# Finding and lessons learned of pilot applications of Drought Watch Mongolia

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National Agency for Meteorology Environmental Monitoring – NAMEM.

Team building meeting, ESCAP

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Bangkok, Thailand

# Background

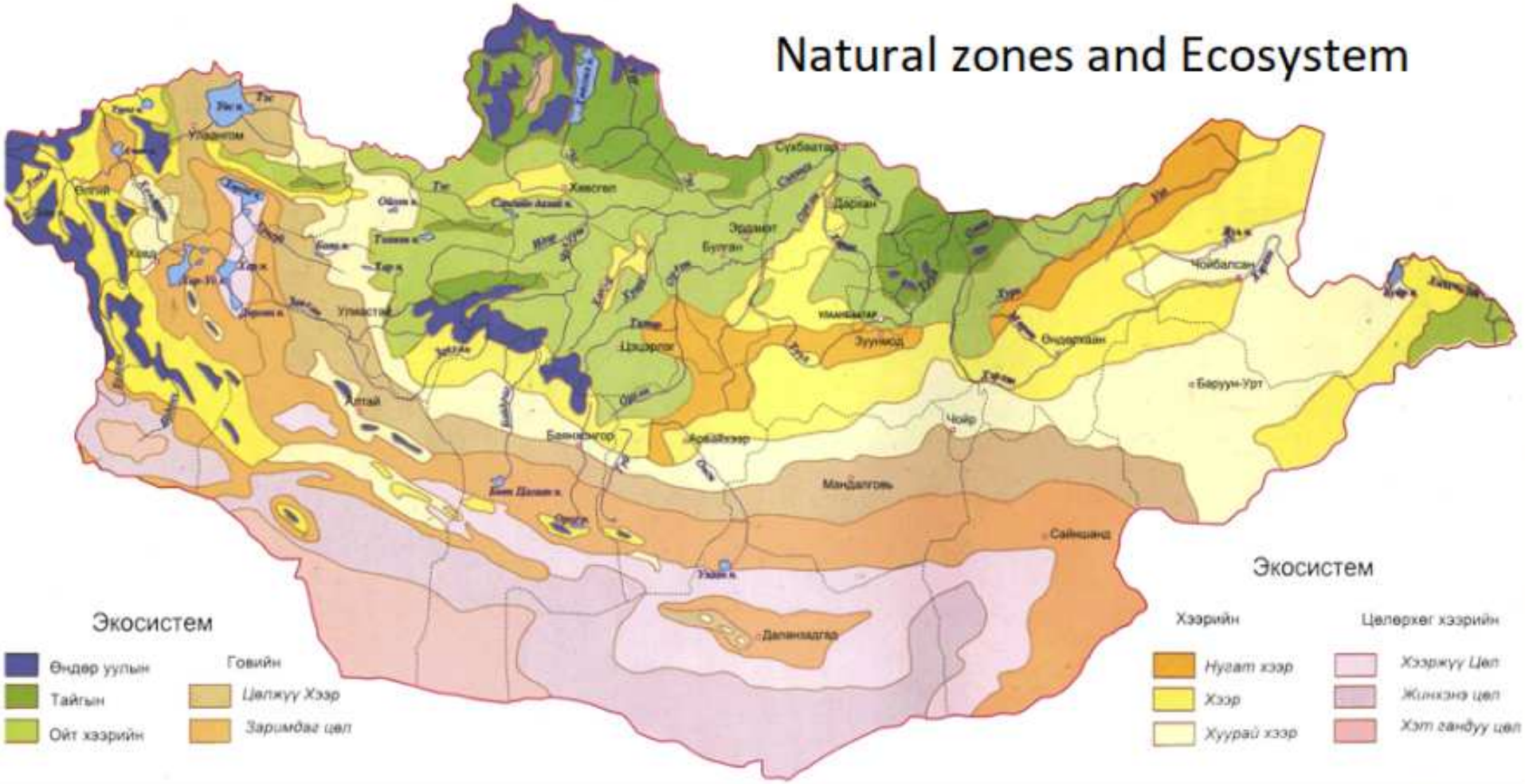


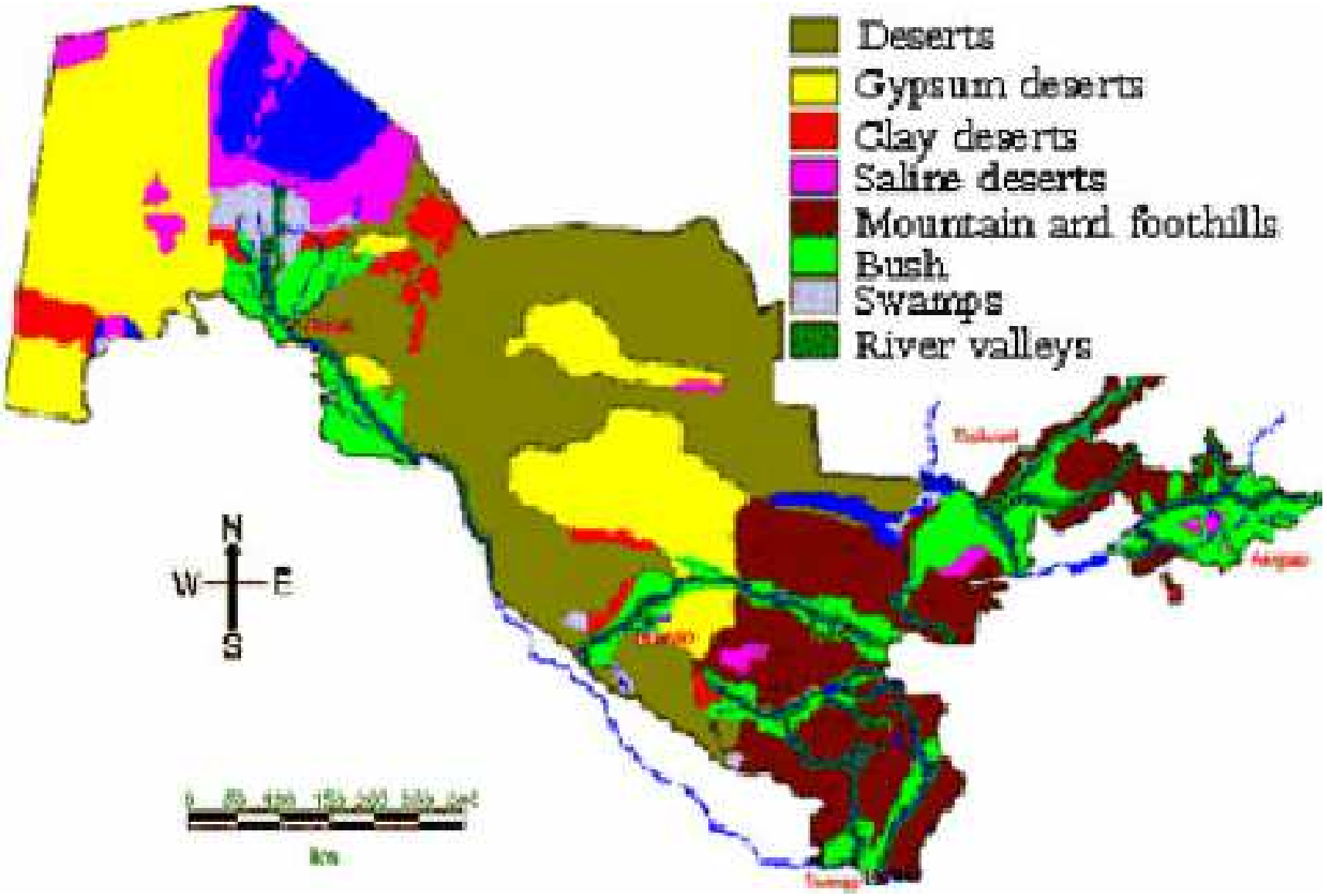



**Mongolia nature and geography**

Mongolia is located in between Russia and China. The highland with an area of 1,565,000 km2 and a population of 3 million,

Mongolia has one of the coldest climates in the world, with temperatures dropping below -25$^{o}$C for several months each year but summer is hot and not so long.

