Study Visit on Reducing Desertification and the Risk and Negative Impacts of Sand and Dust Storms

DESERTIFICATION CONTROL AND SAND-DUST STORM PREVENTION IN MONGOLIA

For this presentation have been used slides prepared by Dr. Bat-Oyun Ts., Dr. Mandakh N. and Dr. Khaulanbek A.

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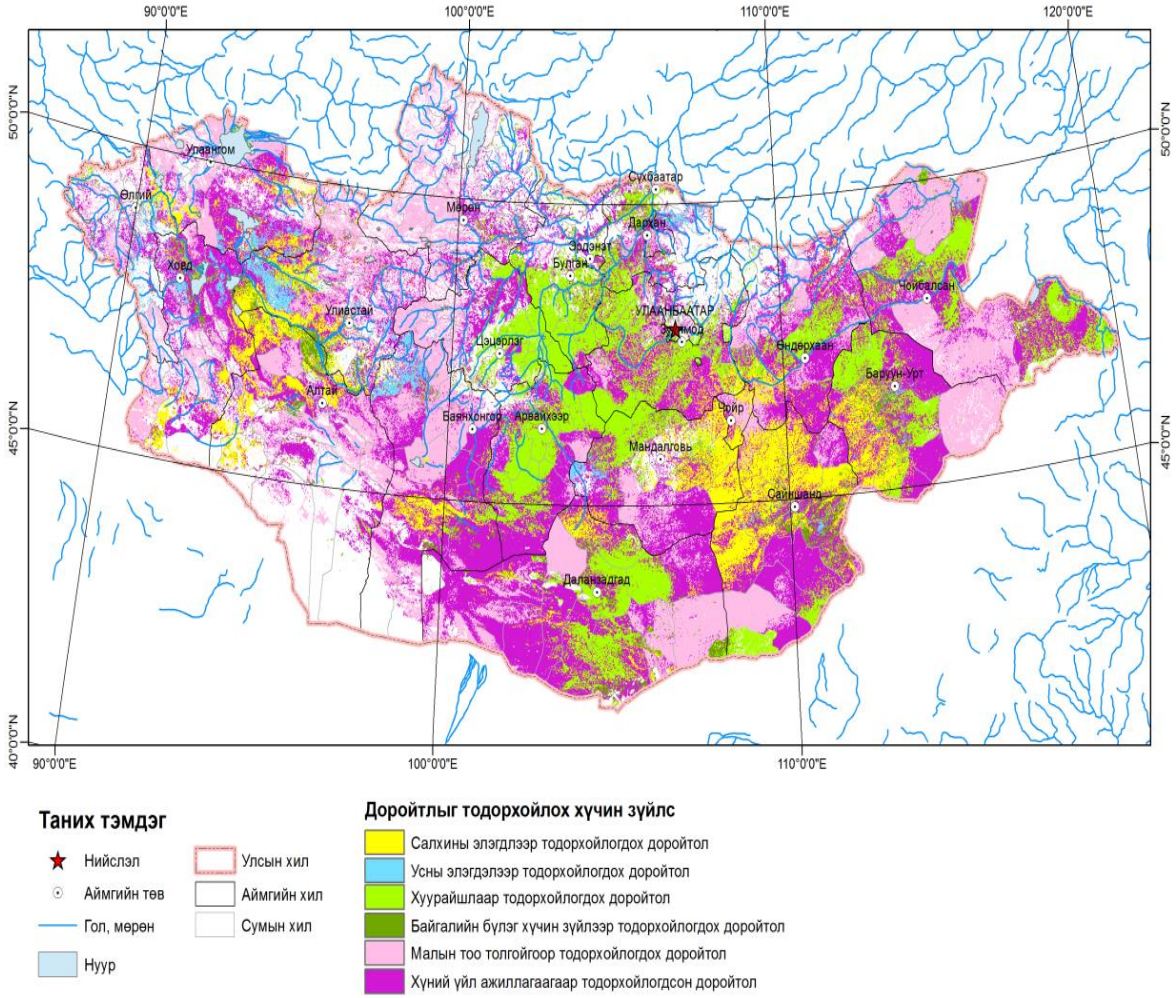
Current state of desertification in Mongolia

- The main factors of desertification are:
  - Drought and increased aridity
  - Wind erosion
  - Increase of livestock density in a certain places
  - Increased centralization
- As of spatial distribution of land degradation processes
  - 20.8 % affected by wind erosion
  - 36 % affected due to overgrazing
  - 16 % of the territory have experienced successive drought events



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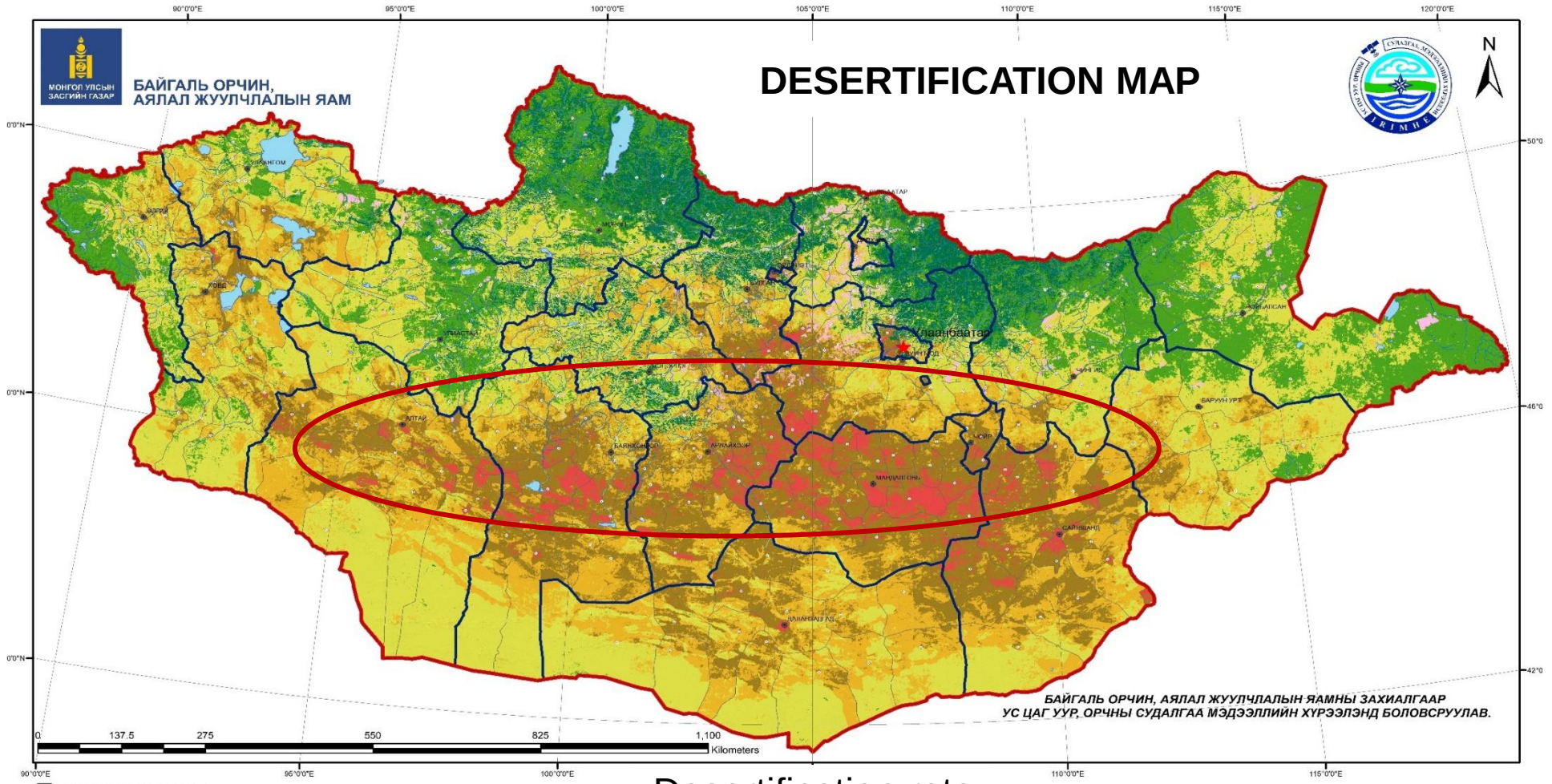
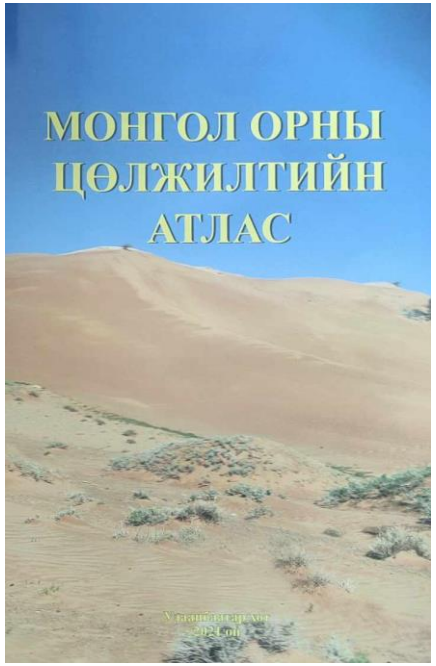


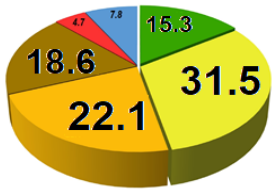


Таних тэмдэг

- Улсын хил
- Нийслэл
- Аймгийн хил
- Аймгийн төв
- Сумын хил
- Сумын төв
- Нуур
- Гол
- Ой
- Тариалангийн газар

