

Agriculture and Drought In Mongolia

*Regional workshop on understanding the operational aspects of
the drought observation system in Mongolia*

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17 Sep 2018

Country profile

Geography	Northern Asia, between China and Russia, landlocked
Territory	1.566.500 sq.km. (17th largest land in the world)
Population	3.08 million (as of 2017)
Capital	Ulaanbaatar
GDP	\$10.27 billion
Per capita	\$3,641 (as of 2017)

Country geographic

The Great Mongolian territory contains extensive region of several landscape, and is located in the north part of the Russia and south-eastern part of the China.

Precipitation fall higher in the north (average of 200 to 350 millimeters per year) and lower in the south regions which ranges between 100 to 200 millimeters annually. Most part of the country is hot in the summer and extremely cold in the winter, with January averages dropping as low as -30°C .

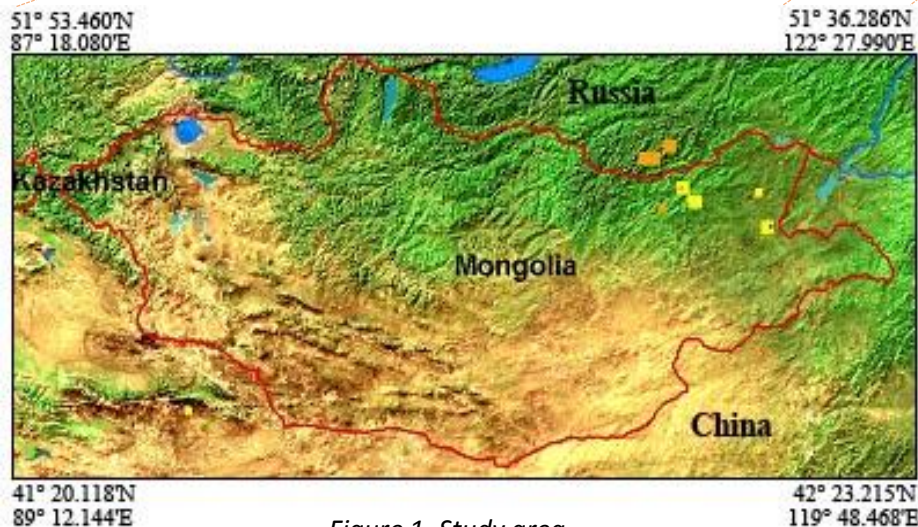
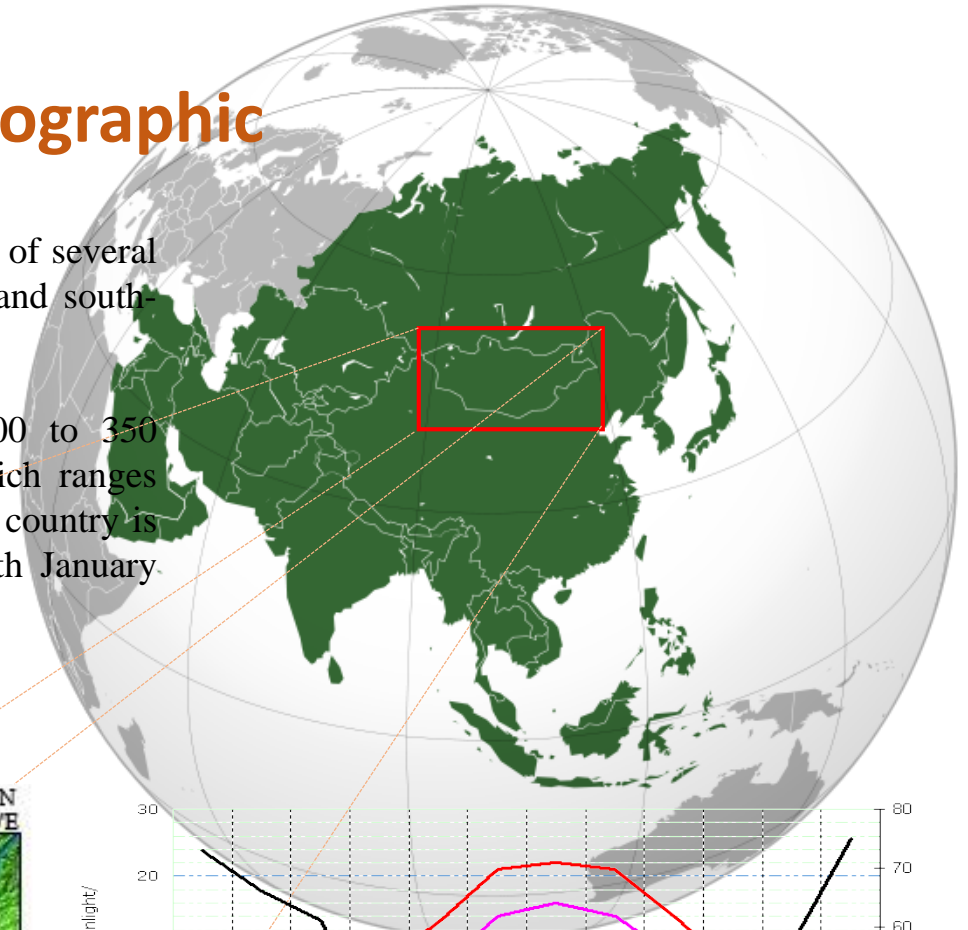


Figure 1. Study area.