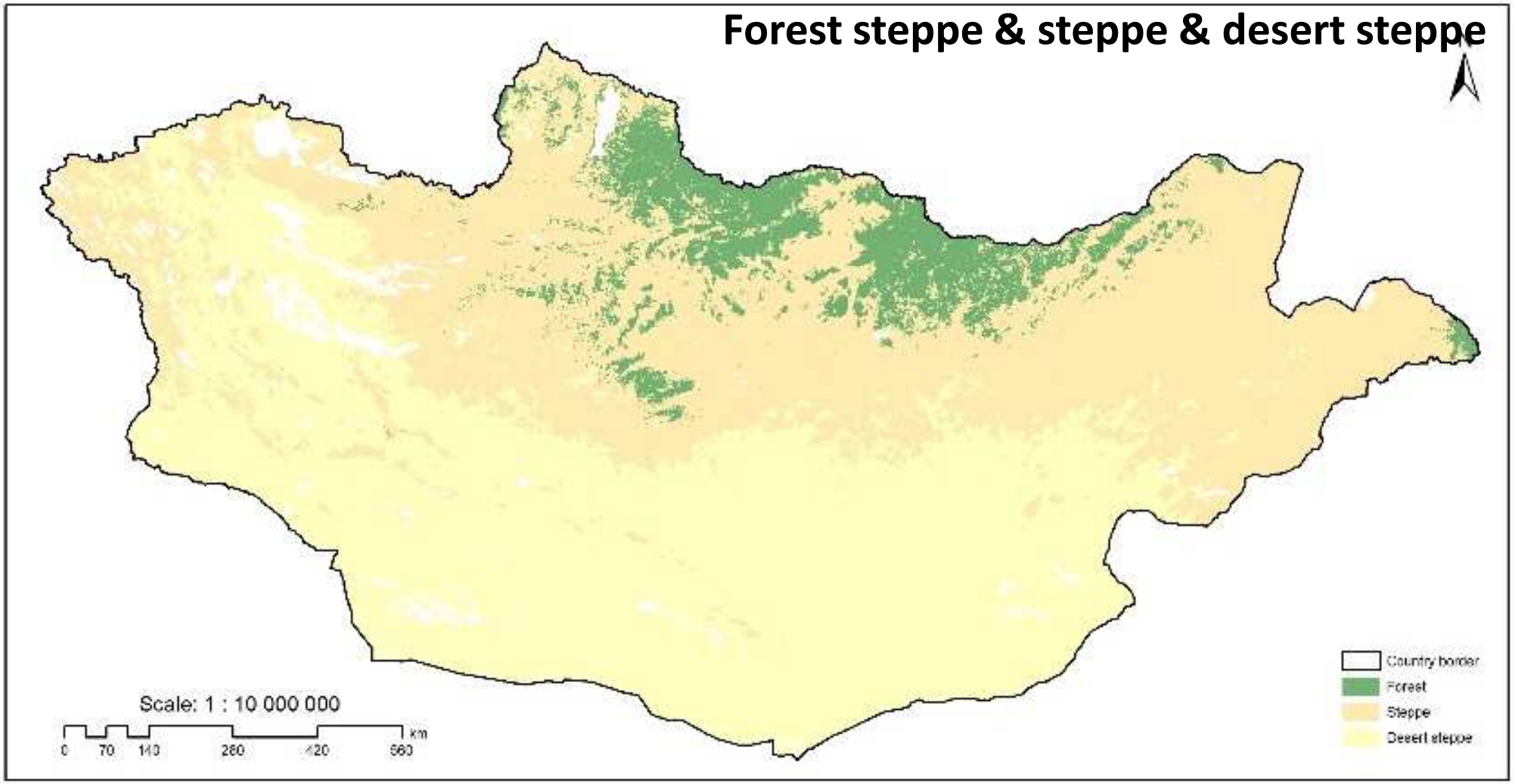

Natural zones and Ecosystem
Экосистем
Өндөр уулын
Тайгын
Ойт хээрийн
Говийн
Цөлжүү Хээр
Заримдаг цөл
Экосистем
Хээрийн
Нугат хээр
Хээр
Хуурай хээр
Цөлөрхөг хээрийн
Хээржүү Цөл
Жинхэнэ цөл
Хэт гандуу цөл