Desertification rate

- Not desertified
- Slight
- Moderate
- Severe
- Very severe



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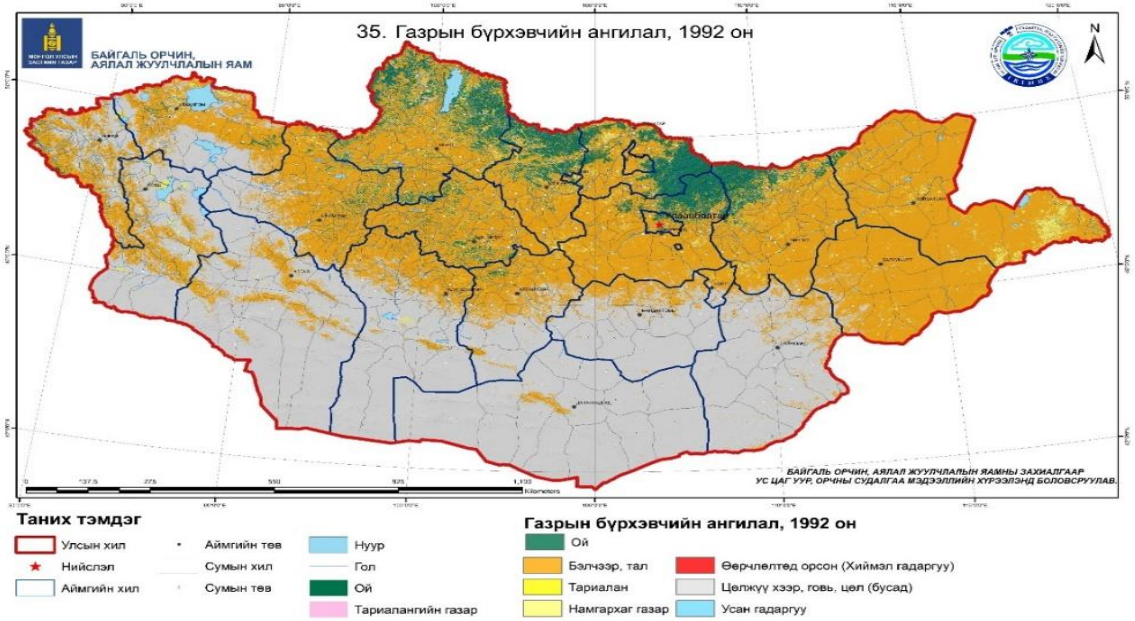
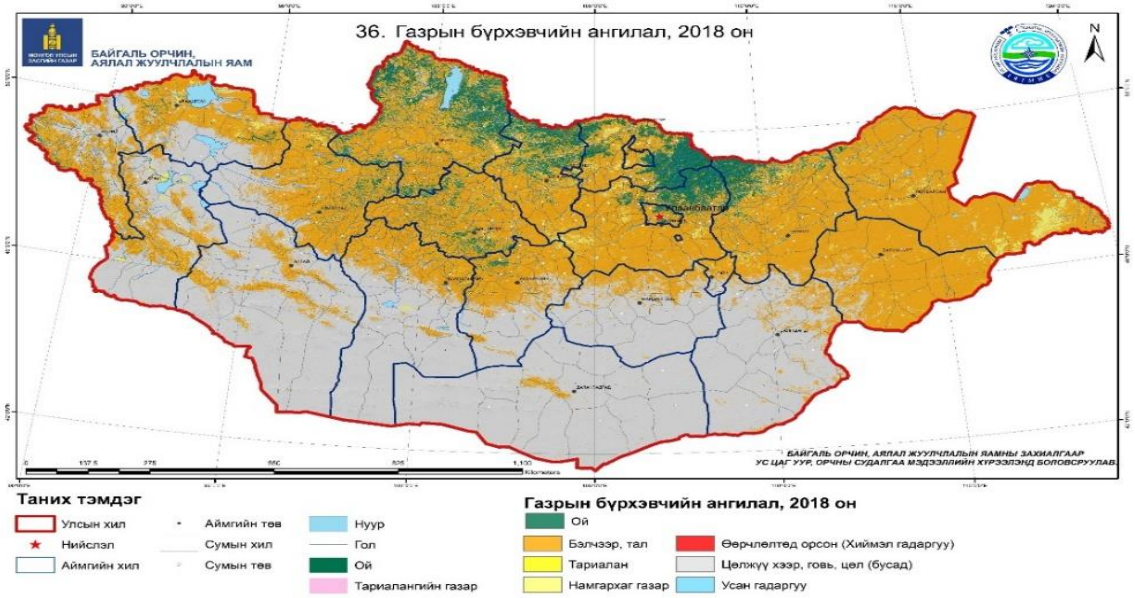
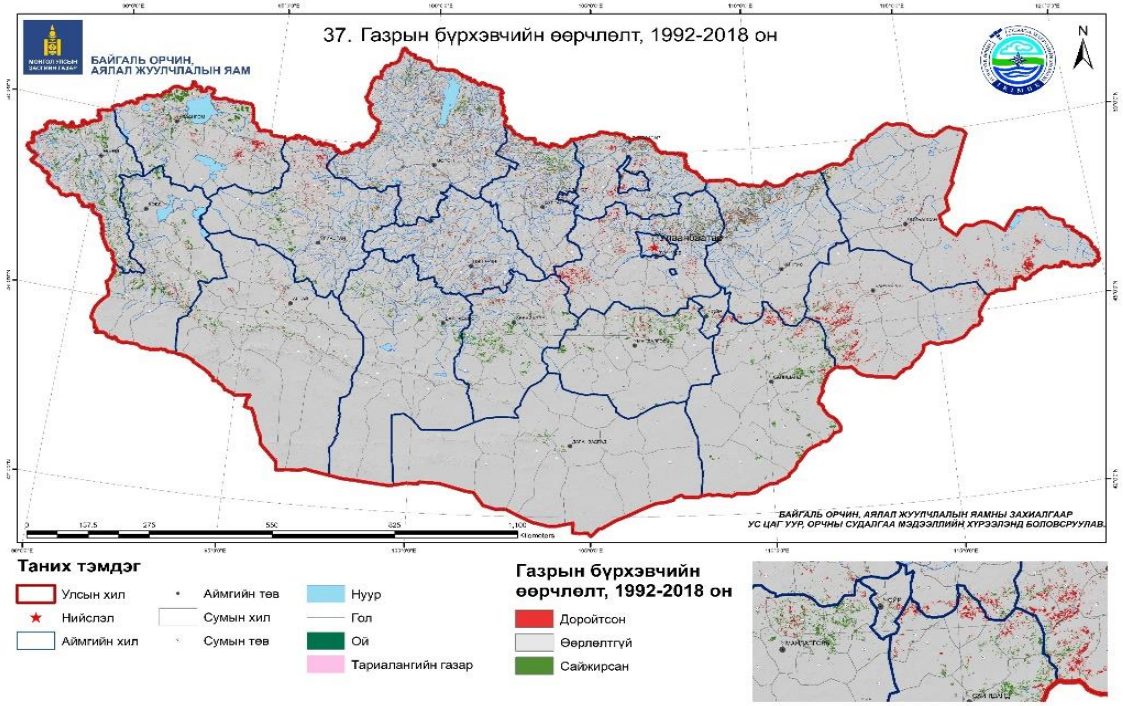
Land cover classification, 1992



Land cover classification, 2018



Land cover change from 1992 to 2018



Land cover change, 1992-2018

Area, ha	Area, ha	Percentage in total
Total	154.988.225.3	100.0
Improved	3.136.555.4	2.02
No change	149.634.279.2	96.55
Degraded	2.217.390.8	1.43

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Desertification assessment in Mongolia

1990: Institute of Geography and the Institute of Desert Studies of Turkmenistan.

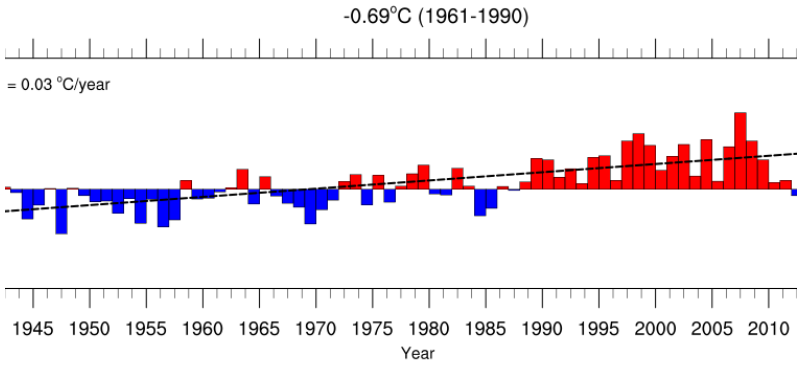
2000: Processes of desertification, land degradation and grassland degradation are mapped separately, **FAO methodology**

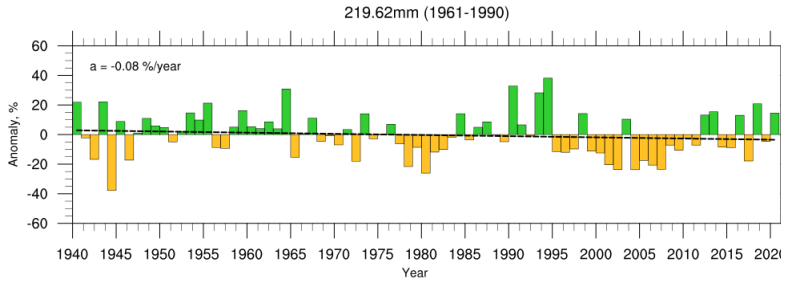
2006: Institute of Geo-ecology (remote sensing and geographic information systems were applied, **MEDALLUS approach**)

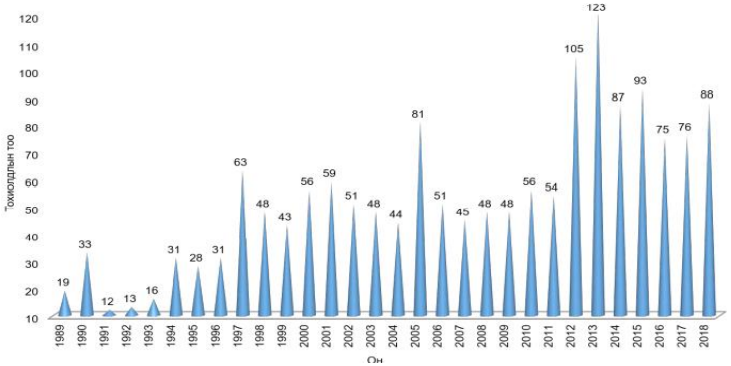
2010: It was mapped using remote sensing, numerical and physical models, and the methodology of the **DPSIR approach** "Land Degradation Assessment in Arid Areas" (**LADA**) program was used.

2020: Information and Research institute for Metrology, Hydrology and Environment (IRIMHE), Ministry of Environment and Climate Change (MECC) **(DPSIR approach, LADA program)**

Climate change

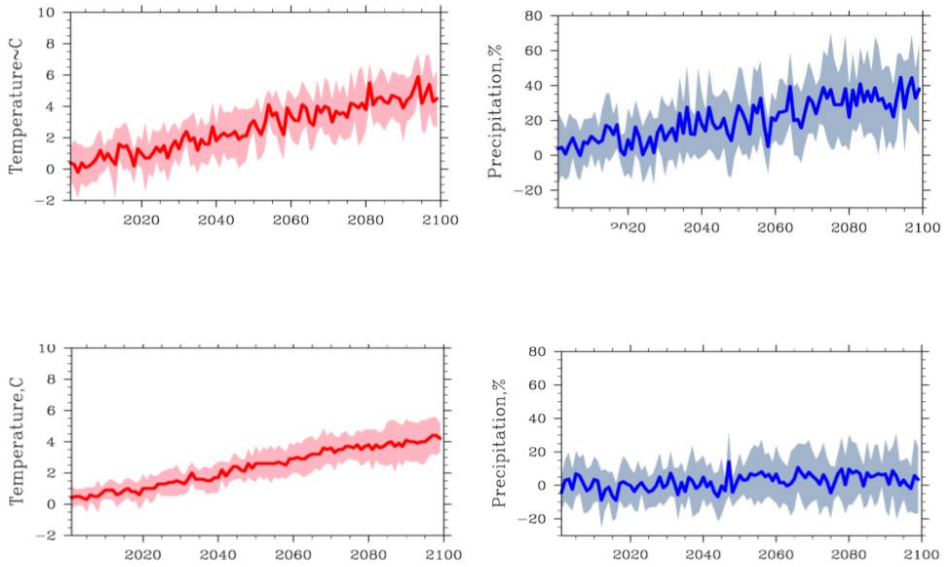


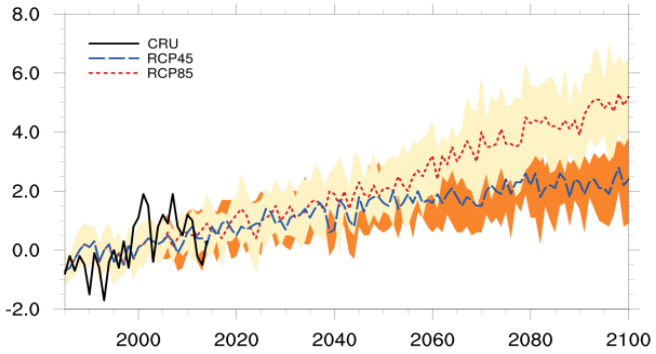




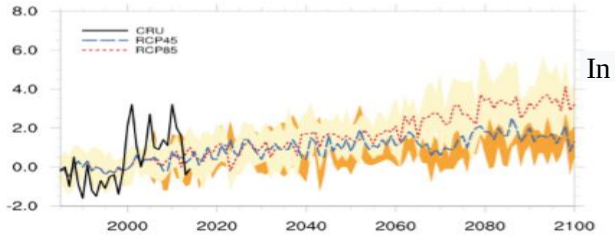
During 1940-2020, air temperature increased by 2.4°C.

