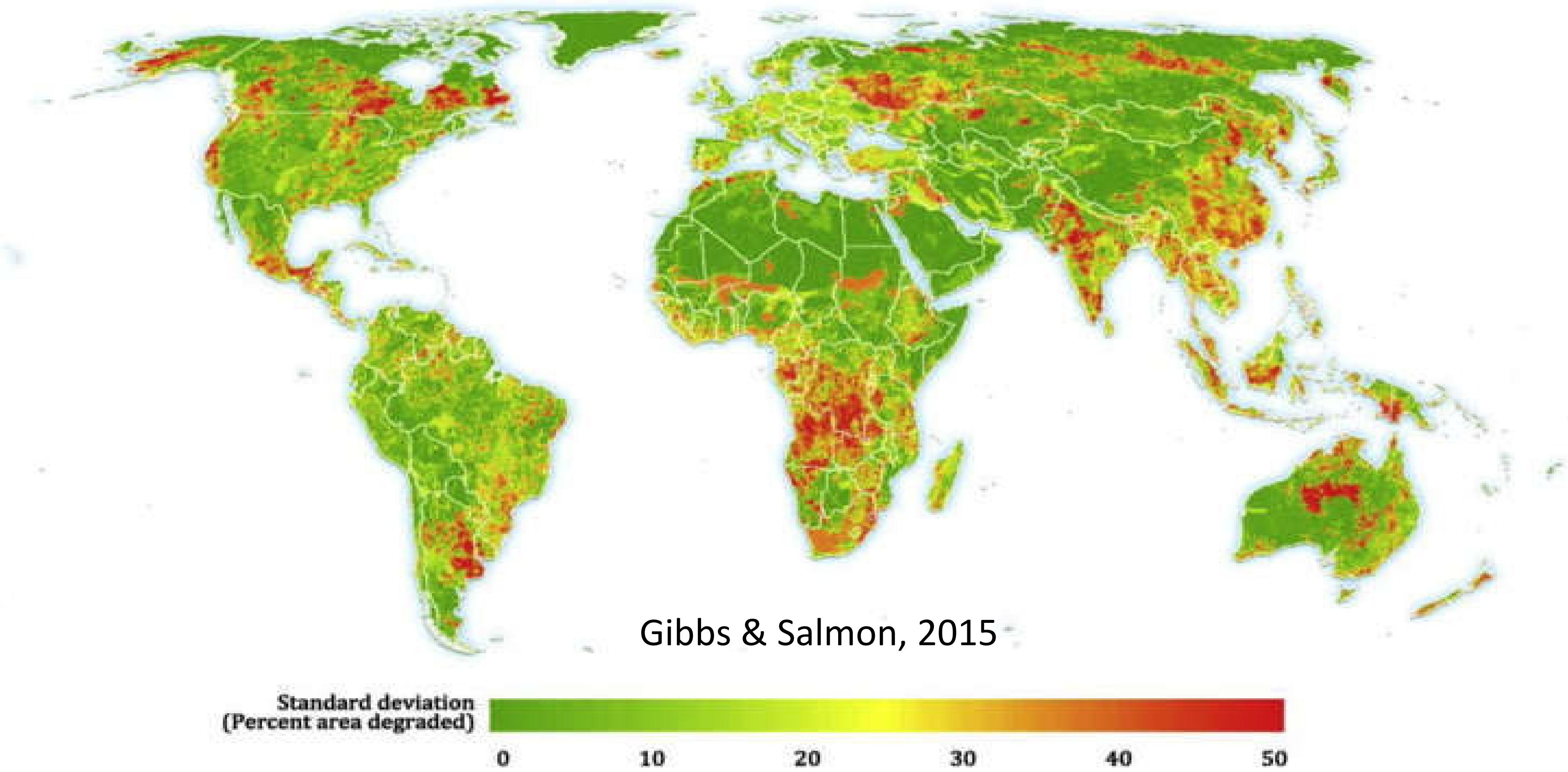
wangsk@lzb.ac.cn

Outline

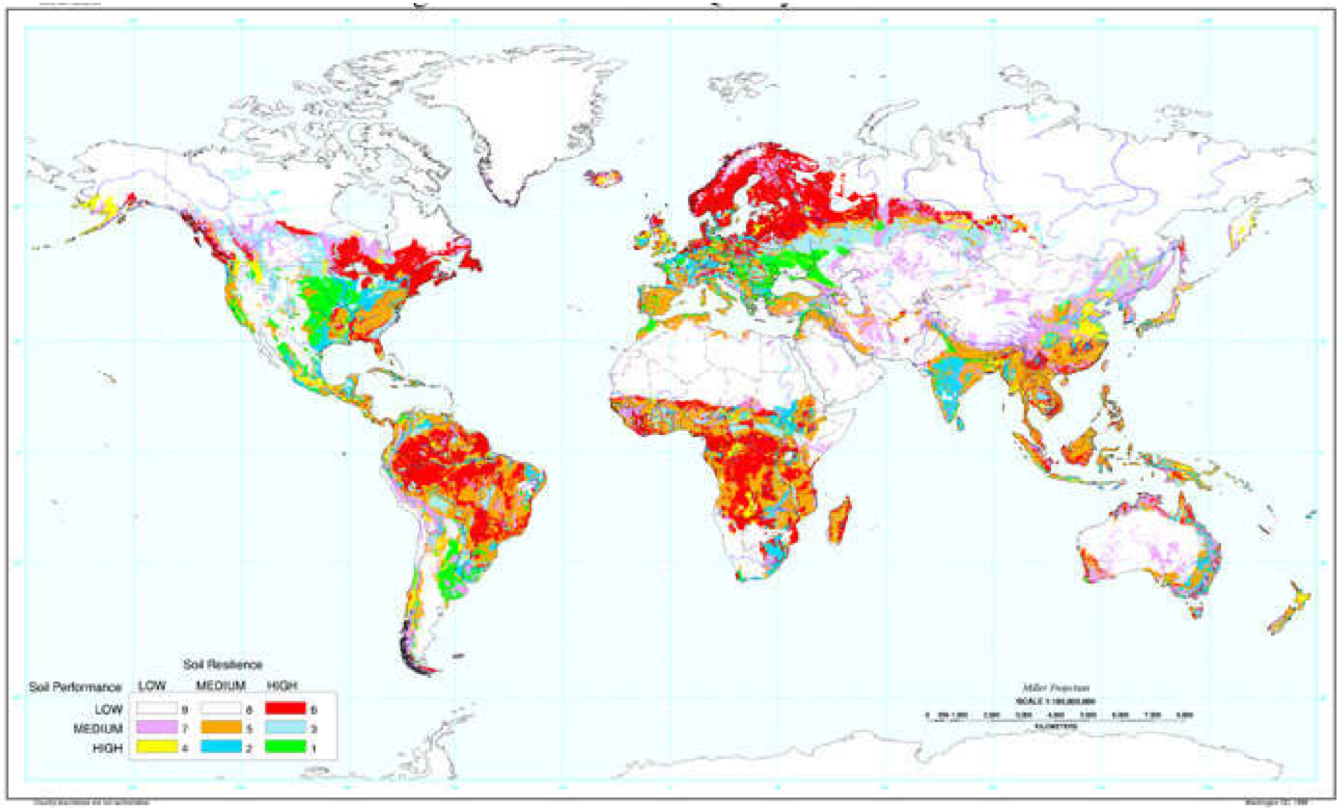
- Background
- Key Issues
- Methods & Demonstration
- Results
- Challenges & Perspectives