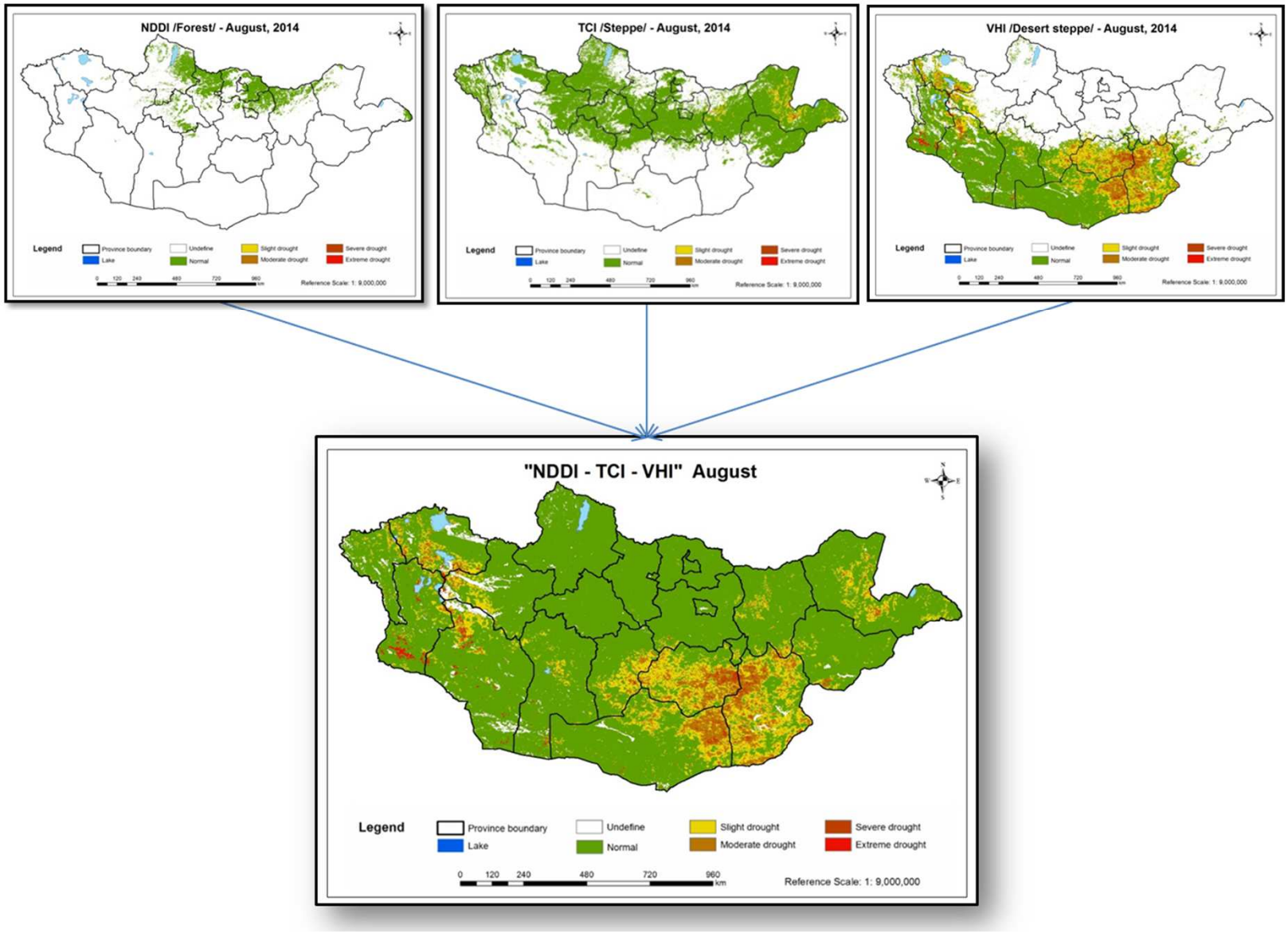

Deserts
Gypsum deserts
Clay deserts
Saline deserts
Mountain and foothills
Bush
Swamps
River valleys
N
W
E
S

# Lesson 1:

- So many natural zones and not possible to monitoring a Drought by one remote sensing aridity index

# Forest steppe & steppe & desert steppe





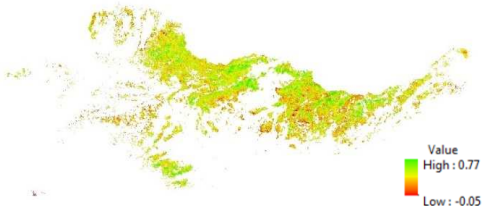

**Forest steppe & steppe & desert steppe**

## *Used data & Methodology*

Normalized Difference Water Index (NDWI)

$$NDWI = \frac{NIR - SWIR}{NIR + SWIR}$$

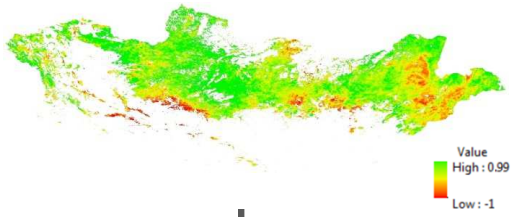
NDWI – Forest




Vegetation Condition Index (VCI)

$$VCI = \frac{NDVI_j - NDVI_{min}}{NDVI_{max} - NDVI_{min}}$$

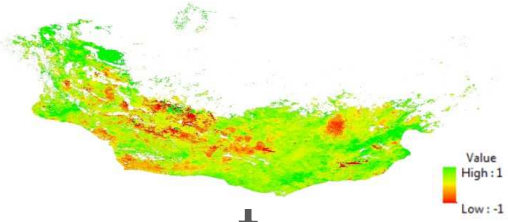
VCI – Steppe



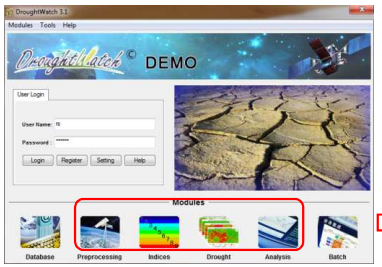

Vegetation Health Index (VHI)