In future: during cold season

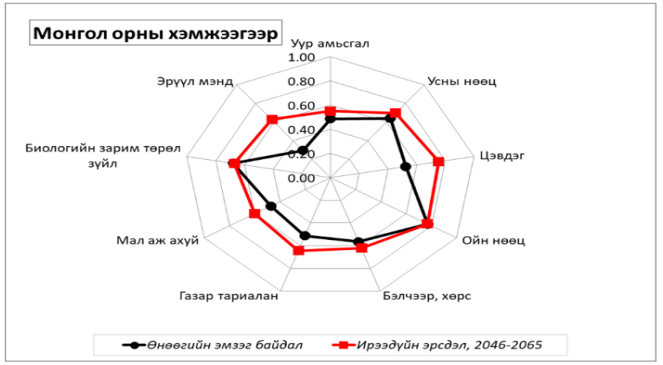




***Dzud* (severe winter)**



Number of disasters:
2001 - 59, 2005 - 81, 2012 - 105, 2021 - 129, 2023 - 132

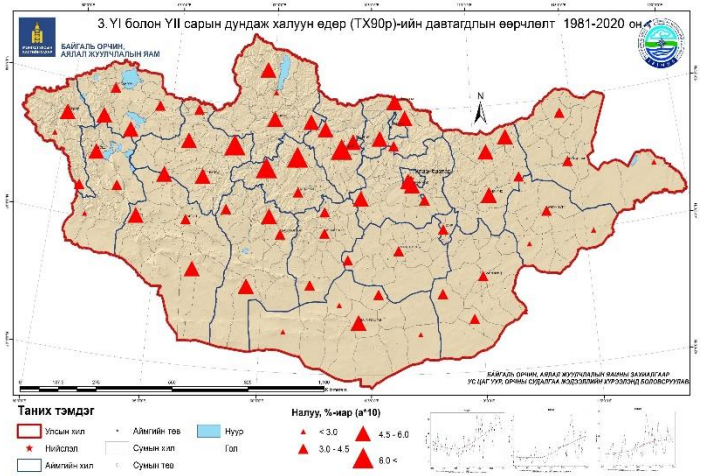


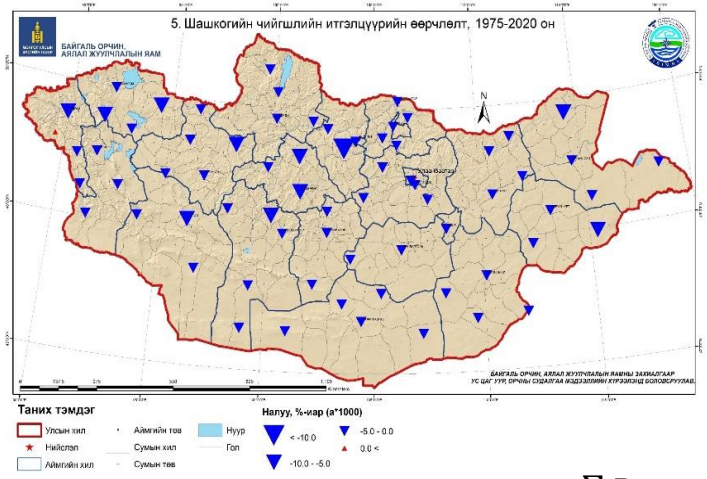
In future, vulnerability of rangeland and livestock sector will increase.

Speed of CC is overcoming ecosystem's adaptive capacity

Assessment of Climate factors for Desertification

Hot days (>30°C) in June, July (1981-2020 SHASHKO moisture coefficient (1979-2020)



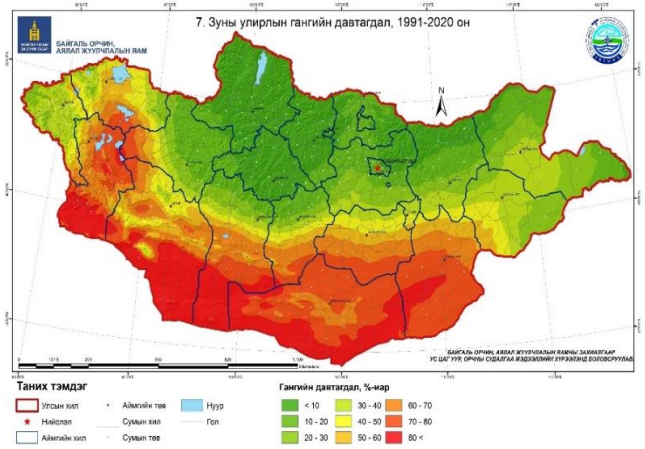


The frequency of average hot days is increasing by 3% in 10 years in Gobi steppe region and 4.5% in 10 years in the mountainous area.

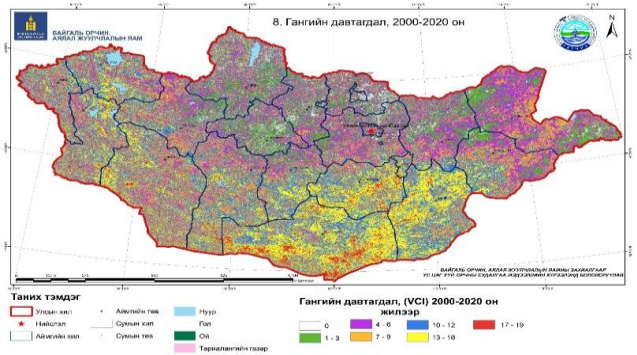
Dryness occurring over Mongolia, among less intense in the Khangai mountain region and less intense in the Gobi desert region.

$$M_d = \frac{\sum P}{\sum (E - e)} = \frac{\sum P}{\sum d}$$

Ground-based **Drought frequency** (1991-2020)



RS-based **Drought frequency** (2000-2020)



$$VCI = \left(\frac{NDVI_i - NDVI_{min}}{NDVI_{max} - NDVI_{min}} \right) * 100$$

Ground observation based drought assessment and RS based drought frequency showed both similar spatial trend. Drought frequency is higher in the Altai Mountain and Gobi regions.

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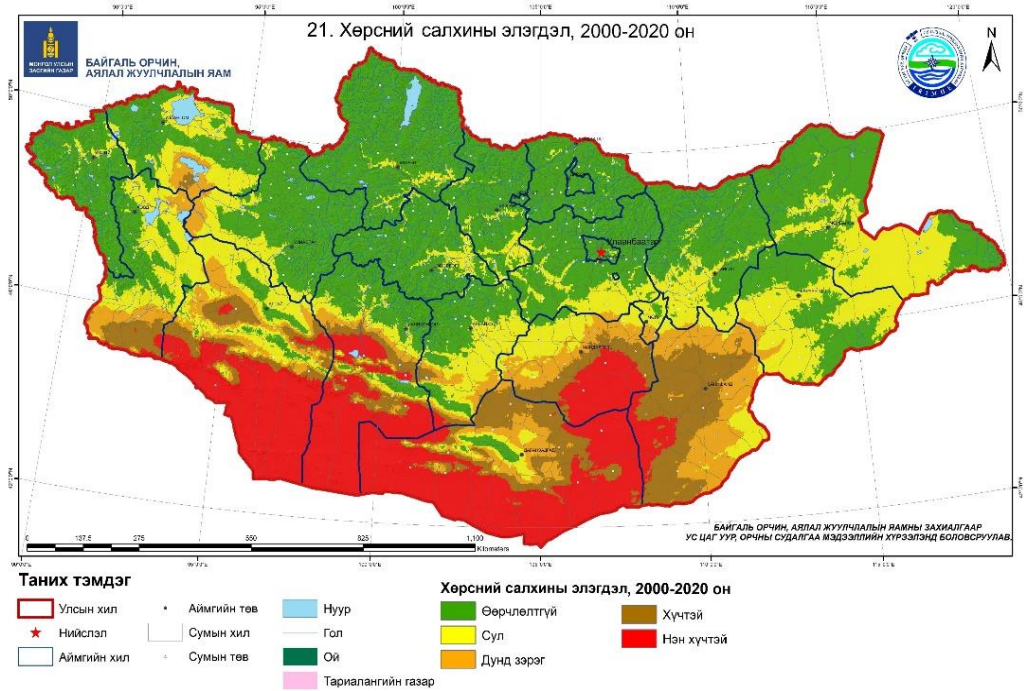
Soil erosion by water (2000-2020)

- Based on the image calculated using the updated model of soil transport (RULSE), the amount of soil eroded by water in the Great Lakes Depression, backside of Mongolian Altai Mountains and Gurvansaikhan mountain is the highest, or **0.09 t/ha year or more**.
- In the **Atlas of World Desertification** (2018), the amount of soil eroded by water in **most areas of Mongolia is 0-1 t/ha per year**. This shows that the soil of our country is relatively less affective by water erosion.

Soil erosion by wind (2000-2020)



The amount of soil eroded by the wind is the highest in the depression of the Great Lakes and in the southern part of the region, it is 100 t/ha. more than a year.

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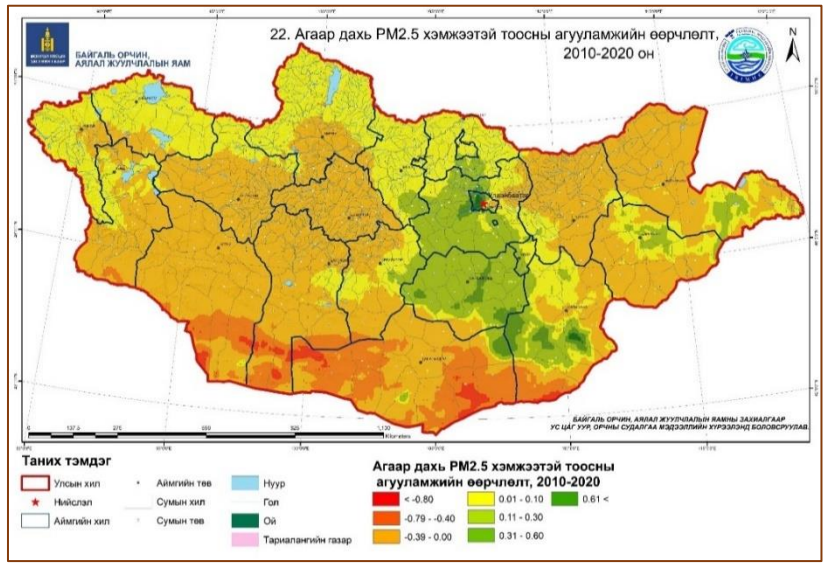
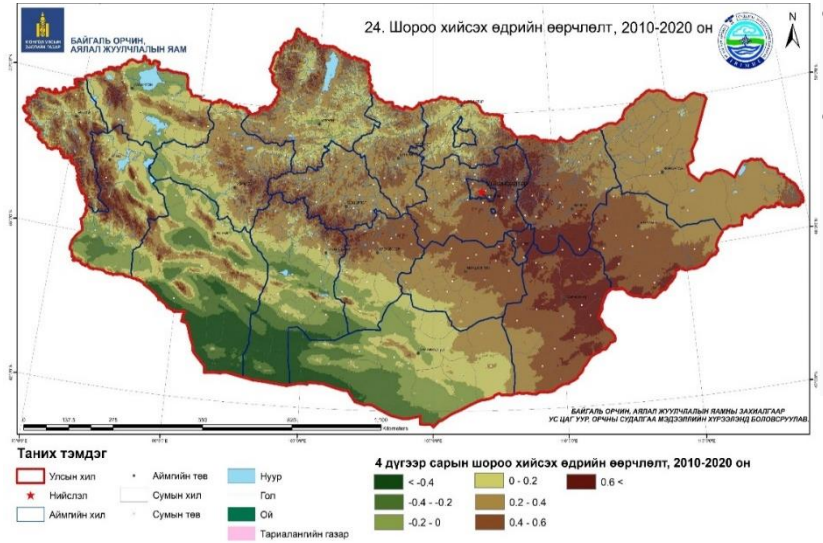
Dust parameters

Changes of PM2.5 dust concentration in air (2010-2020)



- Monthly average values of PM2.5 and aerosol optical thickness (AOD) for 2010-2020 calculated by the ADAM3 model *(Asian Dust Aerosol Model, version 3 by Korean Met.l service)*.
- Changes and trends of PM2.5 dust content calculated by Mann-Kendall trend analysis method.
- Concentration of PM2.5 dust in the air **increased by 0.11-1.5 mg/m3** per year in most areas of Dundgovi, Tuv Provinces and the southwestern part of Dornogovi Province in the last eleven years (2010-2020) in April. However, in the southern part of the region, a decrease of 0.40-1.9 mg/m3 was observed

Number of dust blowing days (2010-2020)



- Number of dust blowing days was calculated in order to verify the trend of dust concentration in the air calculated by ADAM3 model.
- In Dornogovi, Dundgovi, Khentii and Tuv provinces, **days of dust blowing have increased by 0.4-1.1 days/year** in the last ten years, while in the southern part of the region, it has decreased by 0.2-0.76 days/year.