1 Background

1.1 World degraded lands

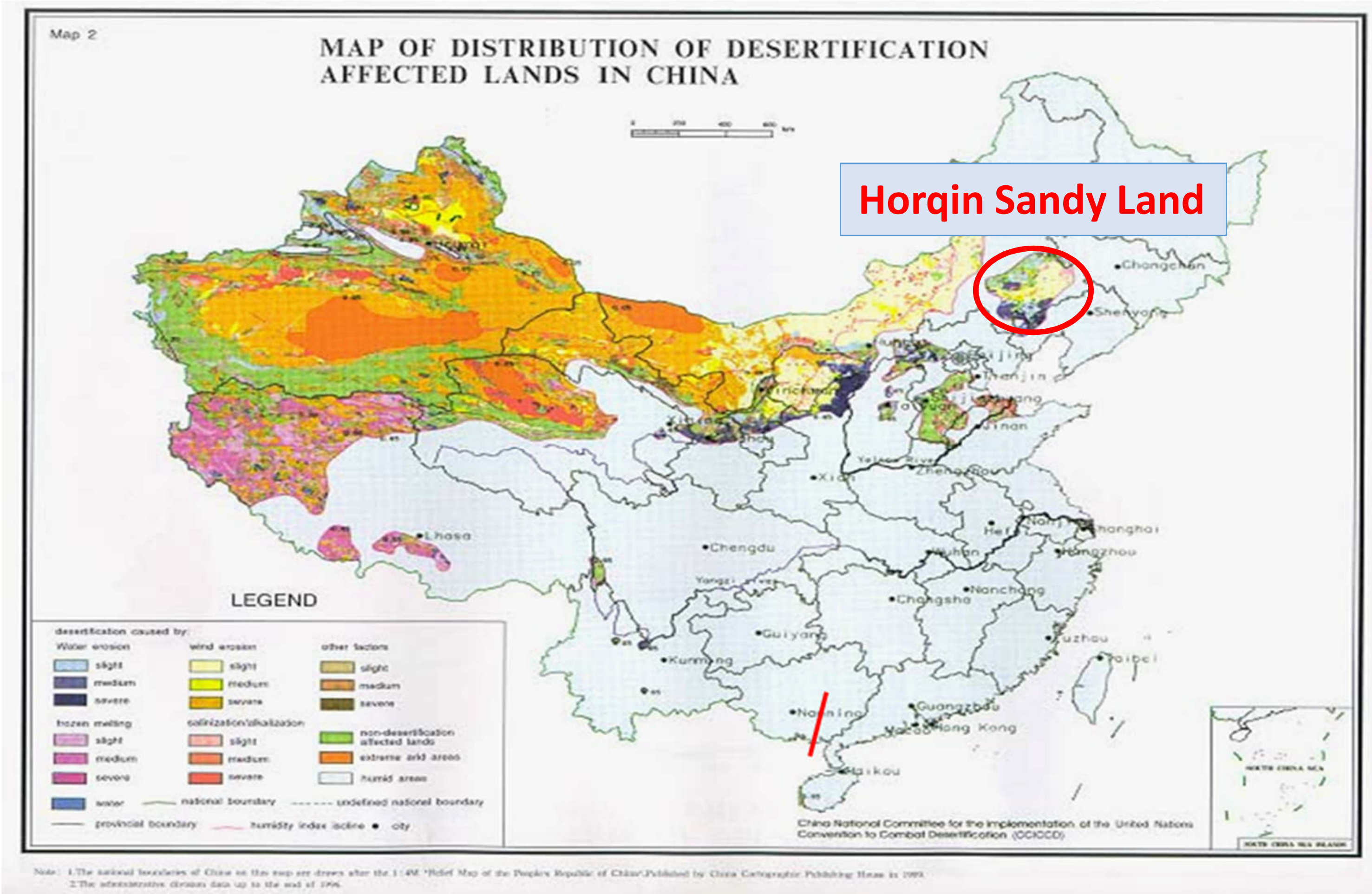


1.2 Global Desertification



- There are about 7.1 million km² of land under low risk of human-induced desertification, 8.6 million km² at moderate risk, 15.6 million km² at high risk, and 12 million km² under very high risk (Eswaran et al., 1999).

1.3 Deserts and Desertification in China

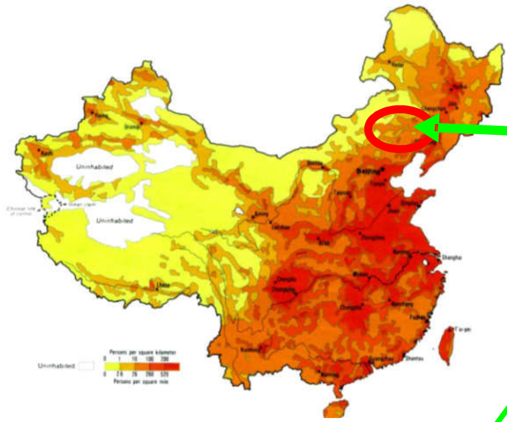


- 1 Desert is 5.8% of the country.
- 2 Degraded land =2.6m km^2
- 3 Desertified Land: 0.67m km^2 and at an increasing rate.

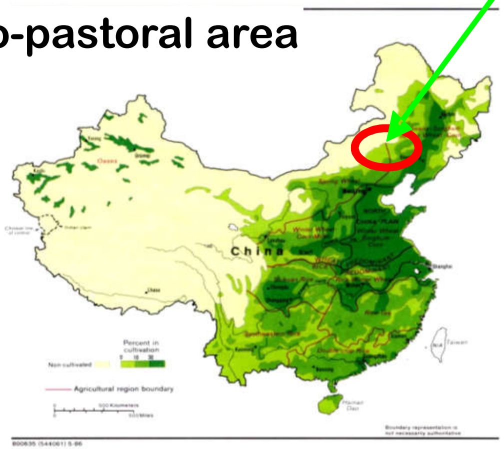
1.4 Characteristics of Horqin Sandy Land

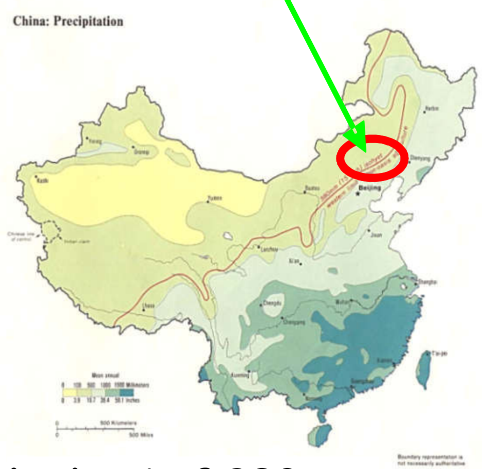
- Multi-transitional area
- Unstable land cover
- Growing pressure
- Potential severe threat
- Fragile ecosystems