$$VHI = 0.5 \times VCI + 0.5 \times TCI$$

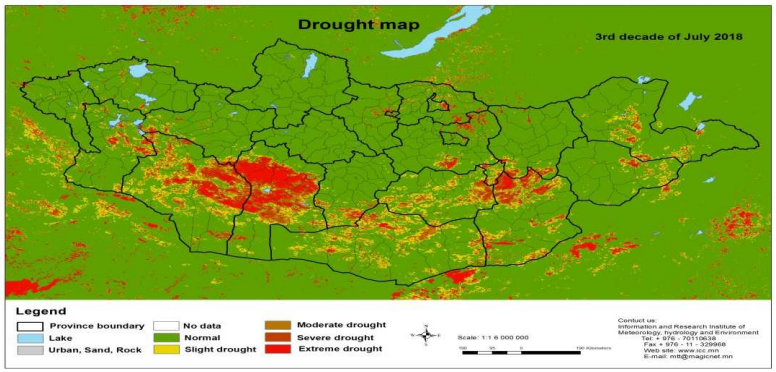
VHI – Desert




DroughtWatch system

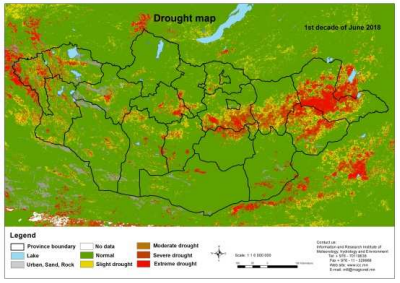



Extracting, Setting the threshold value & Classifying

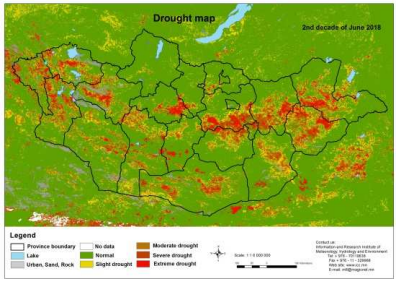



# *Drought map from DroughtWatch system*

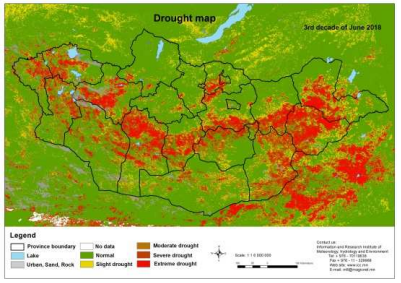
Drought map of MODIS, 2018



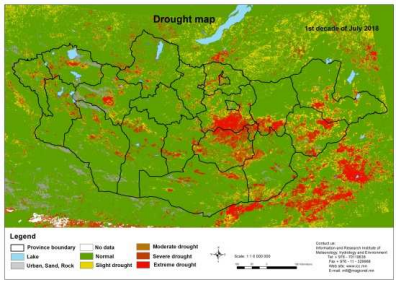

1st decade of June



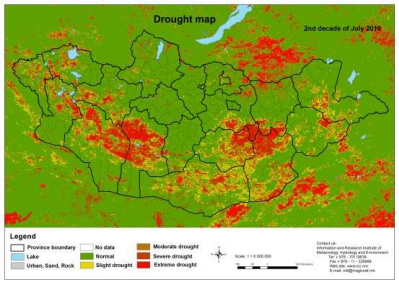

2nd decade of June



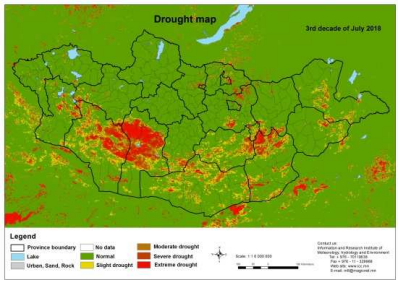

3rd decade of June



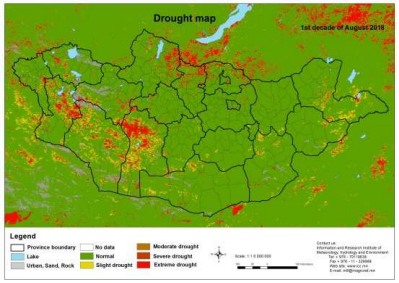

1st decade of July



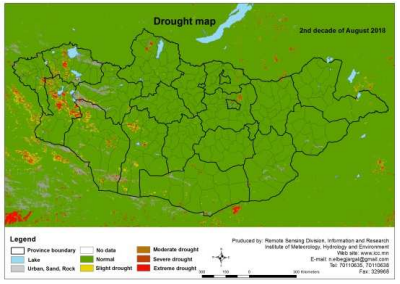

2nd decade of July



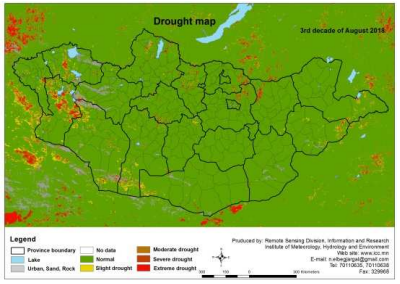

3rd decade of July




1st decade of August



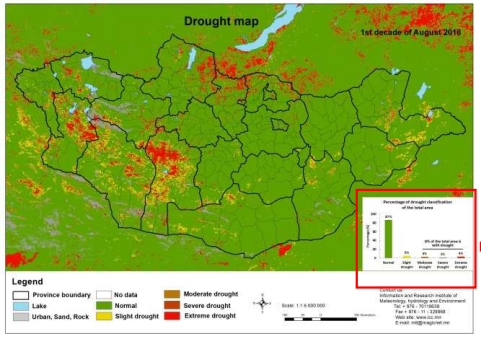

2nd decade of August

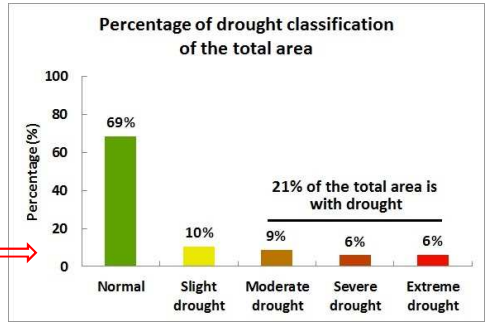



3rd decade of August

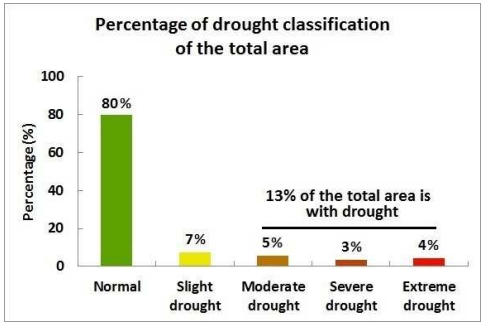
## *Each class of drought by percent in 2018*

Percentage of drought classification of the total area, 2018

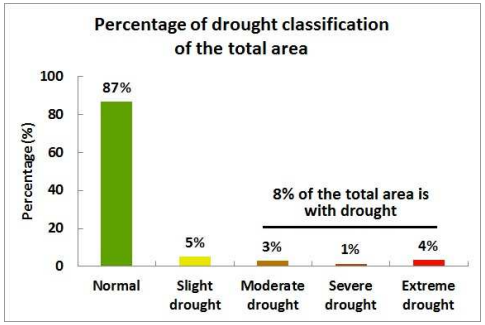


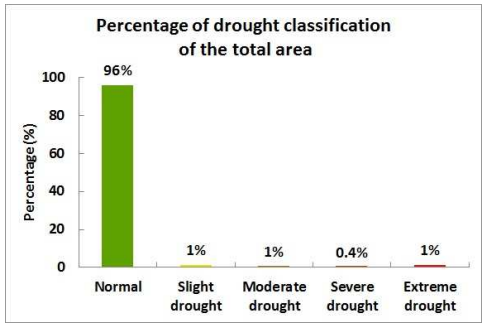

2nd decade of July



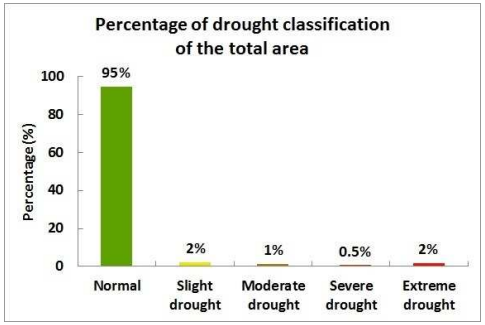

3rd decade of July




1st decade of August




2nd decade of August




3rd decade of August

## *Output drought reports in province level in 2018*

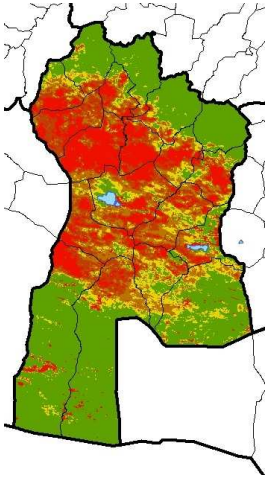
Drought map can provide the drought affected area by province level and each class of drought over selected period.