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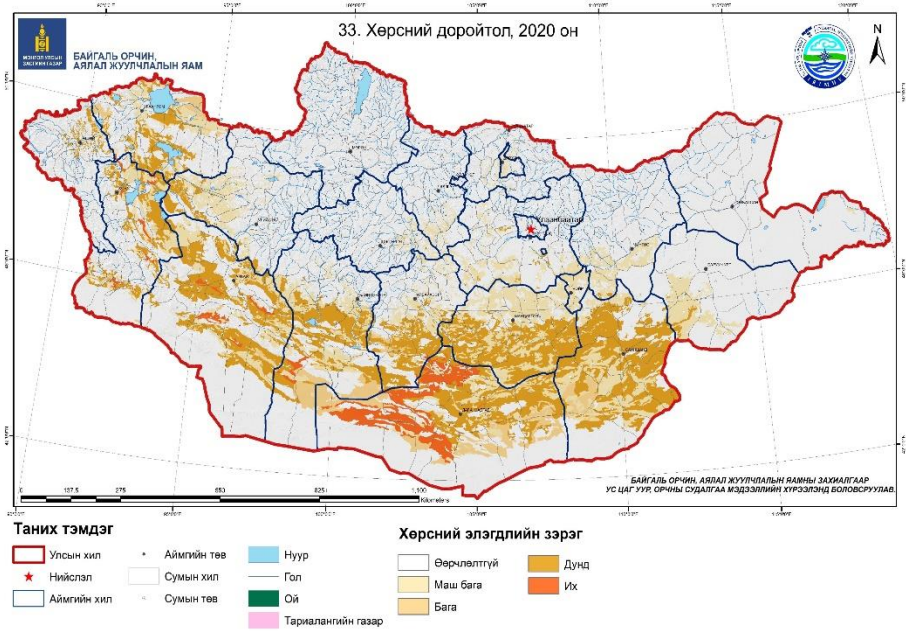
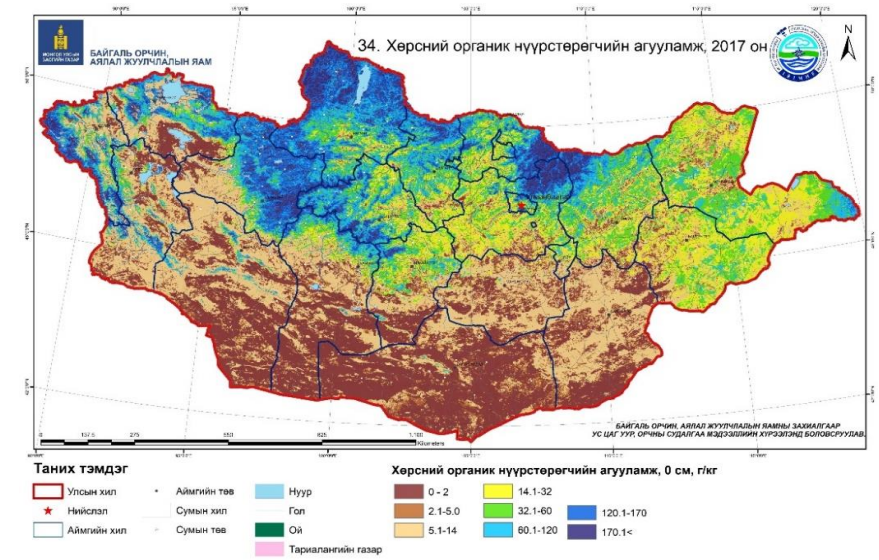
Soil degradation (2020)



Soil organic carbon content (2017)



Soil condition, change

- Soil degradation estimated based on results of previously implemented projects and programs, results of laboratory analysis, which determined the **agrochemical and agrophysical properties of 13 parameters in 85,280 samples, and a total of 6,560 soil profile data from the field research** were used.
- Soil degradation is defined in the following basic ways.

- Soil organic carbon content at 0, 5, 15, 30, 250 cm depth of soil from World Soil Database: (https://data.isric.org/geonetwork/srv/eng/catalog.search#/metadata/).

- As can be seen from the picture, the organic carbon content of the soil surface is the **highest or more than 60 g/kg** in Khangai, Khentii and Khuvsgul mountains, while the lowest is **less than 5 g/kg in the Govi region**. The content of organic carbon in the soil gradually decreases from the surface of the soil to 30 cm, and below the depth of 30 cm to 200 cm, there is little change and it is relatively stable.

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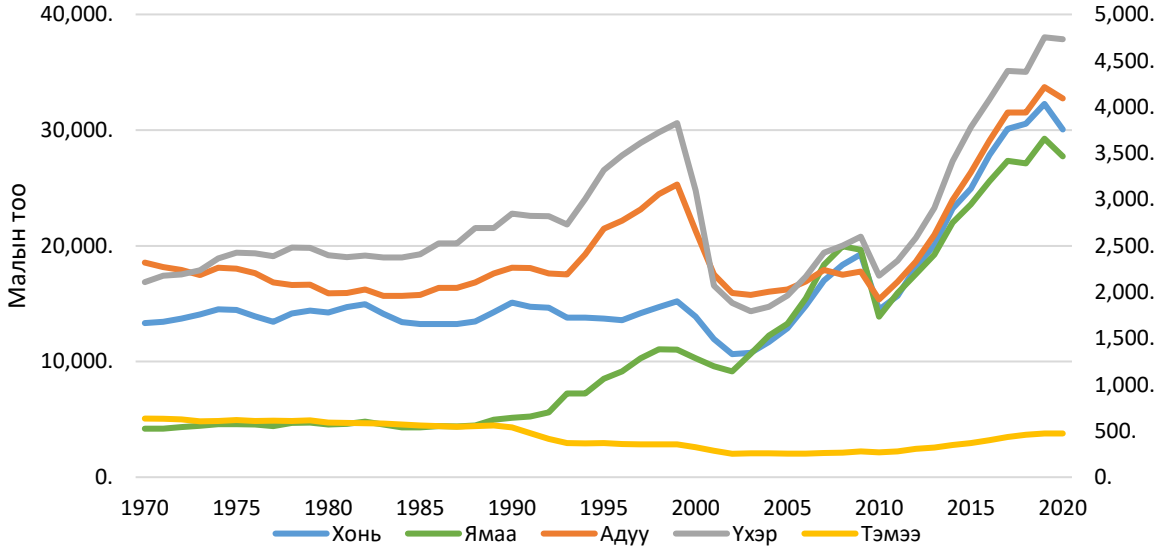
Human activities associated factors for desertification

- **Unsustainable use of lands for crops** over an extended period of time. Over-cultivated land were abandoned without being rehabilitated.
- **Rapid growth of the mining sectors** have contributed to the degree of soil erosion.
- The **increased use of cars**, the development of roads and transportation networks, the physical expansion of **human settlement**, human migration and rapid market growth have all had a negative impact on the environment.



- (**Livestock type/composition changed**) The traditional composition of pastoral livestock herds, established over centuries, is also significantly changing. **Number of goats** significantly increased to gain profit from cashmere. Goats are destructive to pastureland, pulling up vegetation by its roots, and are difficult to rear.

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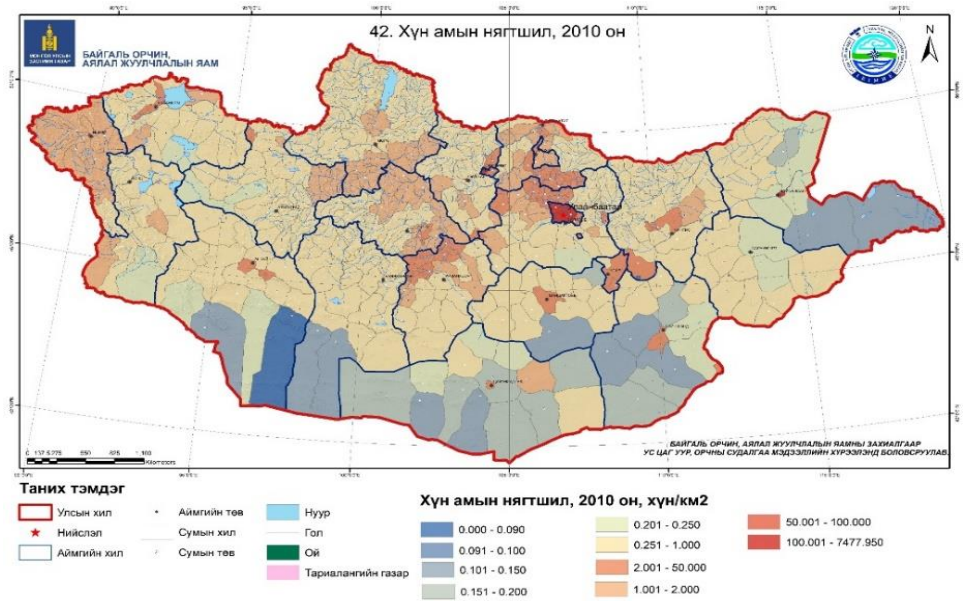
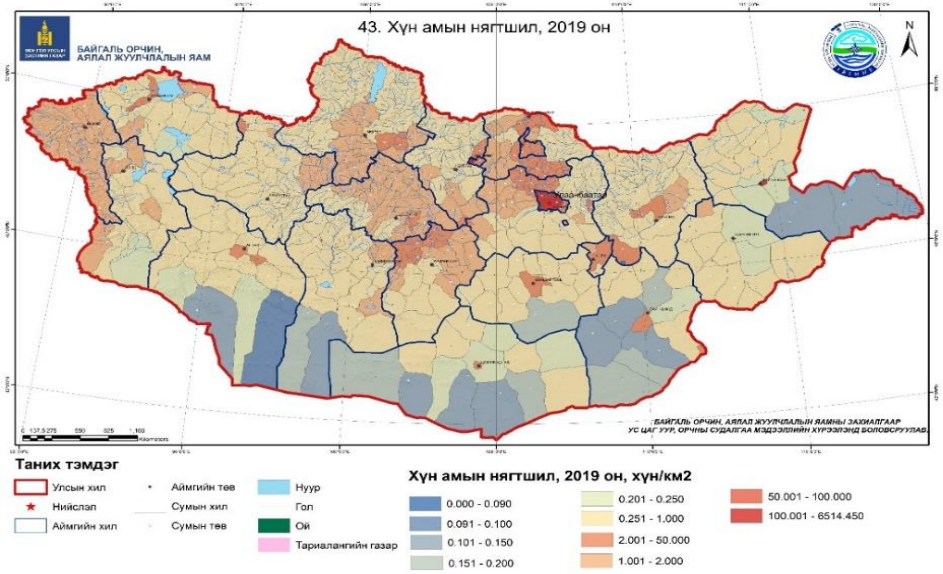
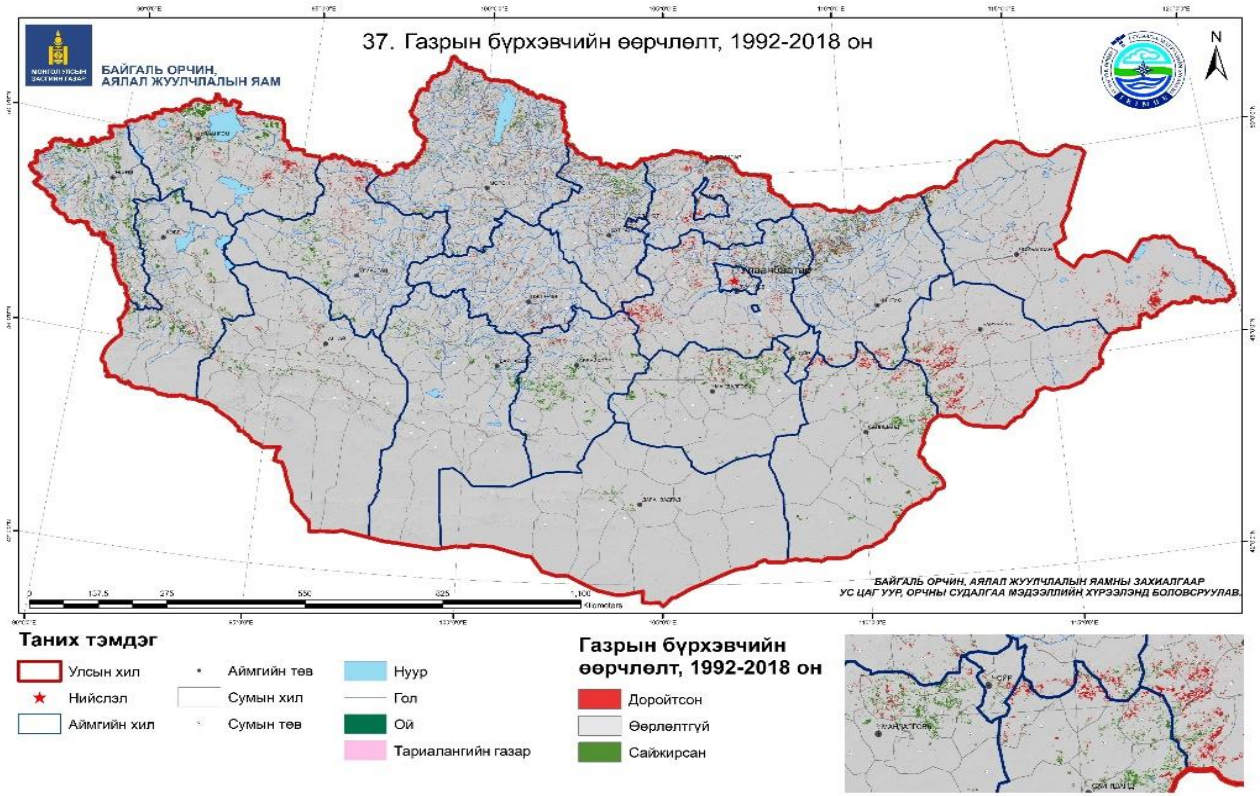
Population density, 2010