Population Density



Agro-pastoral area

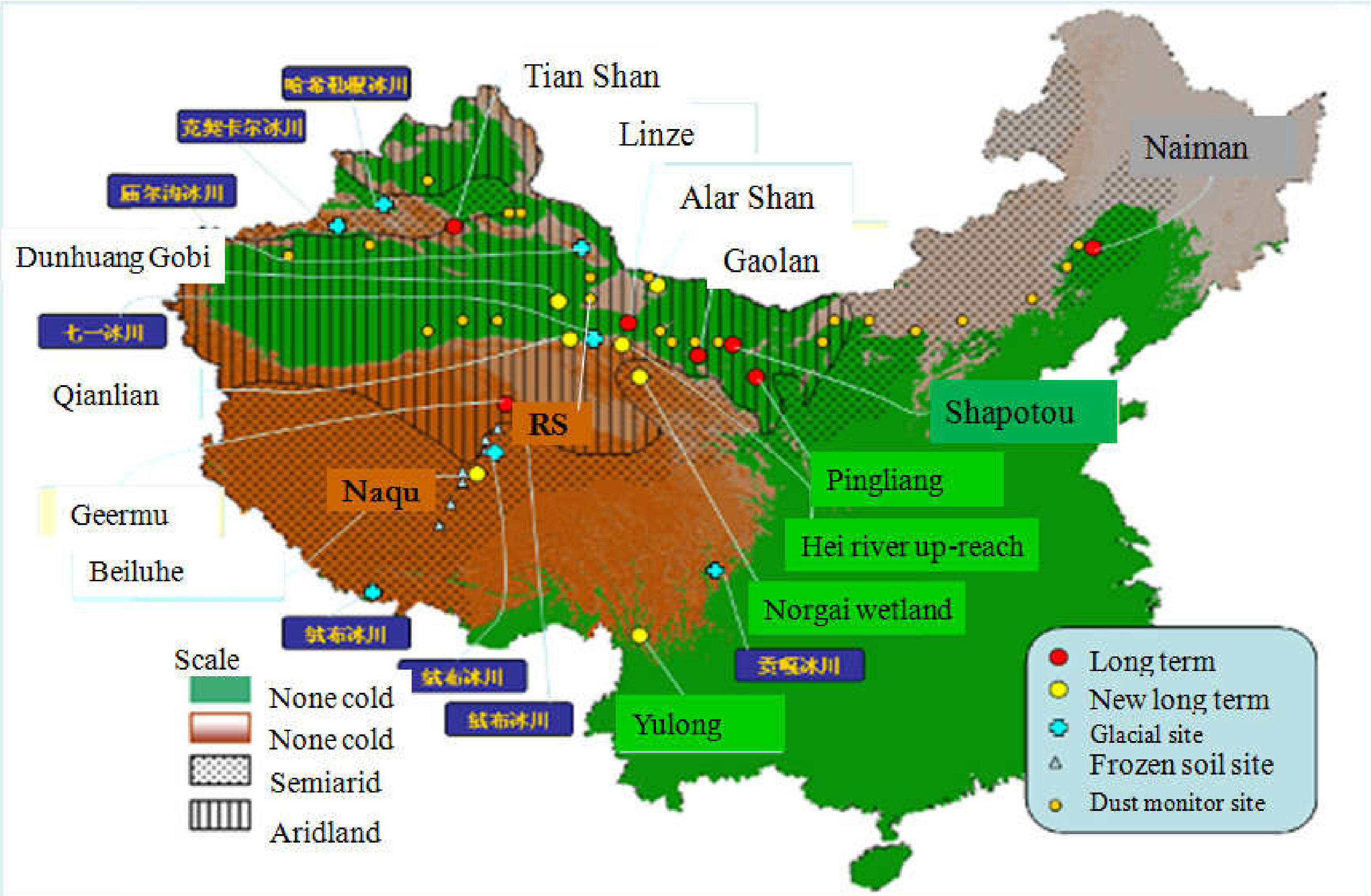




Isohyet of 380mm

Plateau to Plain

1.5 Naiman Desertification Research Station



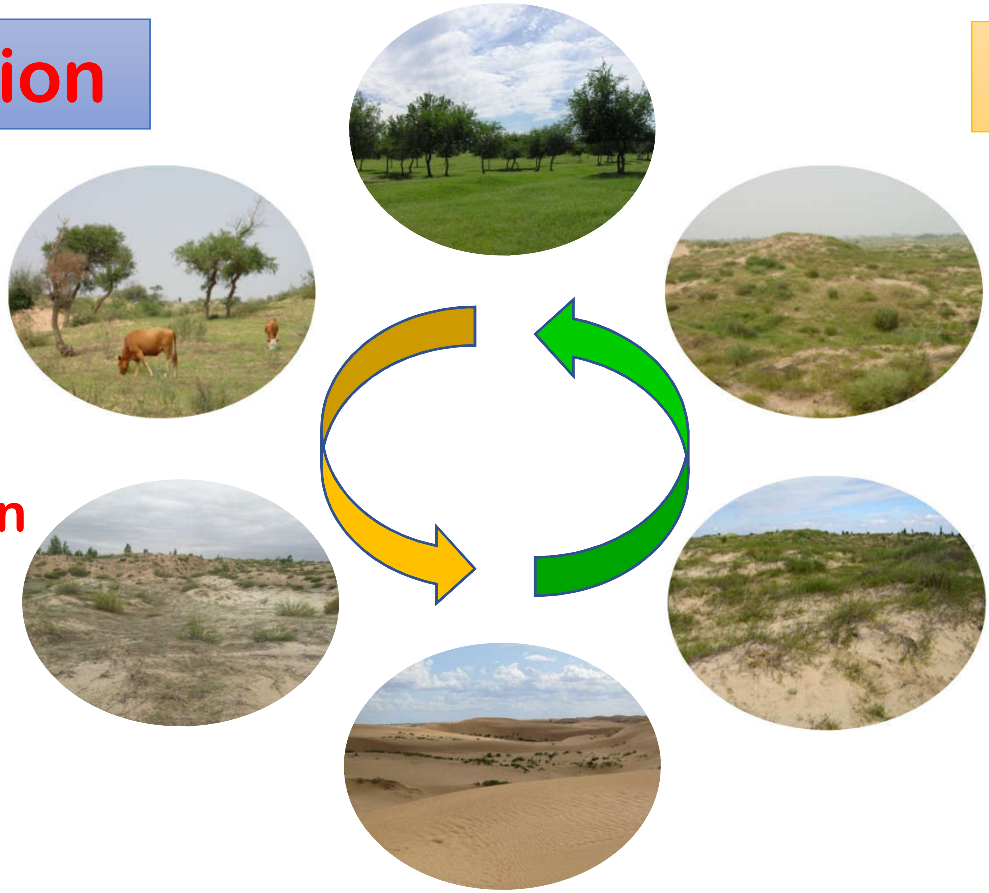
- **Naiman Station was officially founded in 1985, and it is a long-term station that focuses on the research of Land Desertification and Restoration of Agro-Pastoral Transitional Area in NIEER, CAS.**