**Percentage of the drought classification in province level, second decade of July 2018**

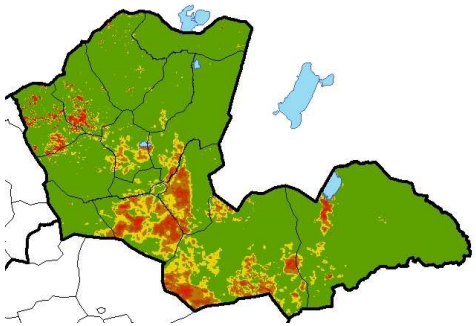
| | Province name | Arkhangai | Bayan-Ulgii | Bayankhongor | Bulgan | Dornogobi | Dornod | Dundgobi | Gobi-Altai | Gobisumber | Zavkhan |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Percentage of the drought classification, | Normal | 98 | 69 | 47 | 98 | 40 | 81 | 43 | 56 | 1 | 72 |
| | Slight drought | 1 | 12 | 11 | 1 | 18 | 9 | 19 | 12 | 2 | 10 |
| | Moderate drought | 0.4 | 10 | 14 | 0.3 | 18 | 6 | 20 | 13 | 8 | 9 |
| | Severe drought | 0.2 | 5 | 13 | 0.2 | 15 | 3 | 12 | 10 | 37 | 5 |
| | Extreme drought | 1 | 4 | 16 | 1 | 9 | 1 | 6 | 10 | 52 | 4 |
| | **Province name** | **Uvurkhangai** | **Umnugobi** | **Khovd** | **Khuvsgul** | **Khentii** | **Selenge** | **Sukhbaatar** | **Tuv** | **Uvs** | **Average** |
| Percentage of the drought classification, | Normal | 90 | 61 | 70 | 91 | 75 | 86 | 74 | 79 | 69 | 69 |
| | Slight drought | 4 | 19 | 9 | 3 | 6 | 5 | 13 | 8 | 8 | 10 |
| | Moderate drought | 2 | 11 | 9 | 2 | 6 | 3 | 8 | 6 | 7 | 9 |
| | Severe drought | 1 | 4 | 6 | 1 | 5 | 1 | 3 | 4 | 4 | 6 |
| | Extreme drought | 3 | 4 | 6 | 4 | 8 | 5 | 2 | 4 | 12 | 6 |