Population density, 2019



Changes in population density from 2010 to 2019



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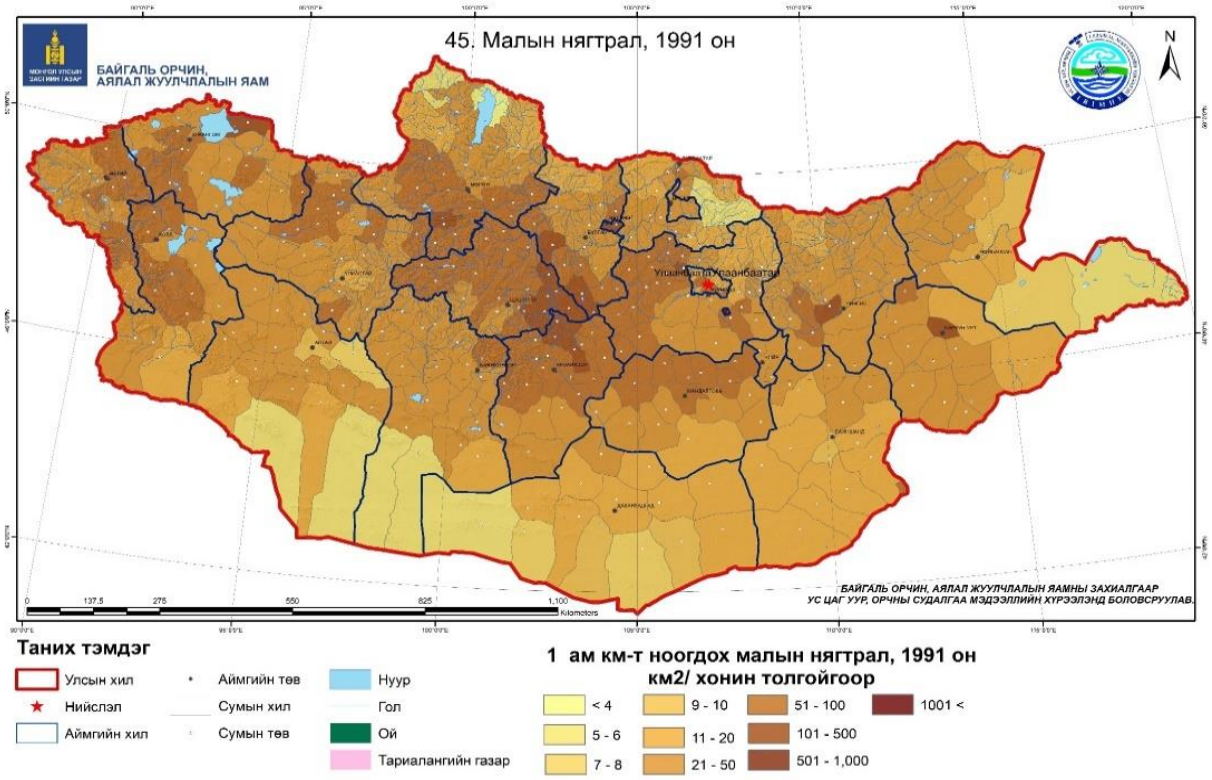
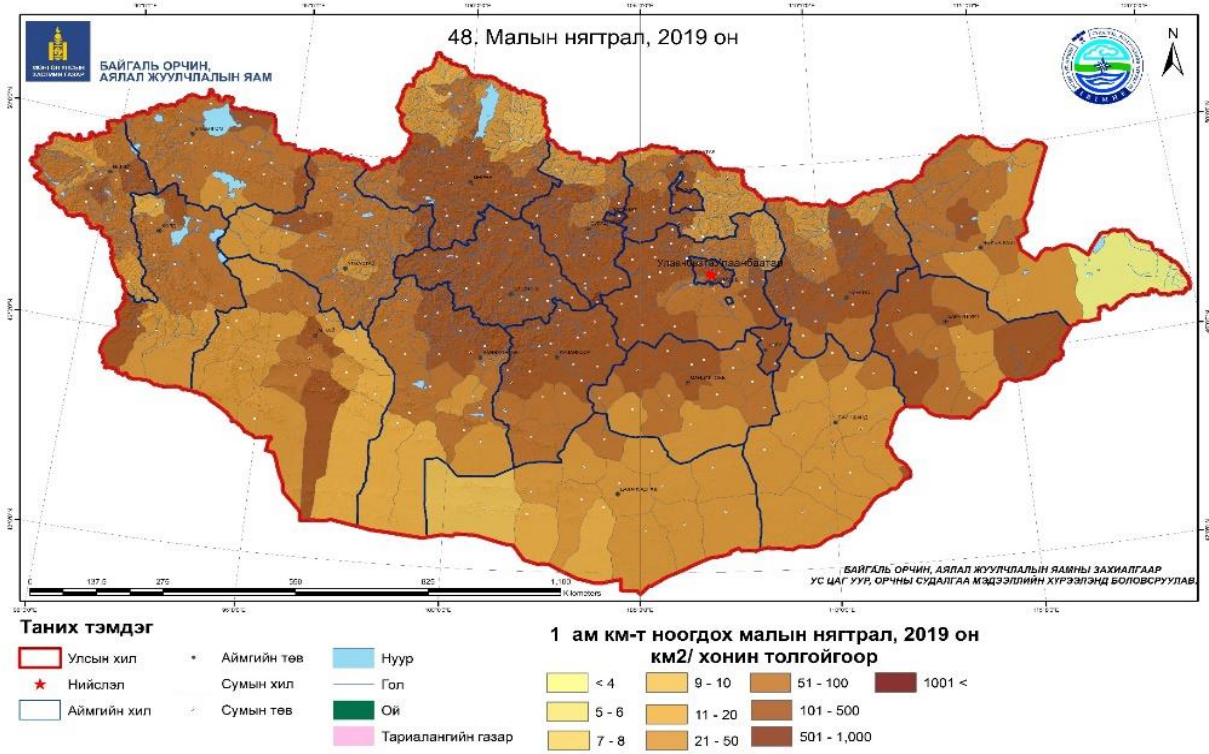
Livestock density, 1991



Livestock density, 2019



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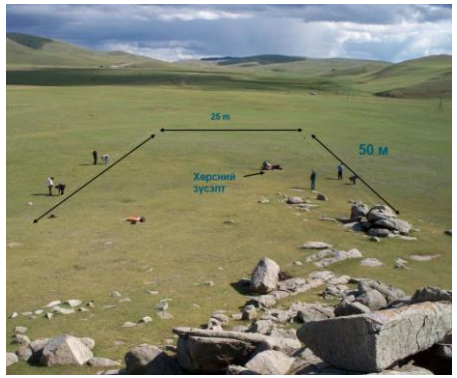
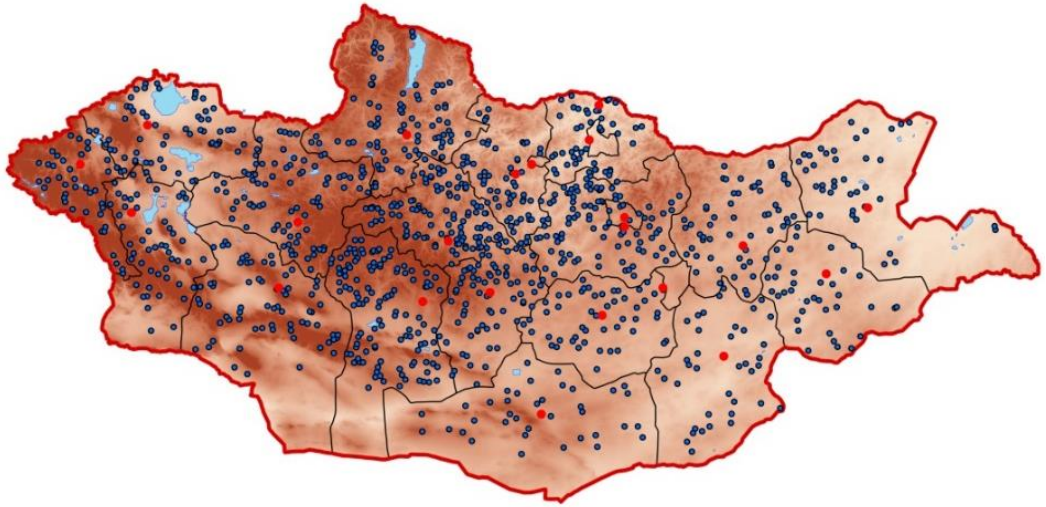
Rangeland health monitoring (over 1500 sites)

Establish two 50 m lines/transects



Recording foliar, sub and basal **cover** (line-point intercept)



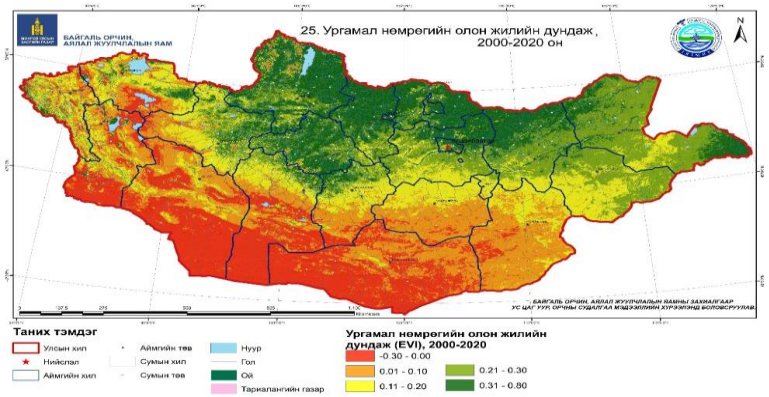
Gap intercept of perennials

Species biomass, Height

5 years/once

-Soil morphology
-Content of soil humus
-Depth of soil humus
-pH
-Salinity
-Surface erodibility
-Soil stability
-Density
-Hydraulic conductivity

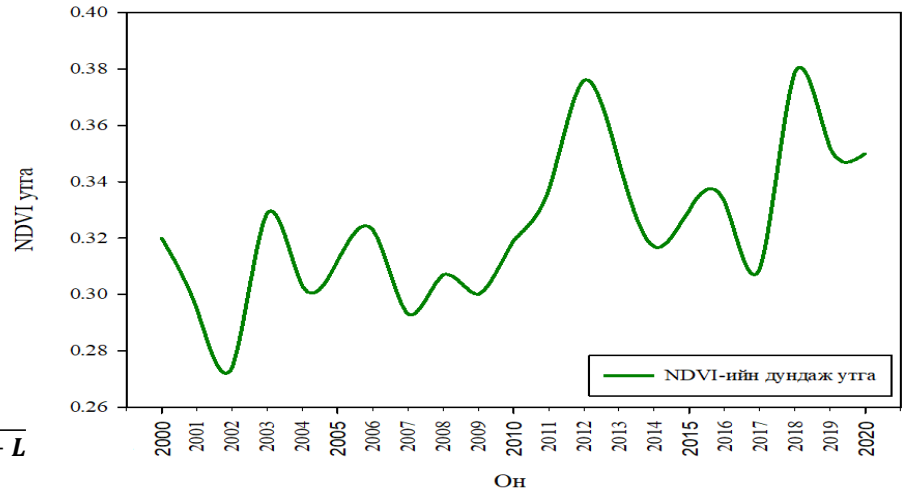
Averaged vegetation cover (2000-2020)