2 Key Issues

2.1 Issue 1 — Desertification

Degradation

- Climate
- Grazing
- Firewood
- Reclamation



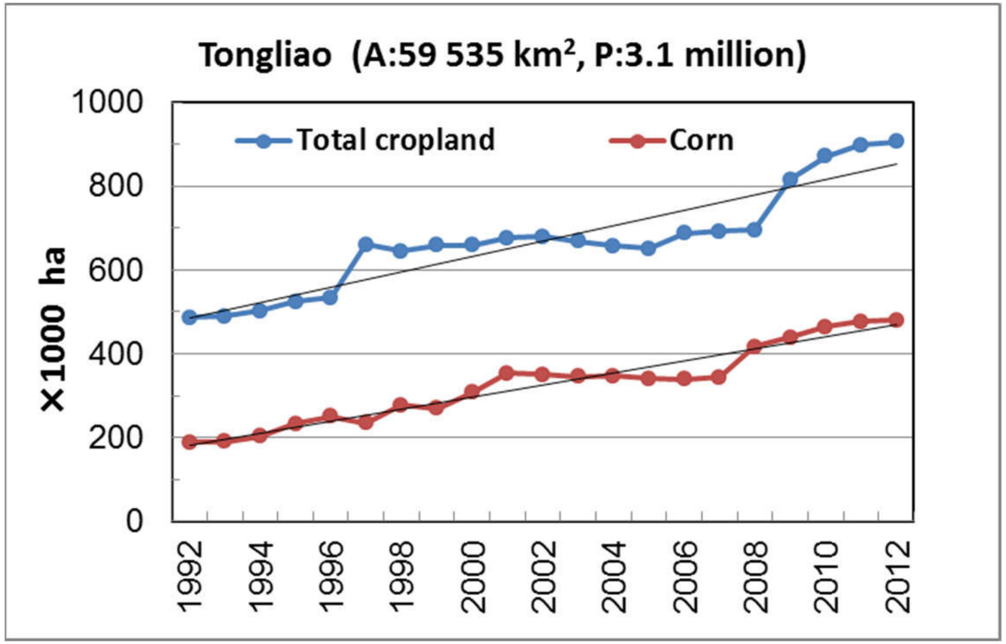
Restoration

- Precipitation
- Fencing
- Seeds resource
- Plant shrub

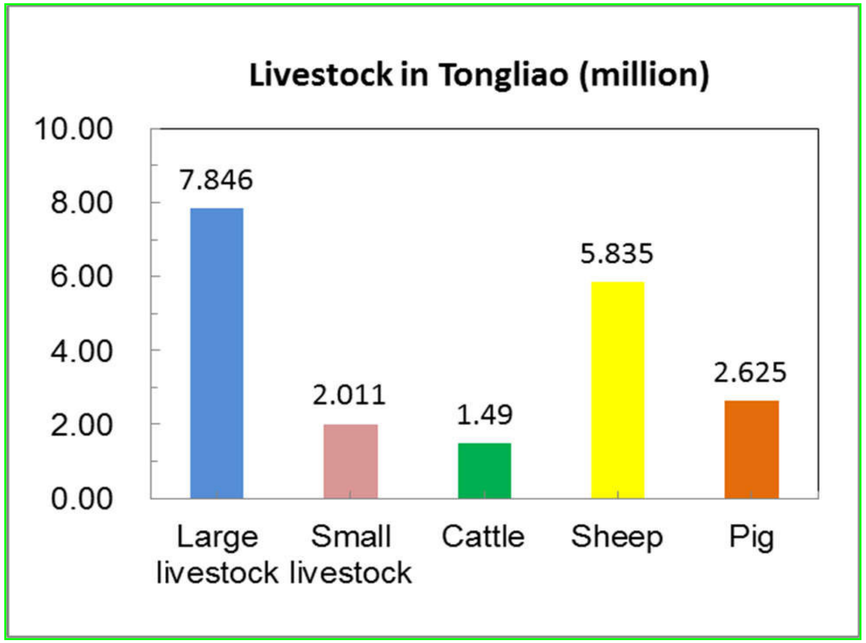
2.1 Issue 2 — Restoration

- Natural and human-aided restoration

2.1 Issue 3 — Agricultural Waste



2.1 Problem 3 — Agricultural Waste



2.2 Questions

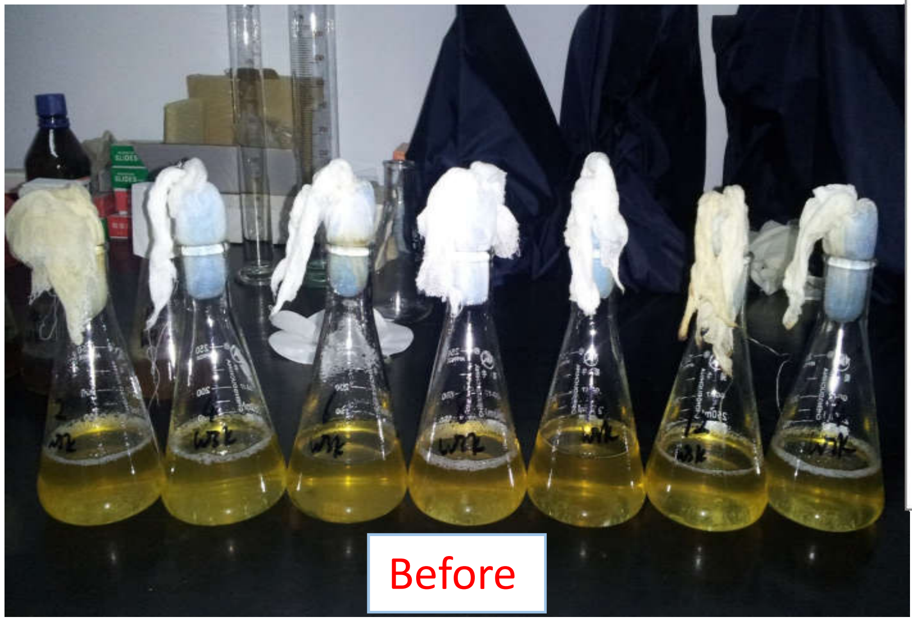
Q1: How to restore the degraded sandy land?

Q2: How to make full use of the “waste”?

Q3: How to be sustainable?