Drought map in each province, 2nd decade of July 2018

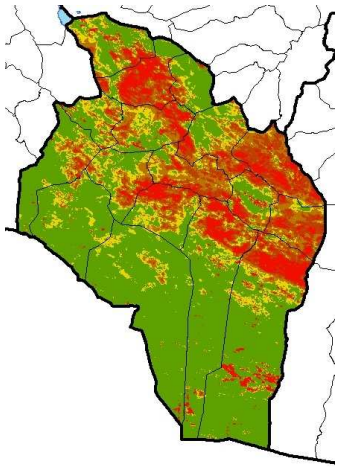
Bayankhongor



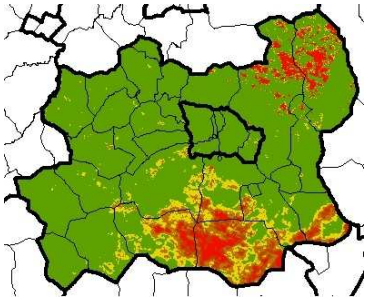
Dornod



Gobi-Altai

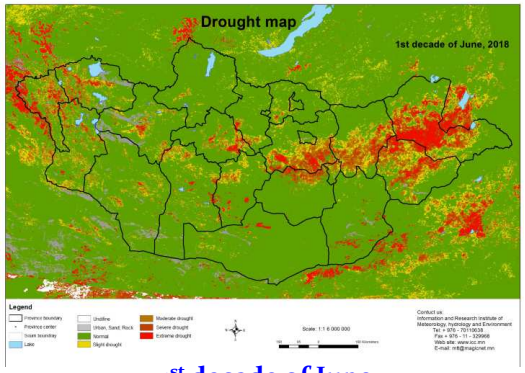


Tuv

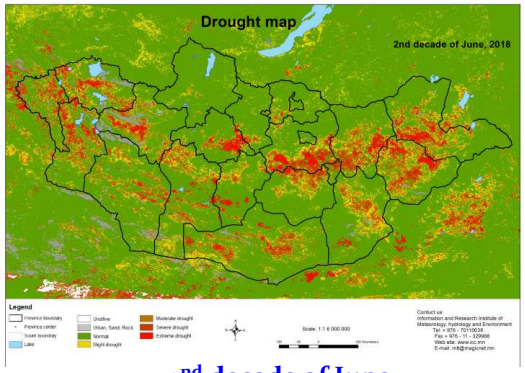


## *Output RS maps*

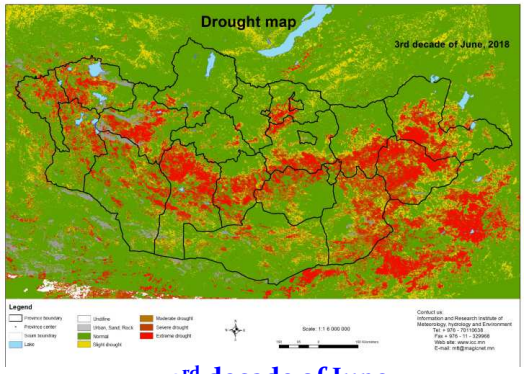
Drought map of MODIS, 2018




1st decade of June

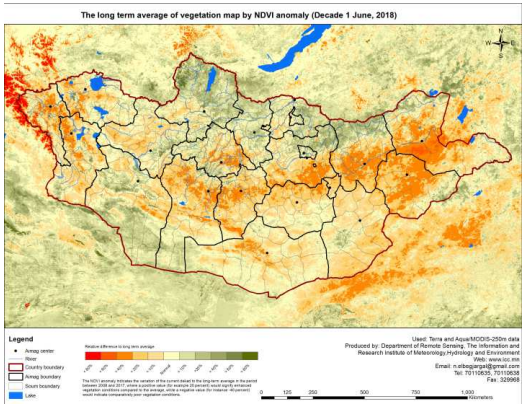



2nd decade of June

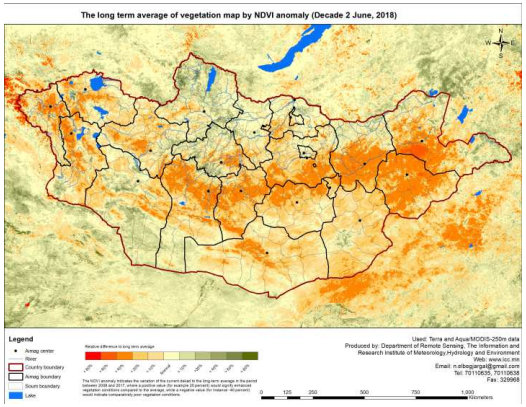



3rd decade of June

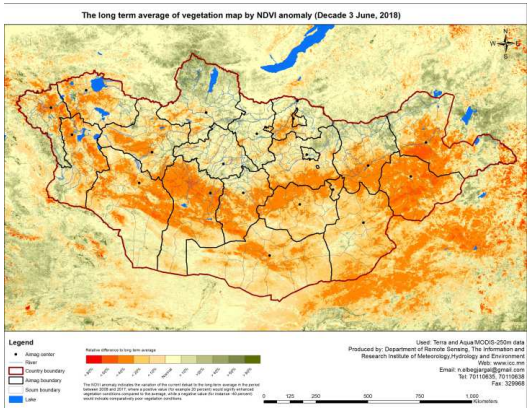
NDVI anomaly map of MODIS, 2018




1st decade of June



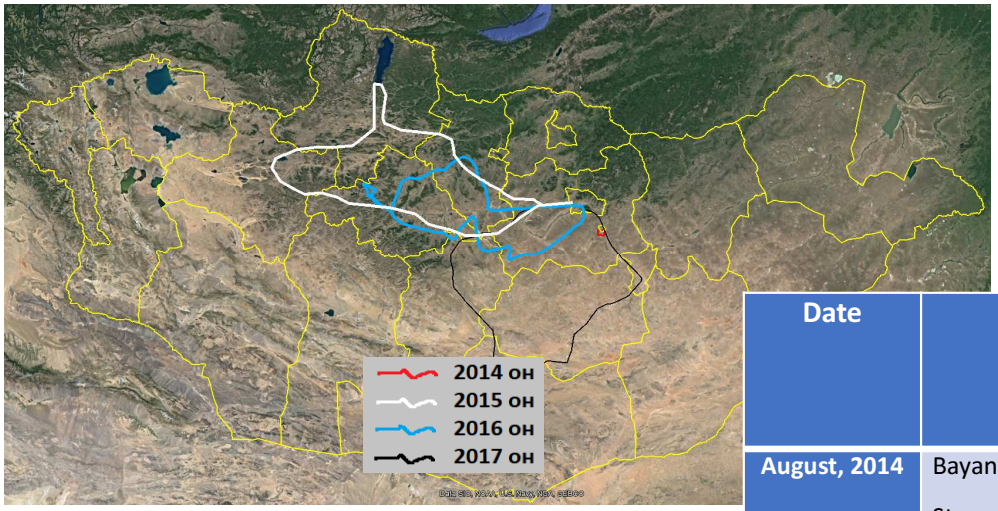

2nd decade of June




3rd decade of June

DroughtWatch system has been well assessed in the maps of drought gives good results, similar picture as NDVI anomaly map.

# Field trip.




| Date | Area of field survey | Number soil moisture measuremnts | Number of biomass measurement | Number of radiance temperature measurement |
|---|---|---|---|---|
| August, 2014 | Bayan soum, Tuv aimag<br>Steppe area. Summner condition and pasture growth were as normal. | 9 | 810 | 9 |
| 27 July-5 Aug, 2015 | Tuv, Uvurkhangai, Arkhangai, Zavkhan, Khuvsgul, Bulgan, Selenge. Forest and steppe area. Summer and pasture condition were as normal | 234 | 78 | 78 |
| 24 July -13 Aug, 2016 | Tuv, Uvurkhangai, Arkhangai, Bulgan. Forest and steppe area. Summer and pasture condition were as normal | 168 | 168 | - |
| 22 July -10 Aug, 2017 | Tuv, Uvurkhangai, Dundgvo, Gobi-sumvber. Steppe and desert steppe area. Summer condition and pasture growth were very bad. | 2362 | 112 | - |

# Validation works

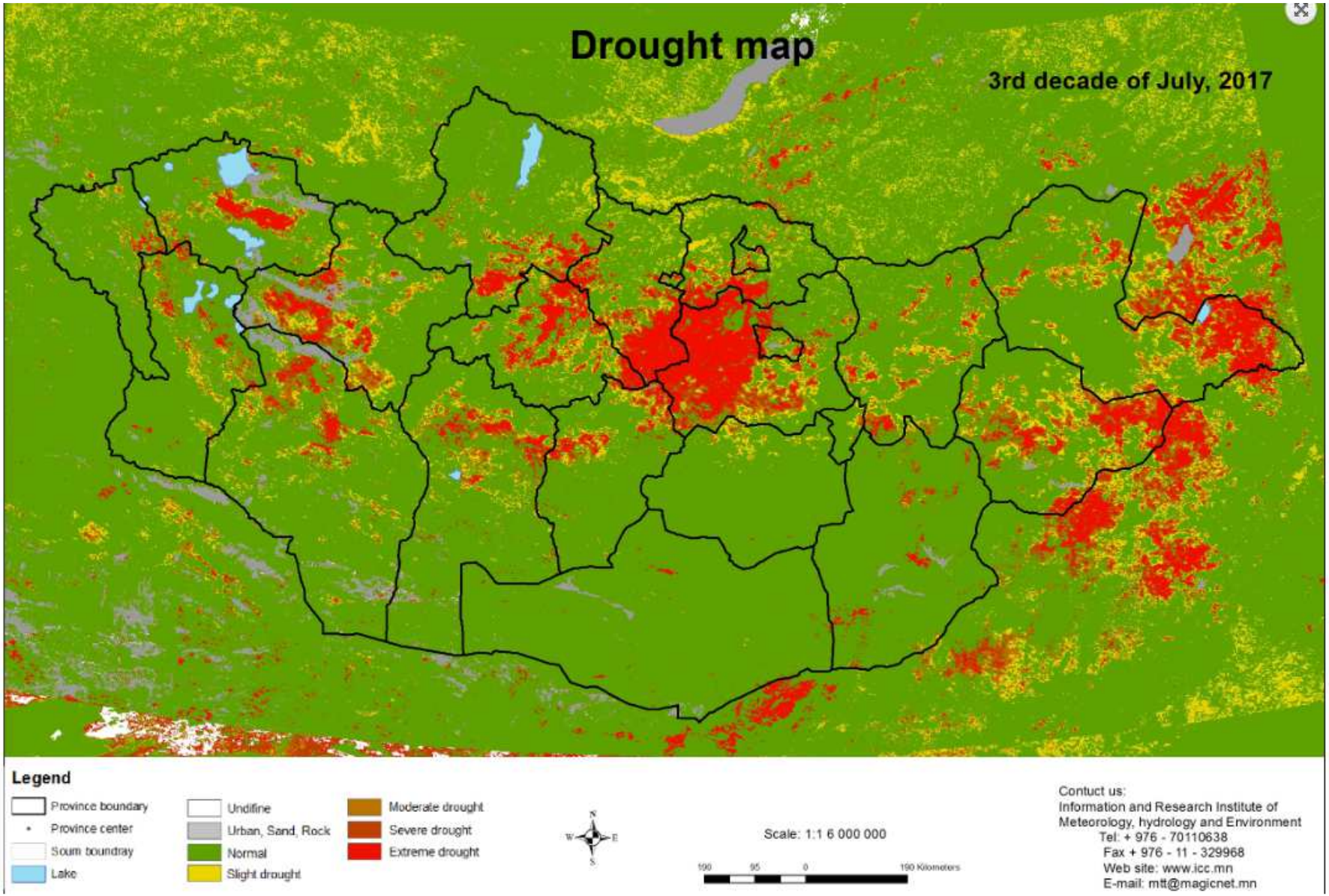
Comparing or correlation analysis were done between