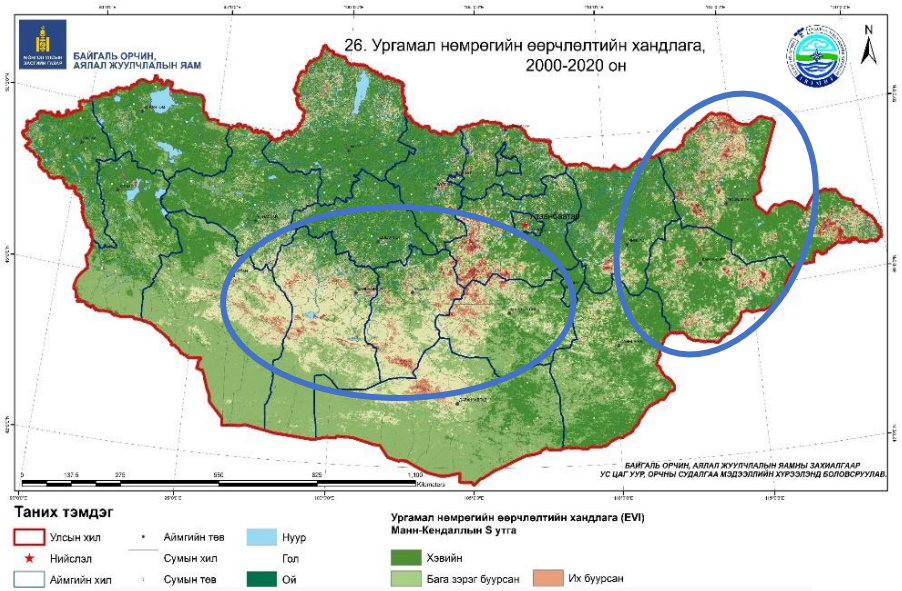
$$EVI = G \times \frac{\rho_{NIR} - \rho_{red}}{\rho_{NIR} + C_1 \times \rho_{red} - C_2 \times \rho_{blue} + L}$$

RS based Vegetation Cover

NDVI trend

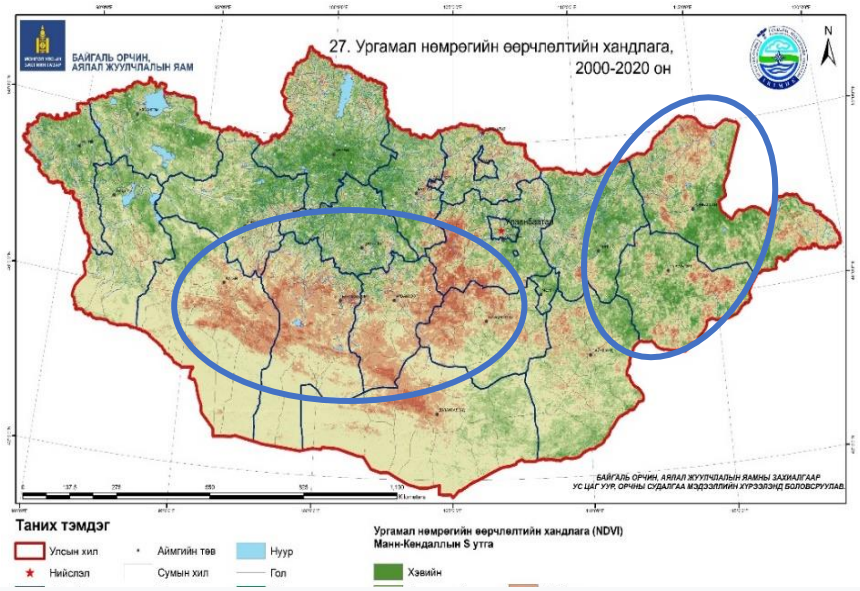


Trend of EVI based vegetation cover (2000-2020)



MODIS- MOD13Q1 product Enhanced Vegetation Index or EVI data were used.

Trend of NDVI based vegetation cover (2000-2020)



Annual mean Normalized Vegetation Index (NDVI) data from Land Productivity Data or MODIS and AVHRR were used.

Modis based EVI
&
Modis and AVHRR based NDVI showed similar trends.

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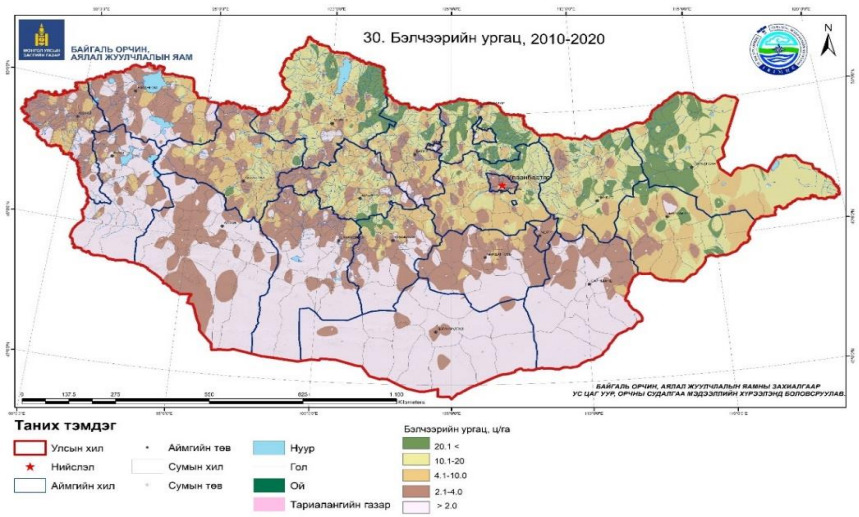
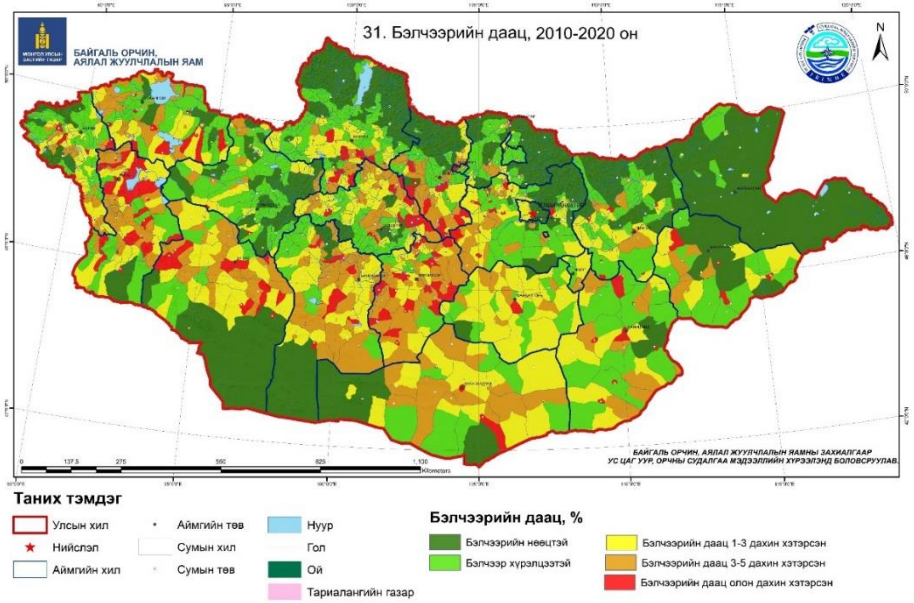
Pasture biomass, 2010-2020



- One of the main indicators of desertification and land degradation is the yield of natural pastures and their changes.
- Maximum amount of biomass is
  - 10-20 t/ha in the mountainous area
  - 2-10 t/ha in the forest steppe zone, and in the northern part of the steppe zone
  - less than 2 t/ha in the entire Gobi region.

Pasture carrying capacity, 2010-2020



- Pasture carrying capacity depends on biomass, number of livestock and pasture area.
- Overgrazing/exceeded pasture carrying capacity is causing rangeland degradation and deteriorating pasture quality. Carrying capacity exceeded for several times more than 40% of the area.

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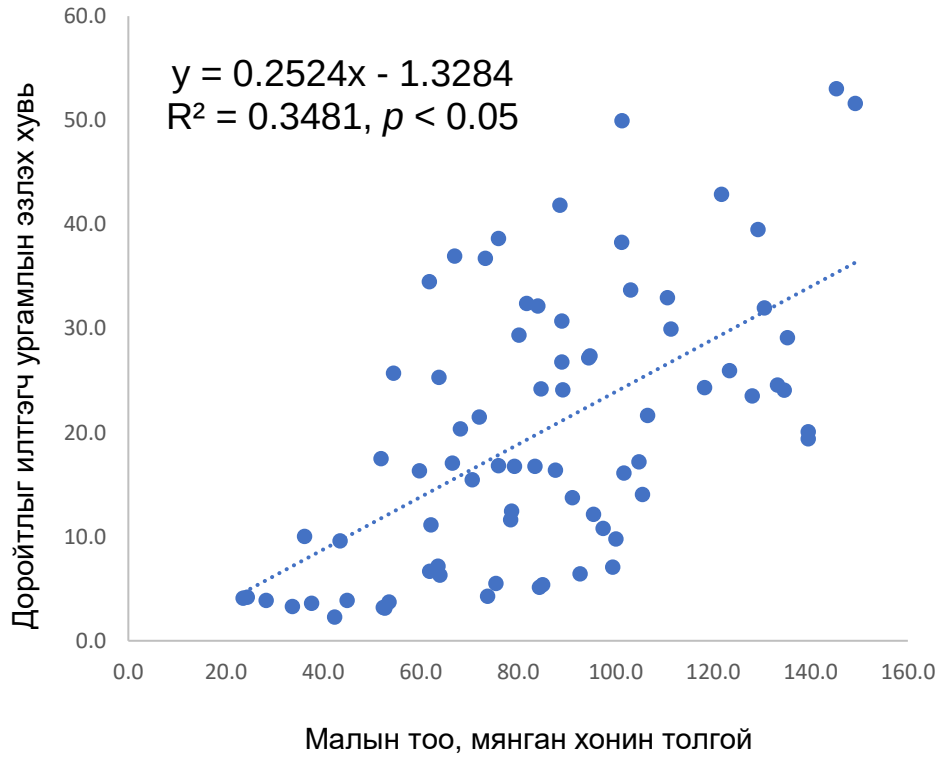
Changes in plant species composition

Number of livestock	AGB_G/AGB_{UG}							
	PAF[a]	PPG	PPL	UAF	UPS	Palatable	Unpalatable	Total
Total[b]				0.951	0.980	−0.673		−0.810
Sheep	0.924		−0.822	0.972	0.993			−0.649
Goat		−0.713	−0.806	0.837	0.986	−0.635		−0.636
Cattle	0.987	−0.624		0.908	0.979			
Horse			−0.782		0.886			

[a] Plant group abbreviations are listed in Table 1.
[b] Total number of livestock in sheep-equivalent units.

- All palatable species groups were negatively correlated with livestock number. In contrast, Unpalatable species were correlated positively with the number of livestock.
- As increasing livestock number, percentage of unpalatable species increased significantly.



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Aeolian desertification consequences
Dust storm event in April, 2022

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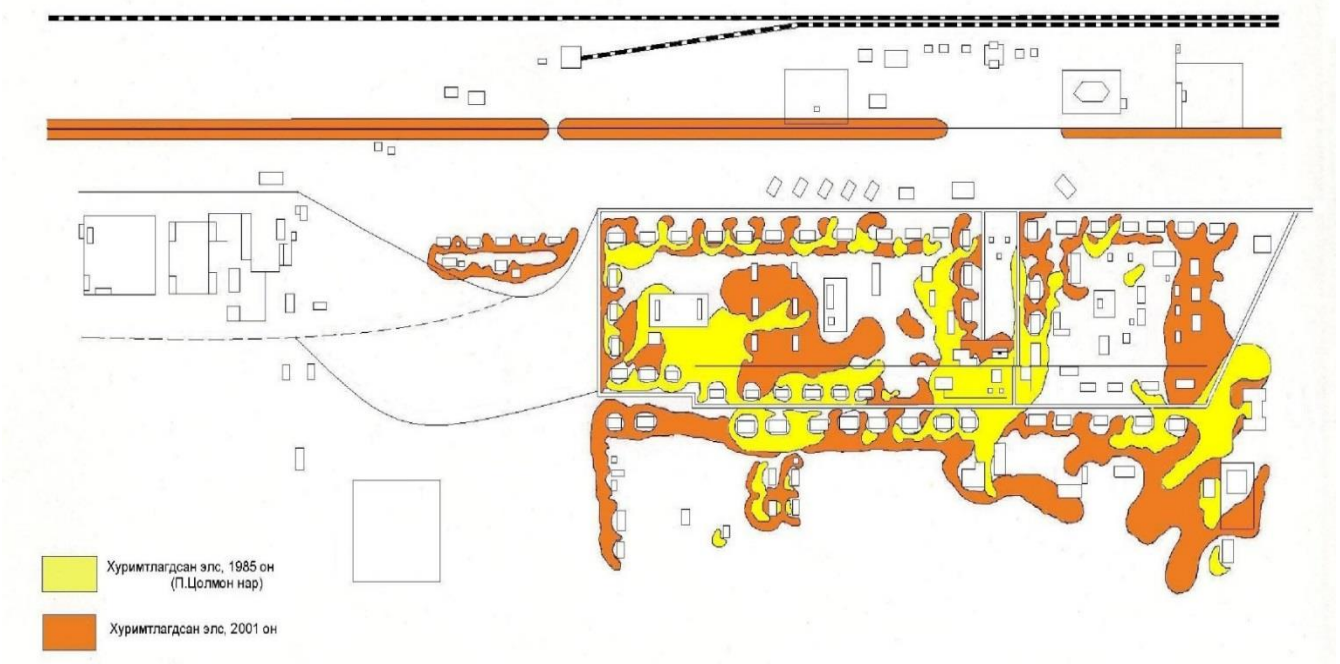
ZAMIIN-UUD SOUM AFFECTED BY SAND MIGRATION AND MOVEMENT.