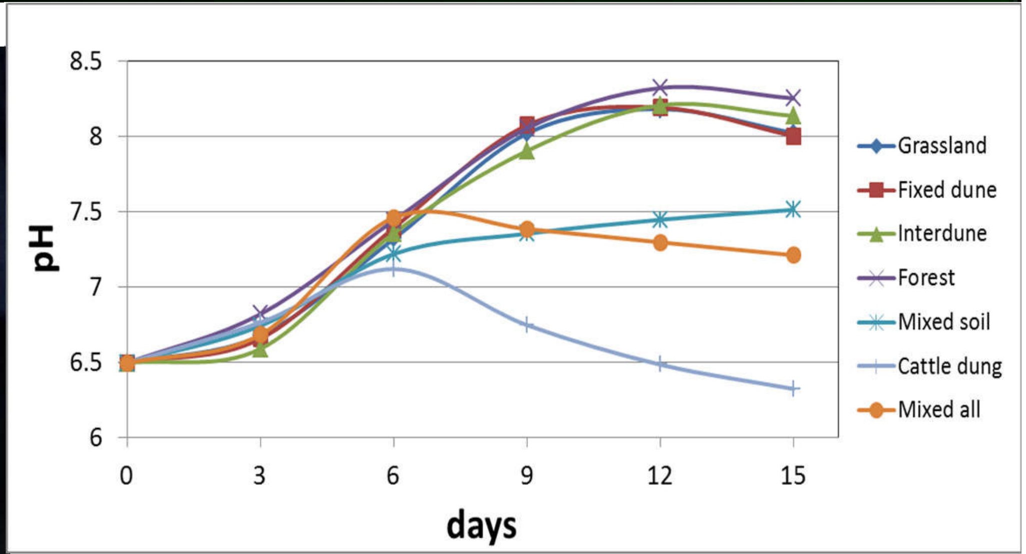
3 Methods & Demonstration

3.1 Cellulose decomposers



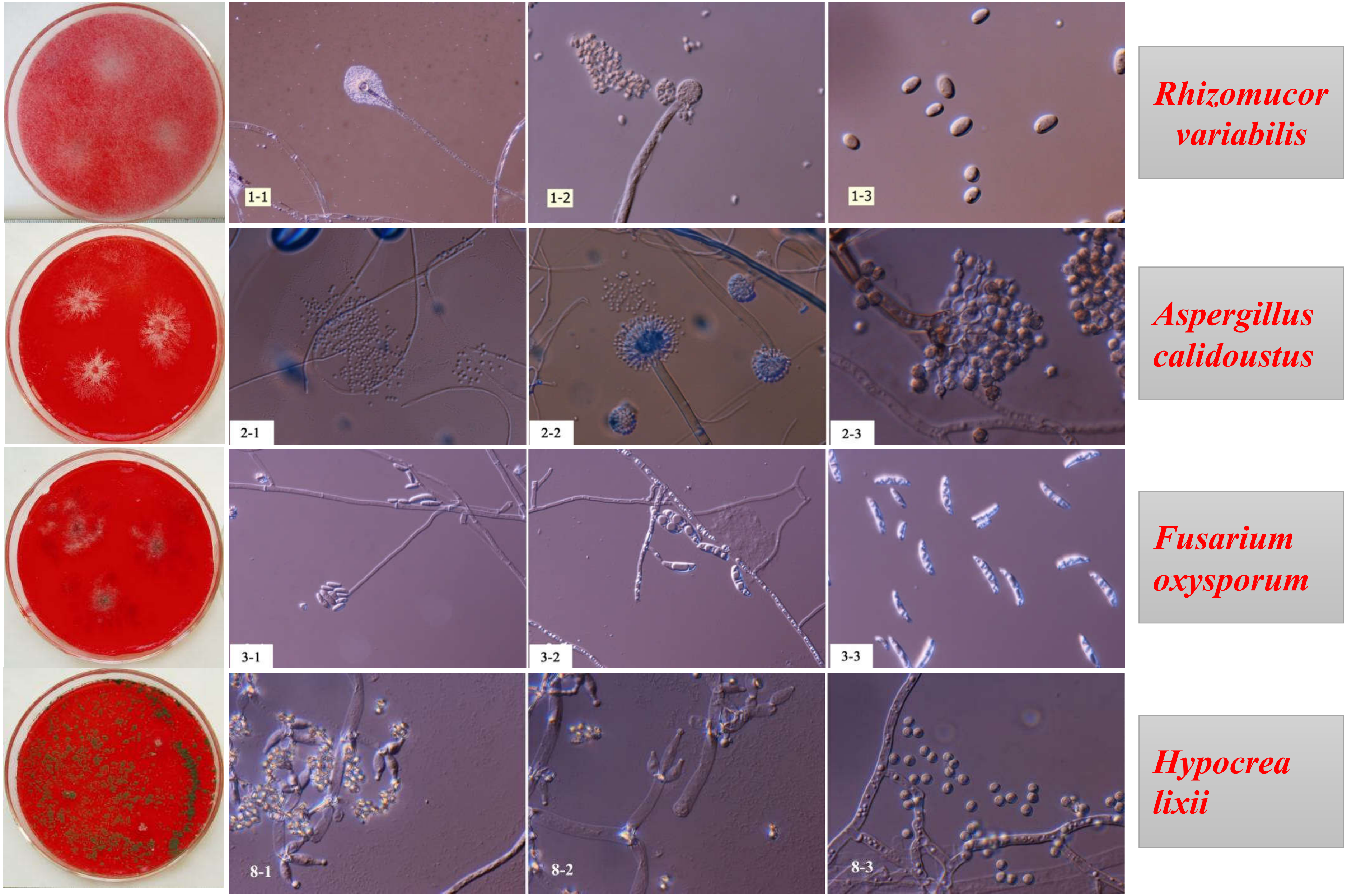
Before

10 days later



	Decomposition rate		
	1st day	3rd day	5th day
Grasslands	9.59	21.81	42.33
Fixed dune	9.47	20.46	41.41
Interdune	9.57	23.81	40.34
Forest	10.43	20.67	40.67
Mixed soil	11.96	23.37	45.71
Cattle dung	13.70	25.70	50.70
Mixed all	14.16	29.74	58.67

3.1 Cellulose decomposers



3.2 Microbial organic compound

3.3 Demonstration 1— Degraded Sandy Land

Small area of blowouts

Large area of mobile dunes

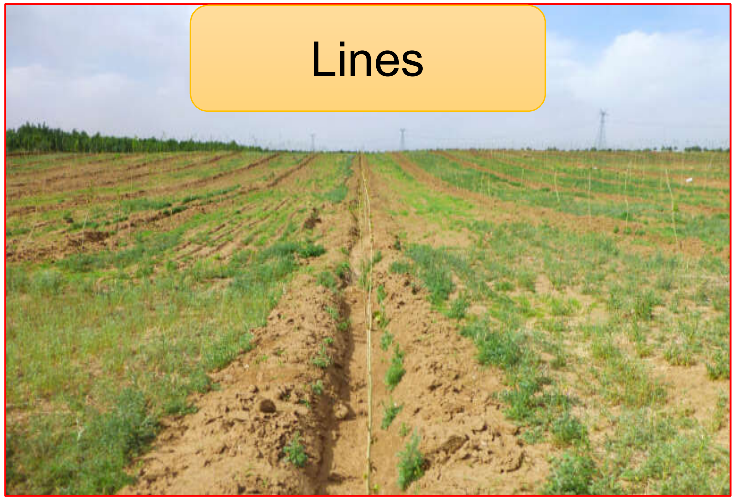
Sowing native plant seeds

Adding MOC

Covered by degradable net

3.3 Demonstration 2— Afforestation Pits

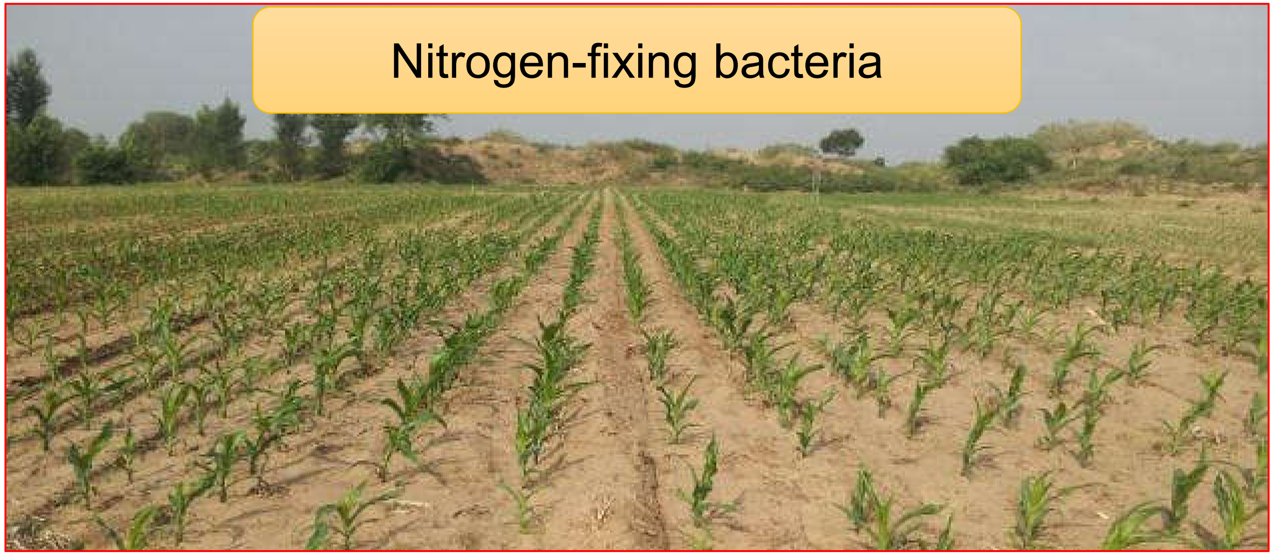
Points



Lines

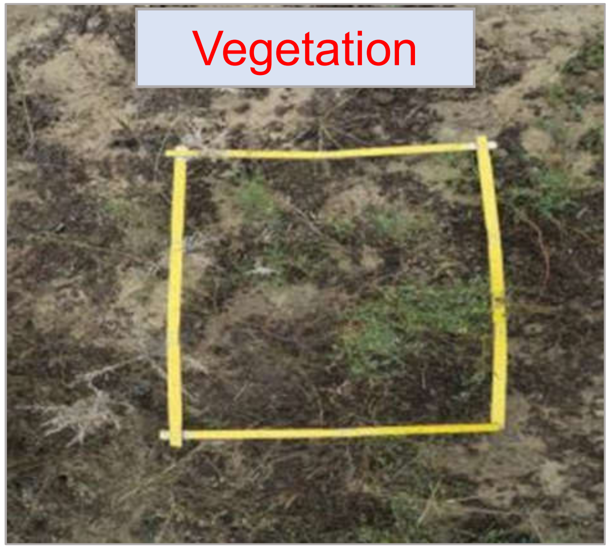
Increase the tree survival rate and decrease the wind erosion