**Ground indexes** as

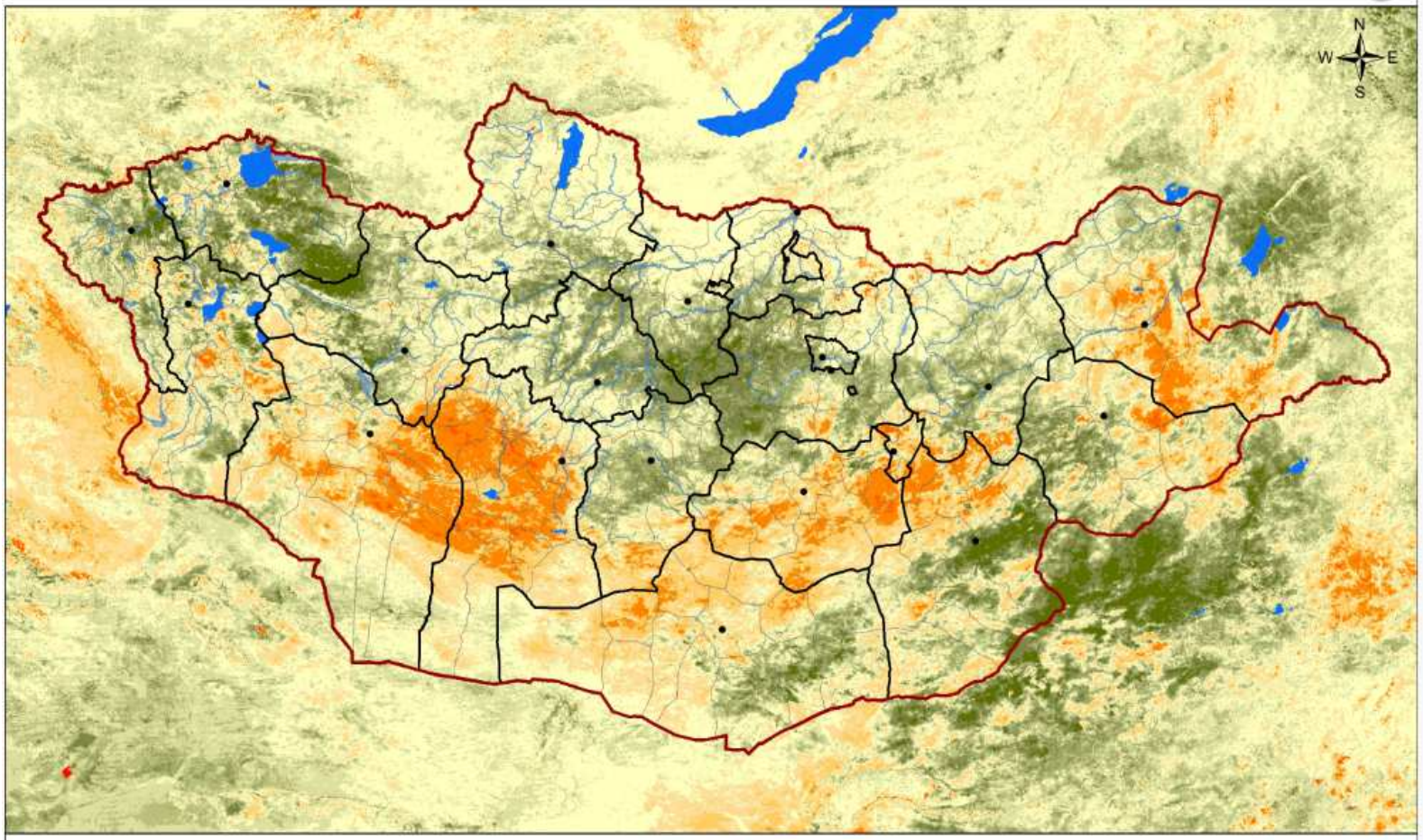
- ✓ standardized precipitation index(SPI),
- ✓ Pedi index (PED),
- ✓ ratio index of precipitation to evaporation(SPEI)
- ✓ biomass per one meter square area and its standardized value
- ✓ soil moisture at 3.5, 12, 20 cm depth

**MODIS data derived indexes** such as

- ✓ VCI,
- ✓ TCI,
- ✓ VHI,
- ✓ NDDI
- ✓ NDWI
- ✓ VSWI.


Drought map
3rd decade of July, 2017
Legend
Province boundary
Province center
Soum boundray
Lake
Undifine
Urban, Sand, Rock
Normal
Slight drought
Moderate drought
Severe drought
Extreme drought
N
W
E
S
Scale: 1:1 6 000 000
100 95 0 190 Kilometers
Contuct us:
Information and Research Institute of
Meteorology, hydrology and Environment
Tel: + 976 - 70110638
Fax + 976 - 11 - 329968
Web site: www.icc.mn
E-mail: mtt@magicnet.mn

# The long term average of vegetation map by NDVI anomaly (Decade 3 July, 2018)




**Legend**

- Aimag center
- River
- Country boundary
- Aimag boundary
- Soum boundary
- Lake

Relative difference to long term average

<60% <60% <40% <20% <10% Normal >10% >20% >40% >60% >80%

The NDVI anomaly indicates the variation of the current dekad to the long-term average in the period between 2008 and 2017, where a positive value (for example 20 percent) would signify enhanced vegetation conditions compared to the average, while a negative value (for instance -40 percent) would indicate comparatively poor vegetation conditions.

Used: Terra and Aqua/MODIS-250m data

Produced by: Department of Remote Sensing, The Information and Research Institute of Meteorology,Hydrology and Environment
Web: www.icc.mn
Email: n.elbegjargal@gmail.com
Tel: 70110635, 70110638
Fax: 329968

0 125 250 500 750 1,000
Kilometers

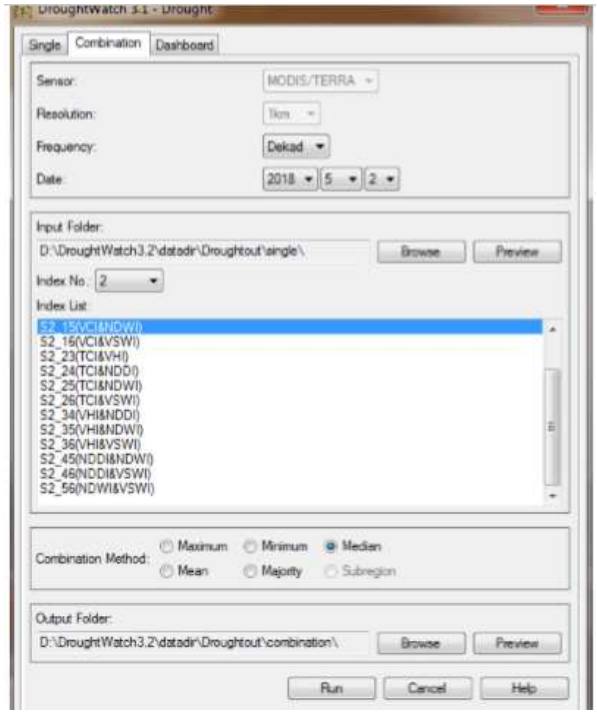
# Lesson 2:

- Although map has 5 classes: domain like to 1 class – Drought but in nature many types of pasture condition.

## System advantage

**The interface is well designed and easy to use.**

- The interface is grouped and separated as layout.
- Input parameter to the system is easy by selecting from the drop-down list as below.