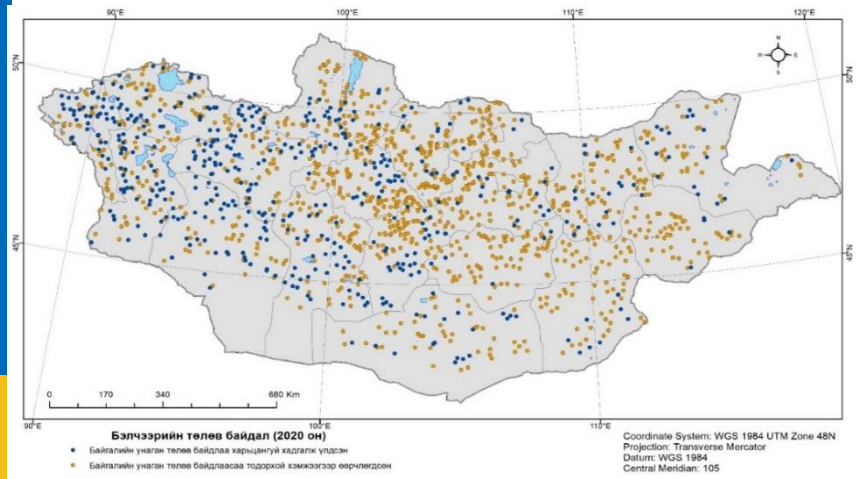


Key factors of desertification in Mongolia

Continental extreme climate of Mongolia ✚ CC ✚ Increase of livestock (pressure)

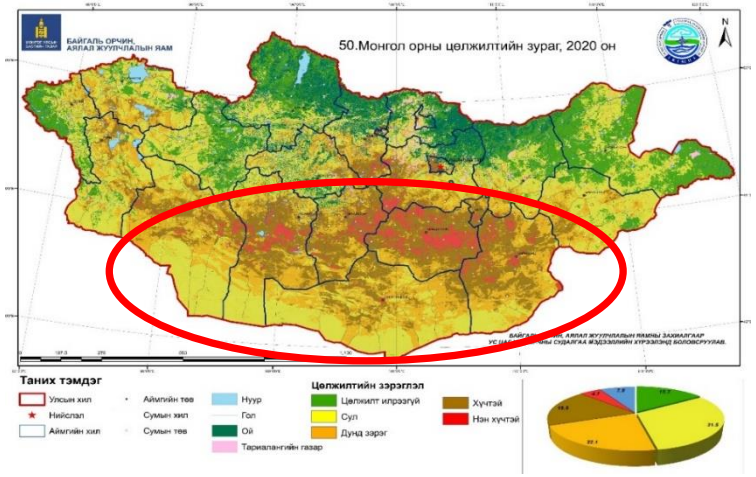
Rangeland health condition, 2020

Species composition changed from reference state in about 70% of sites.

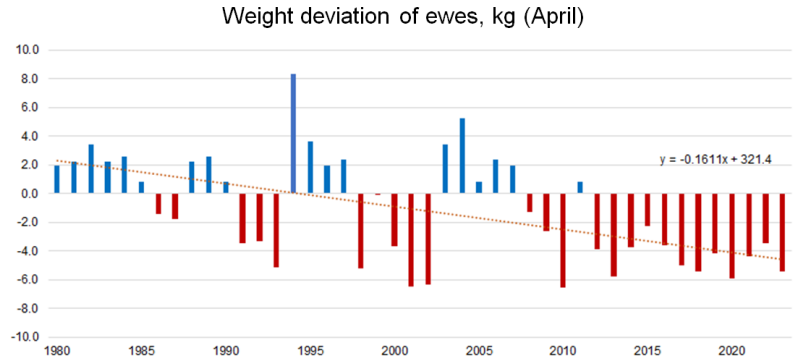


Desertification map, 2020

76.9% degraded (18.6% strongly, 4.7% very strong).



Dry & Naturally low productivity areas under intensive CC and high grazing pressure very vulnerable, where seriously degraded.



- Number of dusty days increasing.
- Species composition changing from palatable species to degradation indicator species.

- Grassland productivity is decreasing. For example, the yield of 71 million hectares of grasslands in the steppes and deserts has decreased by about 30%.

What is Mongolia doing for combating desertification

- **Policy Responses**

Issues for combating desertification are reflected in official documents.

- **Environmental laws/about 30/**
  - **Law on Environment protection**
  - **Law on Water**
  - **Law on Forest**
  - **Law on Soil conservation and combatting desertification**
- **Government programs /about 26/**

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National Action Program to Combat Desertification /NAP CD/

1st National Action Program to Combat Desertification - 1996

2nd National Action Program to Combat Desertification - 2003

3th National Action Program to Combat Desertification - 2010

Implementation Period:

1st Phase – 2010-2015

2nd Phase – 2016-2020

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Objectives and actions of NAP CD

Objective of component - 1	• Strengthen National capacity and Institutional Framework for Combating Desertification
Objective of component - 2	• Improve the Legal and Policy Framework
Objective of component - 3	• Enhance science, technology and knowledge
Objective of component - 4	• Increase advocacy, awareness rising and education
Objective of component - 5	• Support concrete actions at local level and increase investment

PRESIDENT KHURELSUKH has initiated nation wide billion tree campaign in 2021.

RATIONALE TO IMPLEMENT BILLION TREES NATIONAL MOVEMENT

Environment

IN THE PAST YEARS, AVERAGE AIR TEMPERATURE **2.4** CELCIUS INCREASE

GREENHOUSE GAS EMISSION PER CAPITA COMPARED TO WORLD AVERAGE **2.7** TIMES HIGHER

Desertification and land degradation

76.9%

Frequency of natural disasters

2 TIMES HIGHER

Percentage of above ground water resources compared to all water resources

98%

Area covered with forest

8.01%

Recycled waste

10%

This document is provided by the Forestry Agency under the Government Implementation Agency.

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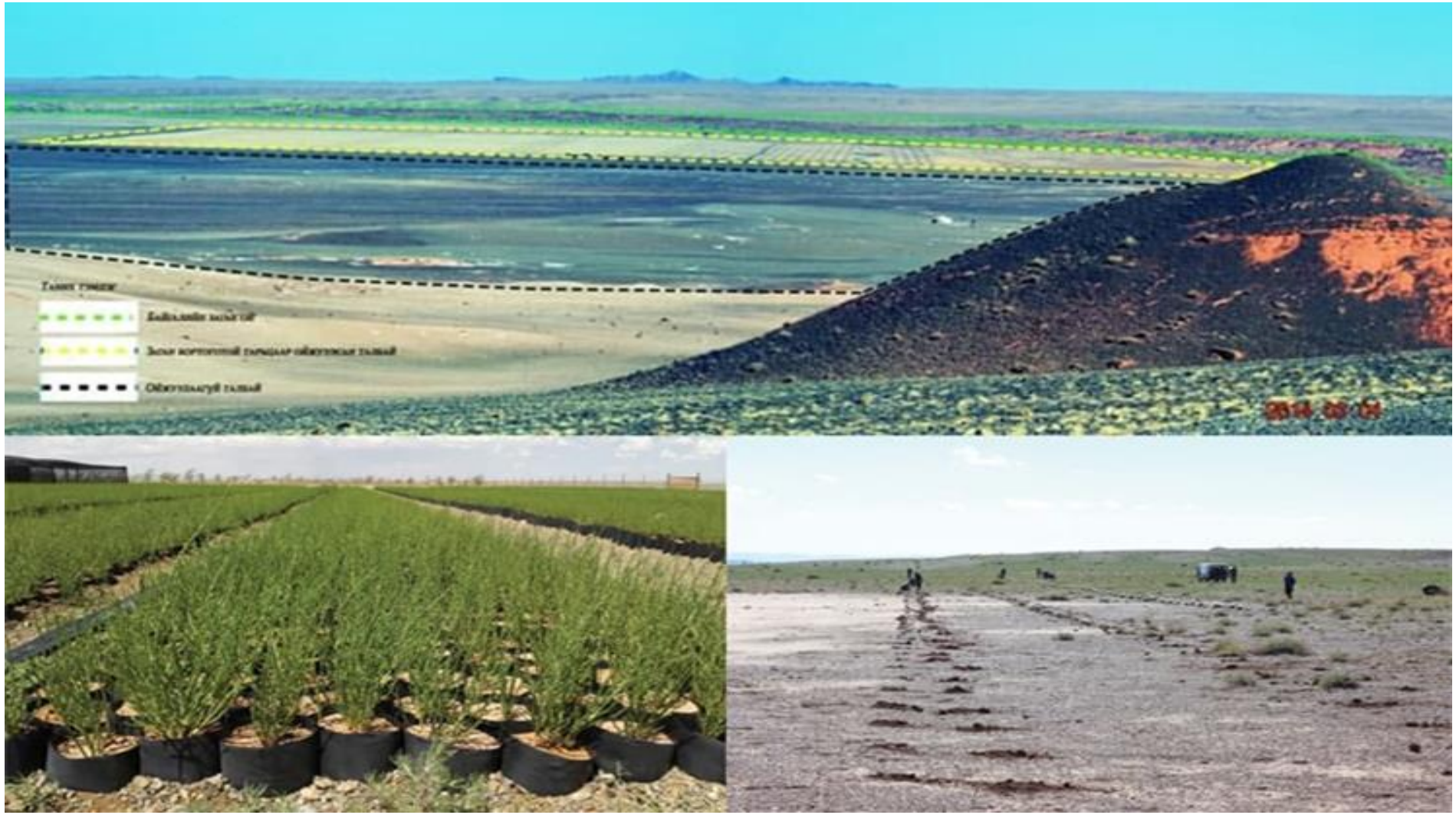
TECHNOLOGY TO RESTORE SAXAUL FOREST