3.3 Demonstration 3— Cropland Restoration



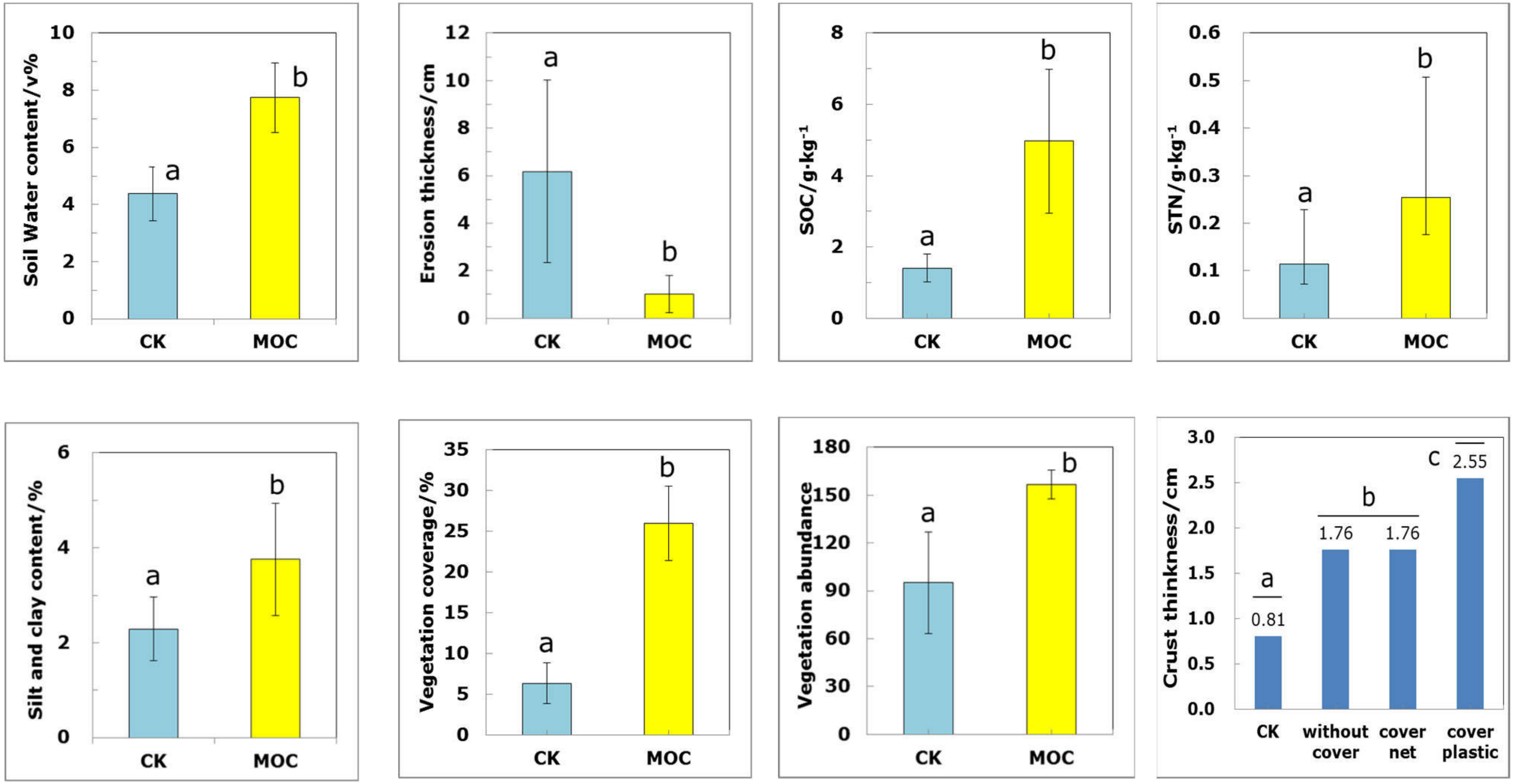
4 Results

4.1. Method and Experimental Design

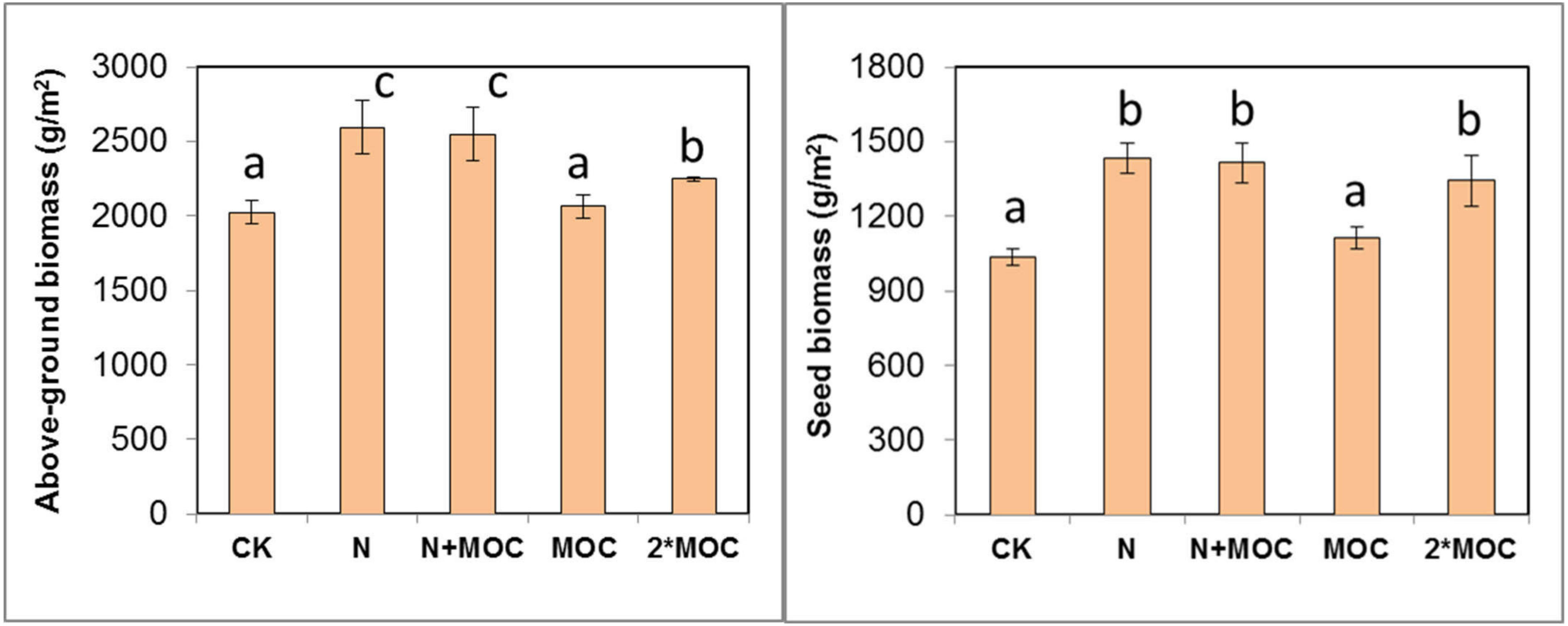


4.2 Visual Restoration

4.3 Results-Grasslands Restoration



4.3 Results- Cropland Restoration



4.4 Conclusions

1. The optimized MOC was significantly efficient in rehabilitating bare sand dunes, accelerating biological soil crust formation, and cropland amendment. The MOC had a potential advantage for increasing water holding capacity, wind erosion resistibility and soil fertility. It is also a potential option to replace the use of chemical fertilizer in cropland.