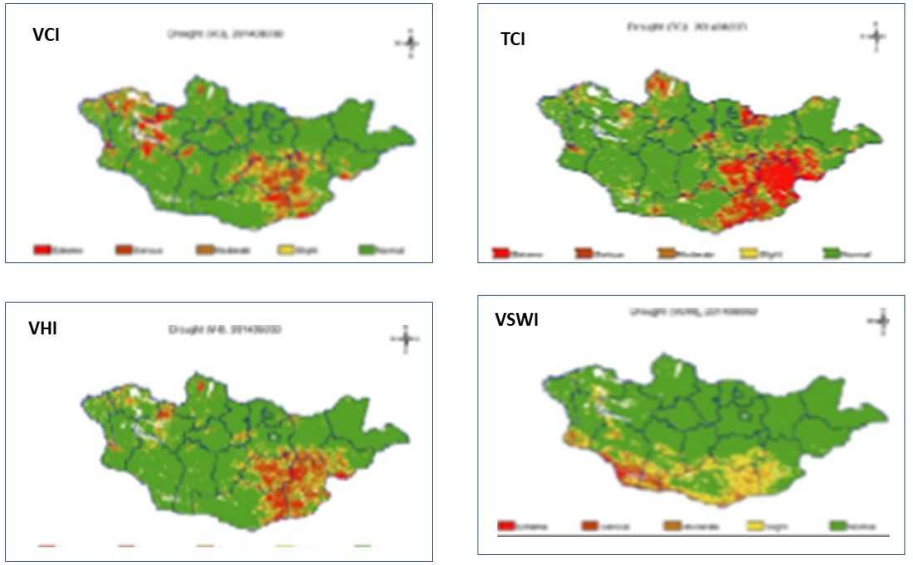


## System advantage

**Analysis tools are powerful.**

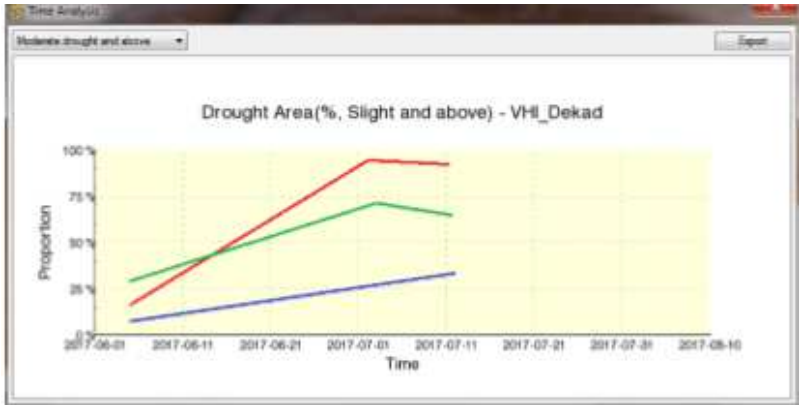
The system has tool ”Dashboard” to simultaneously view multiple images or maps displaying several maps in one window

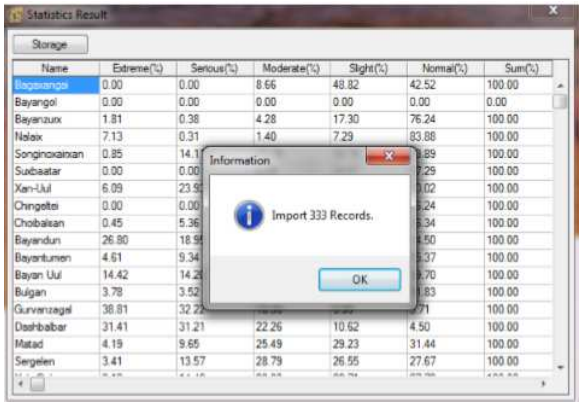
It helps to analyze and compare maps derived from different indices.



## System advantage

The system has tool ”Analysis”
to analyse drought over time and spatial coverage.
It is so useful to track and analyze drought between selected dates and calculate statistics over country or selected administrative unit.




Results can be presented in graph and table form

| Week | гангүй | гандуу | гантай |
|---|---|---|---|
| 2018-05-29 | 57.44 | 42.56 | 26.42 |
| 2018-05-22 | 56.68 | 43.32 | 26.72 |
| 2018-05-15 | 54.36 | 45.64 | 28.28 |
| 2018-05-08 | 55.56 | 44.44 | 27.67 |
| 2018-05-01 | 57.24 | 42.76 | 28.60 |
| 2018-04-24 | 57.51 | 42.49 | 28.99 |
| 2018-04-17 | 57.19 | 42.81 | 28.85 |
| 2018-04-10 | 53.50 | 46.50 | 29.69 |
| 2018-04-03 | 52.45 | 47.55 | 29.42 |

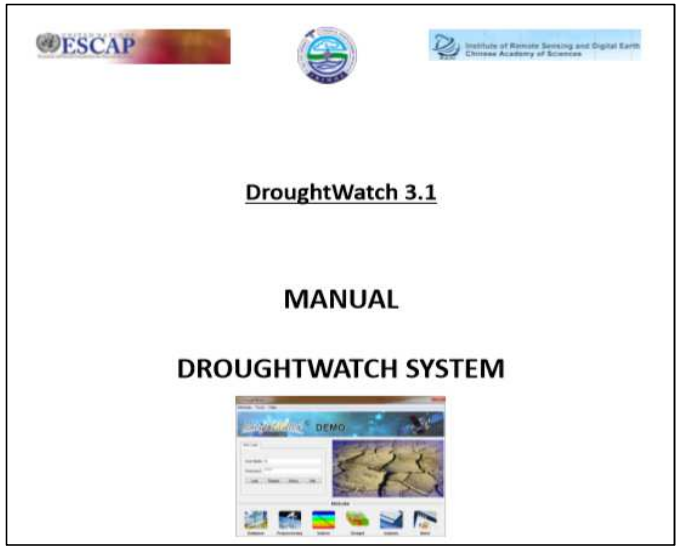
## DroughtWatch system advantage

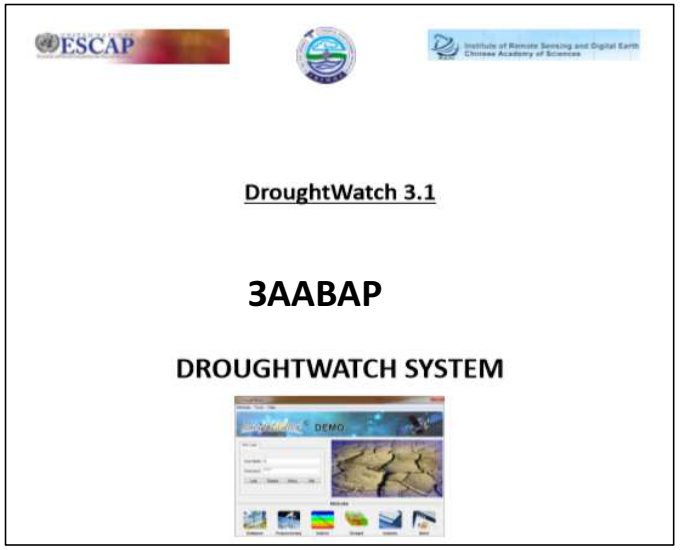
### More automated.

A tool “Batch” helps to process a series of data in any time program automatically without intervention. It is very useful tool to save your time and increase computer use efficiency

## DroughtWatch system advantage

System user manual existed in Mongolian and English



## System disadvantage

- System is not server based
- System has limited licences
- System is only in English
- System not open to public

# *Summary*

- DroughtWatch system helps to analyze and compare maps derived from different indices.
- DroughtWatch system has been well produced the drought map and gives good results, similar picture as ground measurement and NDVI anomaly map.
- Human resource capacity has improved during this project.