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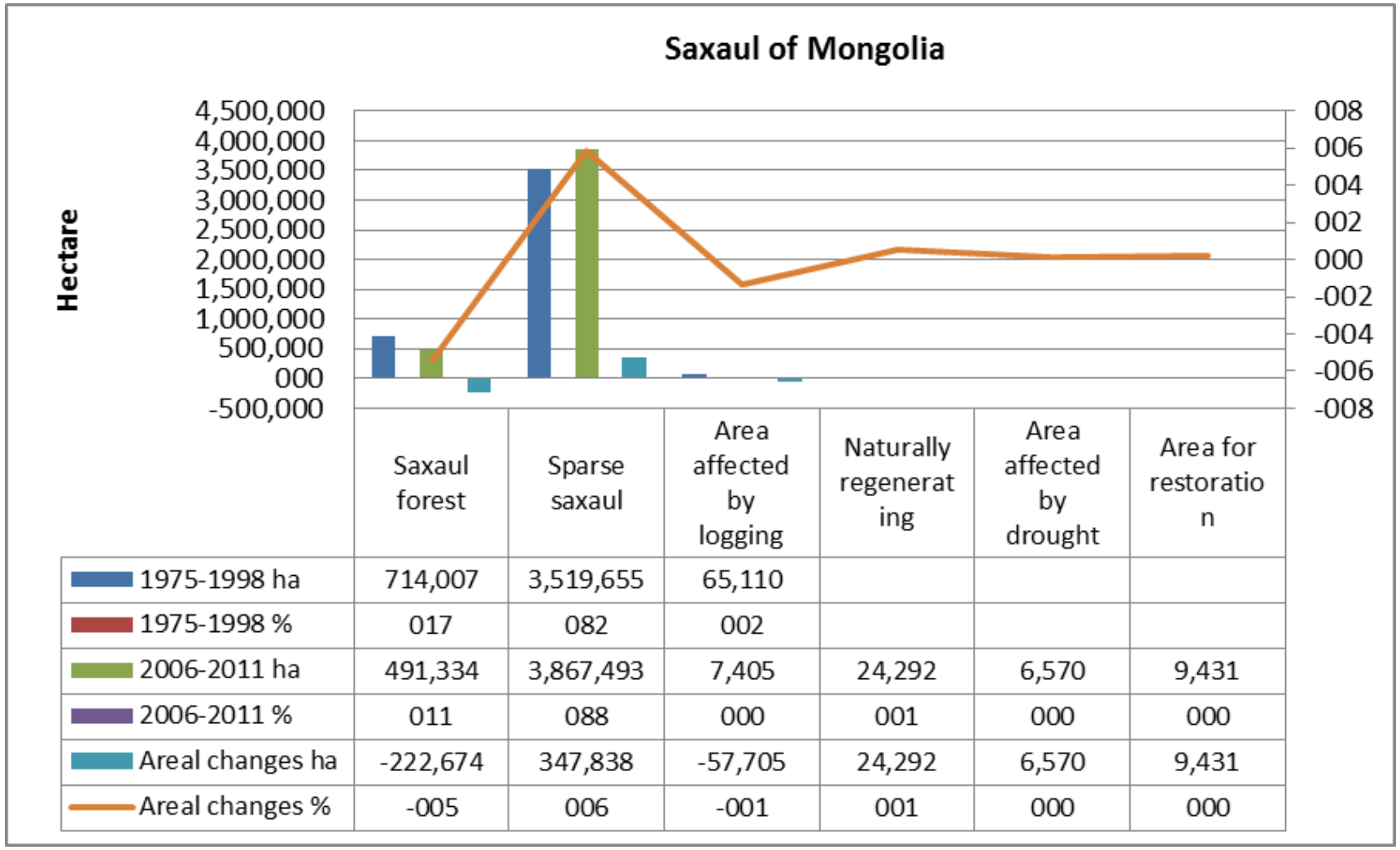
Change of the Saxaul forest in Mongolia by hectare and percentage



	Saxaul forest	Sparse saxaul	Area affected by logging	Naturally regenerating	Area affected by drought	Area for restoration
1975-1998 ha	714,007	3,519,655	65,110			
1975-1998 %	017	082	002			
2006-2011 ha	491,334	3,867,493	7,405	24,292	6,570	9,431
2006-2011 %	011	088	000	001	000	000
Areal changes ha	-222,674	347,838	-57,705	24,292	6,570	9,431
Areal changes %	-005	006	-001	001	000	000

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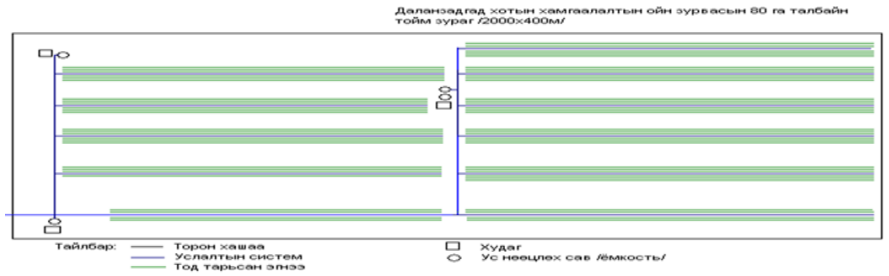
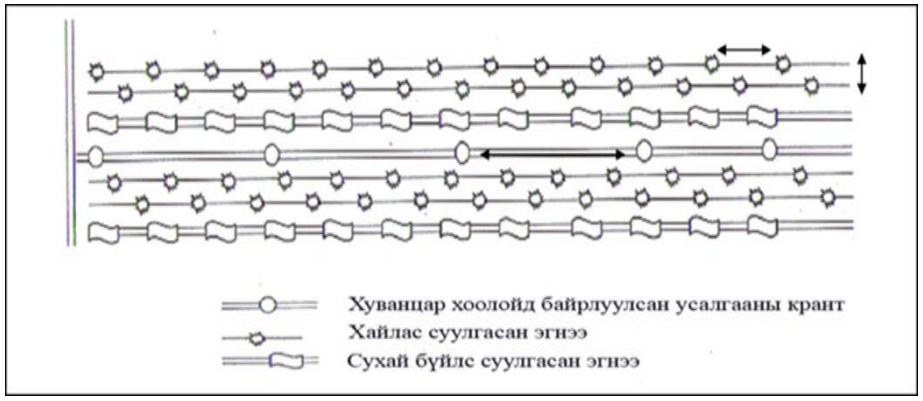
TECHNOLOGICAL SOLUTIONS TO DEVELOP AGROFORESTRY AND SHELTERBELTS IN SETTLEMENT AREAS





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TECHNOLOGICAL SOLUTIONS TO STABILIZE SAND DUNES USING MECHANICAL AND BIOLOGICAL TECHNIQUES

Mechanical techniques using stones, clays, and nets implemented in Umnugovi province for the purpose of abating sand movement.

Mechanical techniques using straws and nets implemented in Tuv and Dornogovi province

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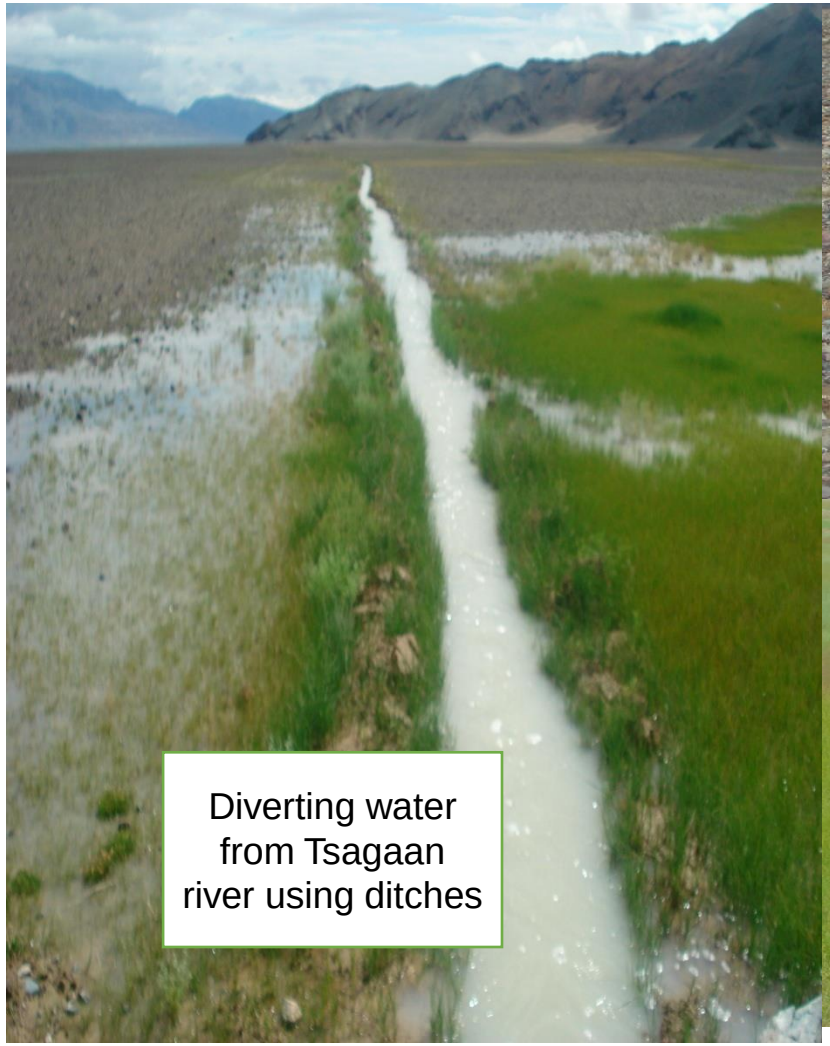
TECHNOLOGICAL SOLUTIONS TO REHABILITATE GRAVELLY SOIL INTO PASTURELAND USING IRRIGATION SYSTEM (WWW.MONCAT.MN)



Diverting water from Tsagaan river using ditches

Before irrigation

After irrigation

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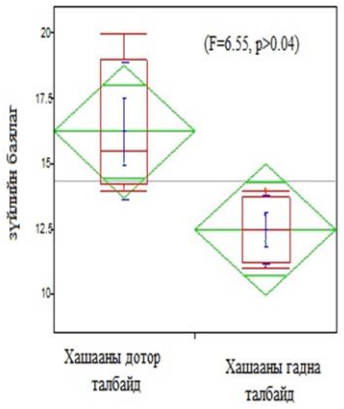
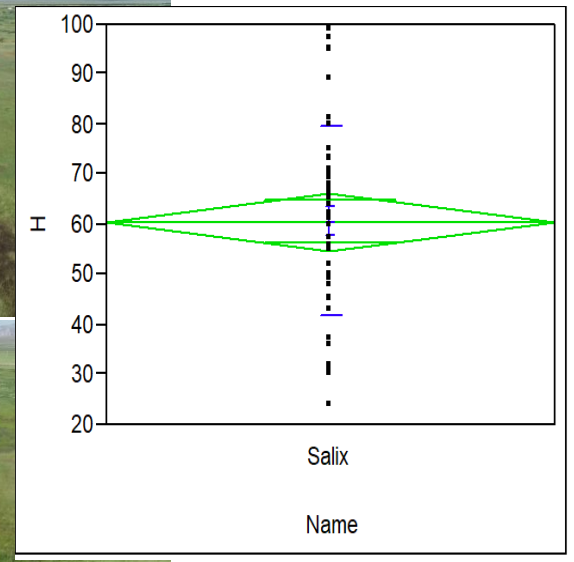
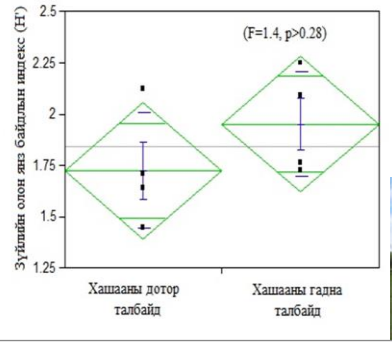
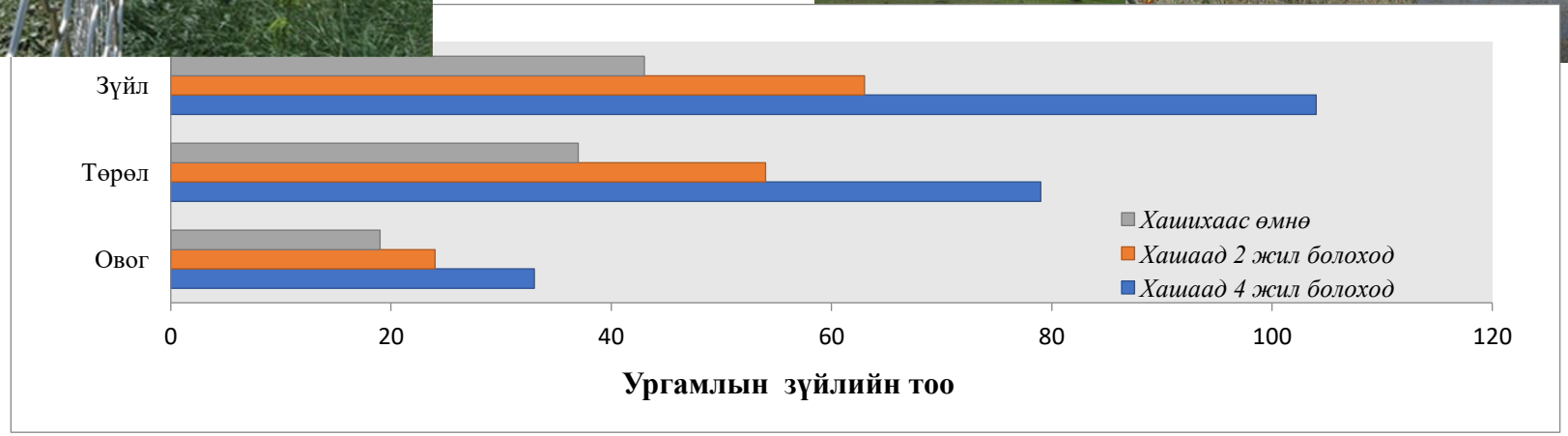
EXPERIMENT AND RESEARCH ON SUPPORTING NATURAL REGENERATION









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WINDBREAK AND SHELTERBELT TECHNOLOGY

Rashaant soum, Bulgan province, Elsentasarkhai station

Before

After

http://www.eic.mn/DLDbase/

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