2. This technique provides an effective and ecological method that aims to accelerate successful restoration from degraded sandy land in the semiarid agro-pastoral transitional area.

5 Challenges and Perspectives


自动化有氧发酵罐
200 L
35–40 ℃
90–100%
45 r/min
40 L
220 V
3 KW

Short term

Small area

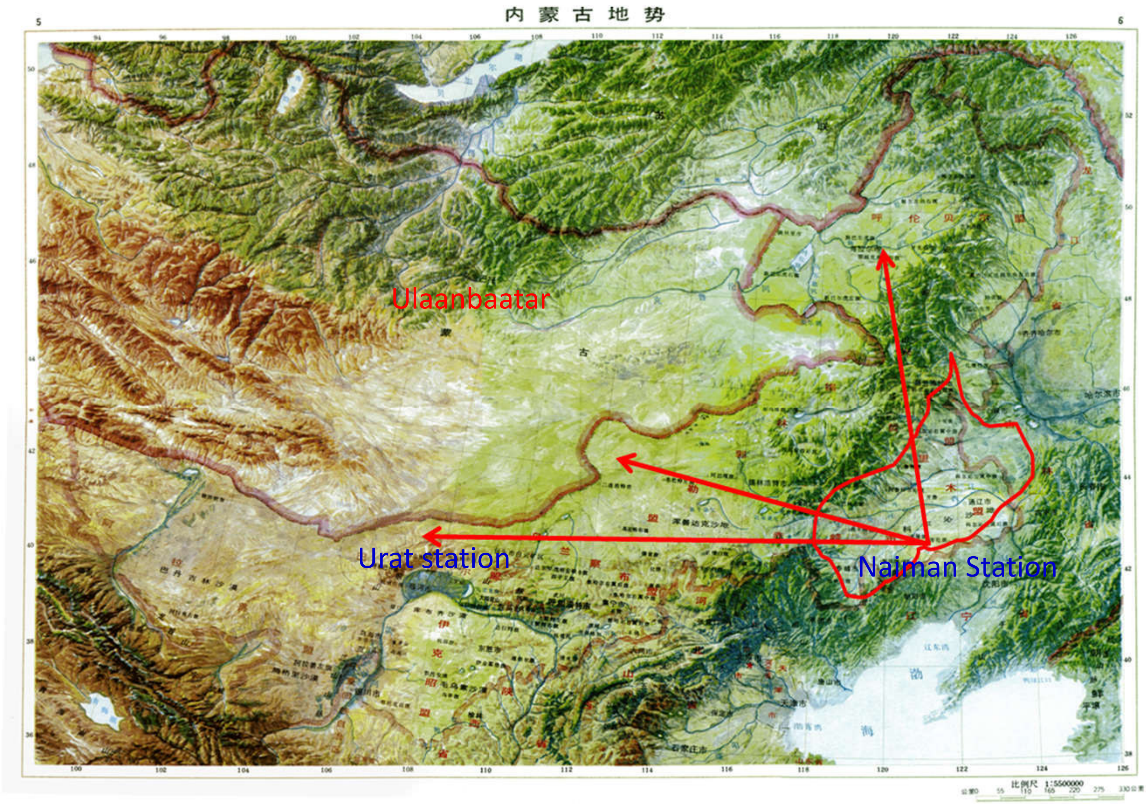
Demonstration

→

Long term

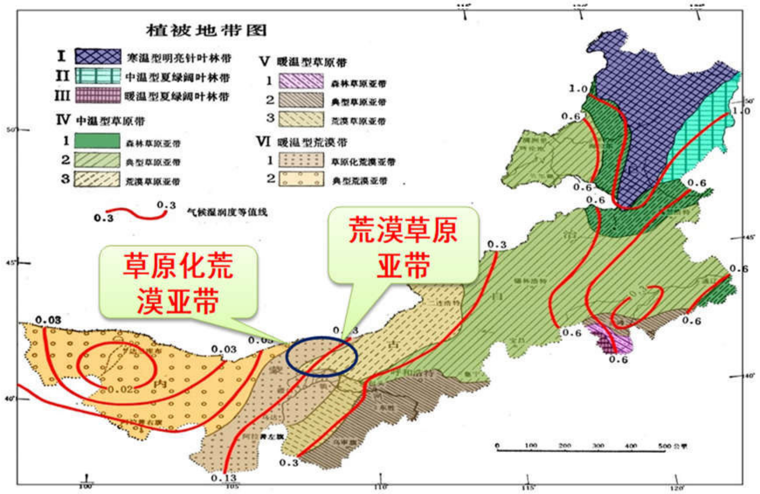
Large area

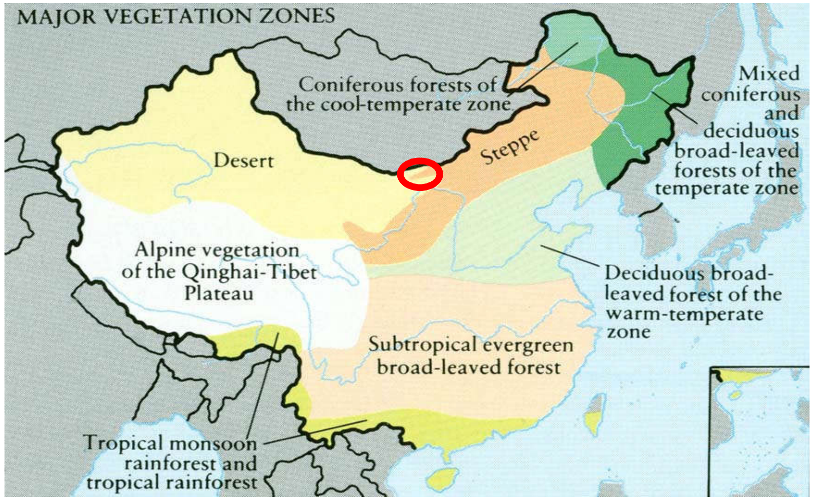
Restoration



Urat Desert-grassland Research Station

- **Ecosystem structure, function and process and their relationship in desert-grassland ecosystem.**
- **Responses and adaptions of desert-grassland ecosystem to extreme climate events.**





Acknowledgements

Research team

Naiman Desertification Research Station
Urat Desert-grassland Research Station

NDRS

国家自然科学基金委员会
National Natural Science Foundation of China

中国科学院
CHINESE ACADEMY OF SCIENCES

国家科技重大专项
National Science and Technology Major Project


Thank you!
Urat Desert-grassland

Introduction of greening activity in Horqin sandy land northeastern China

Green-network

Purpose of the activity

● Restoration of vegetation

- Restoration of vegetation has been destroyed by human activities. Especially economic activity.

● Support local people

- Support to encourage self-help efforts of people living on desertified land
- NPO 's strength is close to the residents.

● Active involvement of citizens

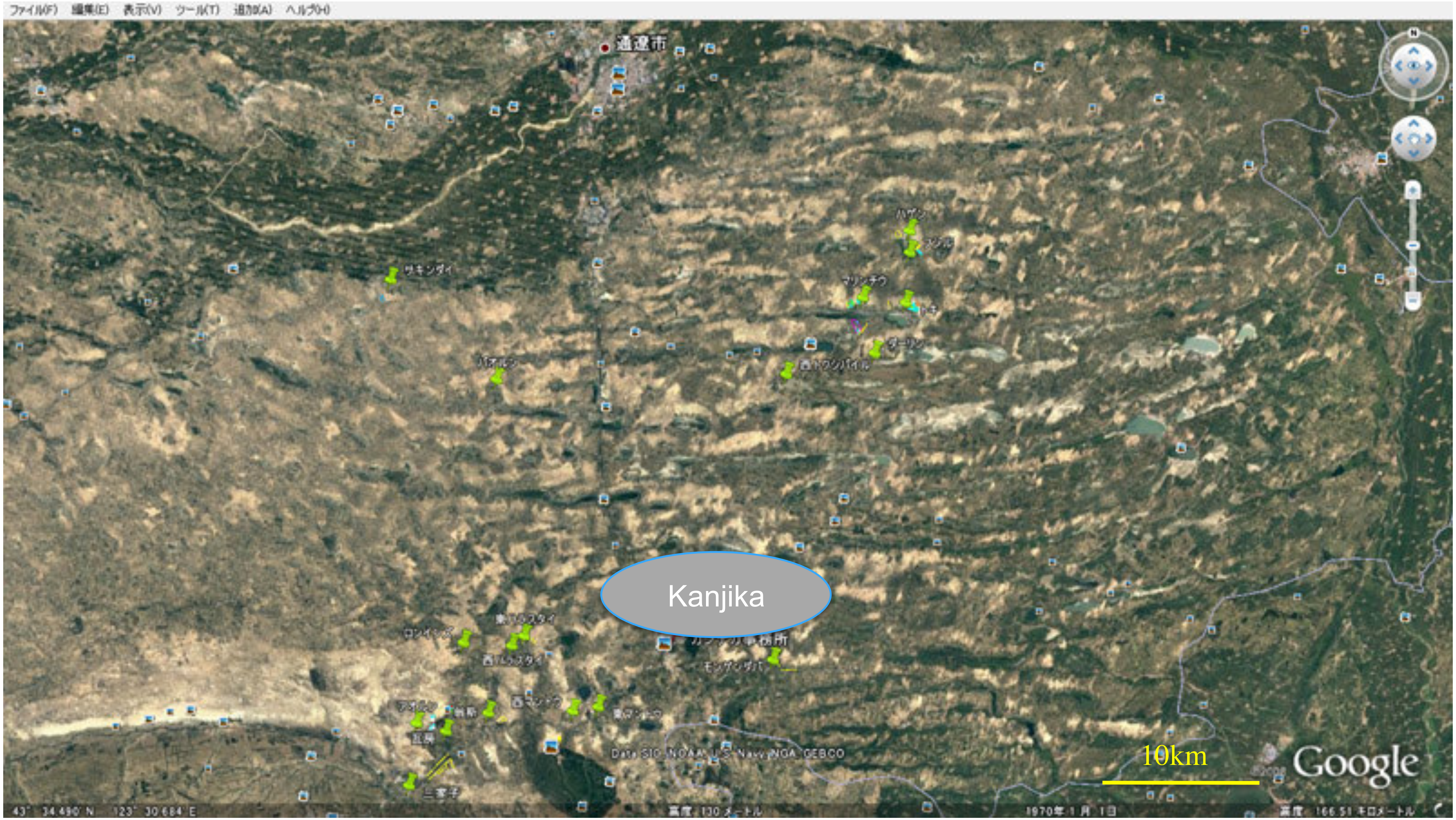
- Not only NGOs but also general citizens participate in activities

Achievement of activity

- Established in January 2000 (19th year of production)
- Active place：In the south of Tongliao city within a radius of 50 km (21 places in total)
- Area that succeeded in greening：Approximately 2,549 ha (= 531 Tokyo Dome)
- Number of trees planted：Approximately 6.42 million
- Survival rate：64.1%
- Major tree species
- （A tall tree）Poplar、Red pine、Willow

  （Shrub）Maple、Mountain apricots、Caragana(Sowing also is done)、Seaberry、Sophora,etc.
- Volunteer tour (cumulative total of 4,400 participants)
- Satoyama preservation and forest improvement project in Japan
- Prevention of desertification and greening activities in Mongolia

21 area in south of Horqin




Target area before planting


The same point one year later


The same point 10years later


The same point 15 years later

Planting poplar by volunteers


After 10 years


Pain tree with young Zhang


After 4 years


10 years Zhang became sturdy


13 years

Participation by local residents

●Local residents as beneficiaries

- Improvement of living area's environment
- Increase in income (improvement of agriculture and livestock industry, harvest of forest products, expansion of employment opportunities etc.)
- Improve awareness about greening and acquire skills

●Local residents as labor force

- Labor for their own land
- Creation of long-term labor opportunities

●Final goal→Voluntary and autonomous efforts of local residents

- The process of accomplishment through repeated experiences with residents is important.
- Requirements for voluntary efforts→Accumulation of experience, economic margin

<u>Greening activity＝Improvement of environment for independence</u>


A distrusting looking expression

5 years, drinking friends

Issues and prospects

●Exploring sustainable effective utilization of greening land

- Understand the productivity of land for sustainable use. Establishment of that method and dissemination to residents.
- Improve profitability as forest land

●Stable operation of organization＝Securing supporters

- Increase participants and donations from China
- Expanding understanding of activities

Workshop participants

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5	Batmunkh.S	Herder from Khovd	
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Workshop participants

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14	B.Gantuya	institute of General and experimental Biology, MAS, Mongolia	
15	Sergelen	Green Network, NPO, China	
16	Zhang ai wei	Green Network, NPO, China	
17	Tana	Green Network, NPO, China	
18	Baatare	Forest agency, local government, Horsing	
19	Uils	Forest agency, local government, Horsing	

WORKSHOP SUMMARY

- This event, entitled "**1ST discussion workshop on ecological vulnerability assessment**" was hold in Gatsaa town of Tongliao city, inner Mongolia, China from 5-8 July 2018 to exchange a knowledge, research output, and practical experiences between scientists, herders, farmers, representing leadership, policy makers and Replanting practitioners collaborated on this project.

WORKSHOP SUMMARY

- The first day we were visited to the different management (individuals, local government and community groups) of replanting areas managed by Green Network NGO, Japan.
- It was great job for all staffs, local managers, supporting government, local communities, volunteers and scientists to replanting large area of sandy desert.
- The participants learned a lot for management, local communities collaboration, their livelihood support, protection of environment and contribution of local sustainability and reduction of both ecological and socio-economic vulnerabilities.

Results of 17 years planting work

WORKSHOP SUMMARY

- The field visit of local herders and farmers was especial event for Mongolian herders from Gobi desert area. They could learned a replanting process, method, management, and livelihood support.

Forest support for local communities livelihood and farmers daily life support

Hay planting and preparation for animals forage.

Vegetables for farmers and herders daily food supply



WORKSHOP SUMMARY

- The second day we hold a workshop, however due to security problem in China we could not officially made a presentations by program. We did it in the one room with foreign speakers where all Chinese speakers could not joined. However, we were distributed all presentations to the all participants.
- As seen from presenters most of them presented a methodology development, assessment results at the case areas, and future algorithm development.

ACKNOWLEDGEMENT

- I would like to express my sincere gratitude to all participants, local staffs, presenters, experts, professors, local managers and guests for providing their invaluable guidance, experiences, knowledge and supports throughout the workshop and field visit.
- Also I would like to to thank Mr. Yoshio Kitaura from Green Network NGG for his assistance to organize the event in the local area and exchange of adaptation experiences sharing.
- Finally, we were appreciated for the Asian Pacific Network for Global Change Research (APN) to support this work (CRRP2017-04MY-Balt).