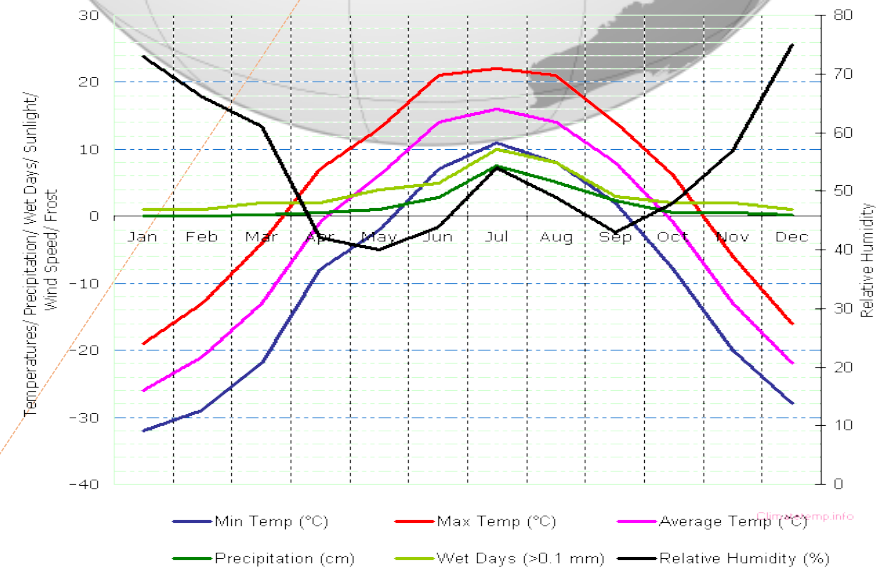
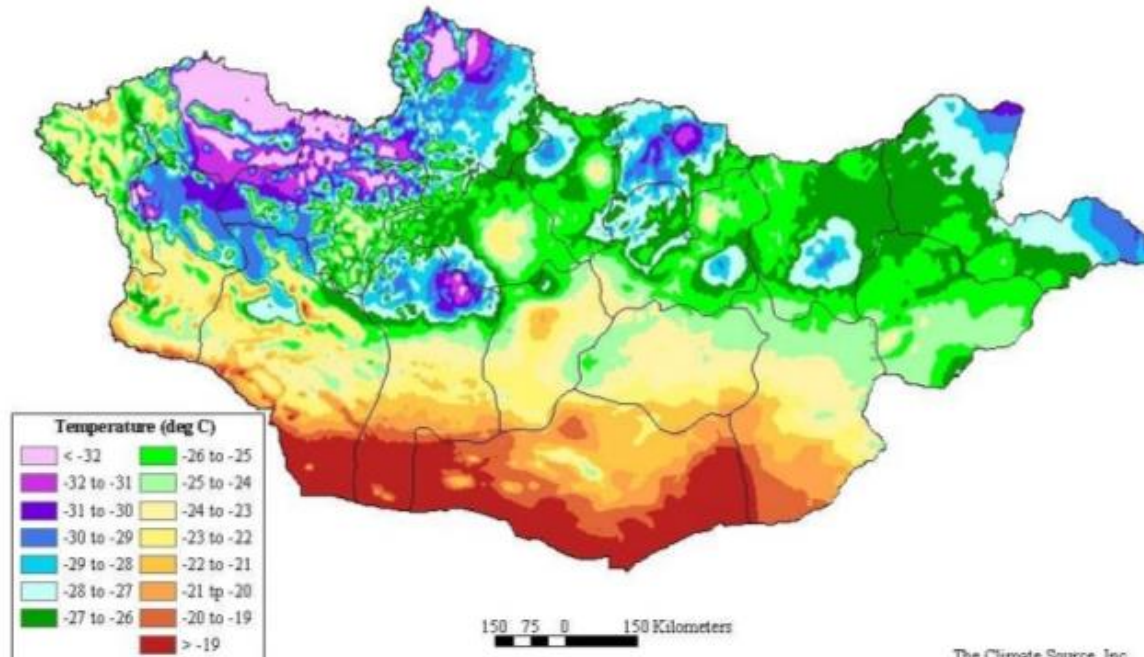


Figure 2. Climate graph, Mongolia.

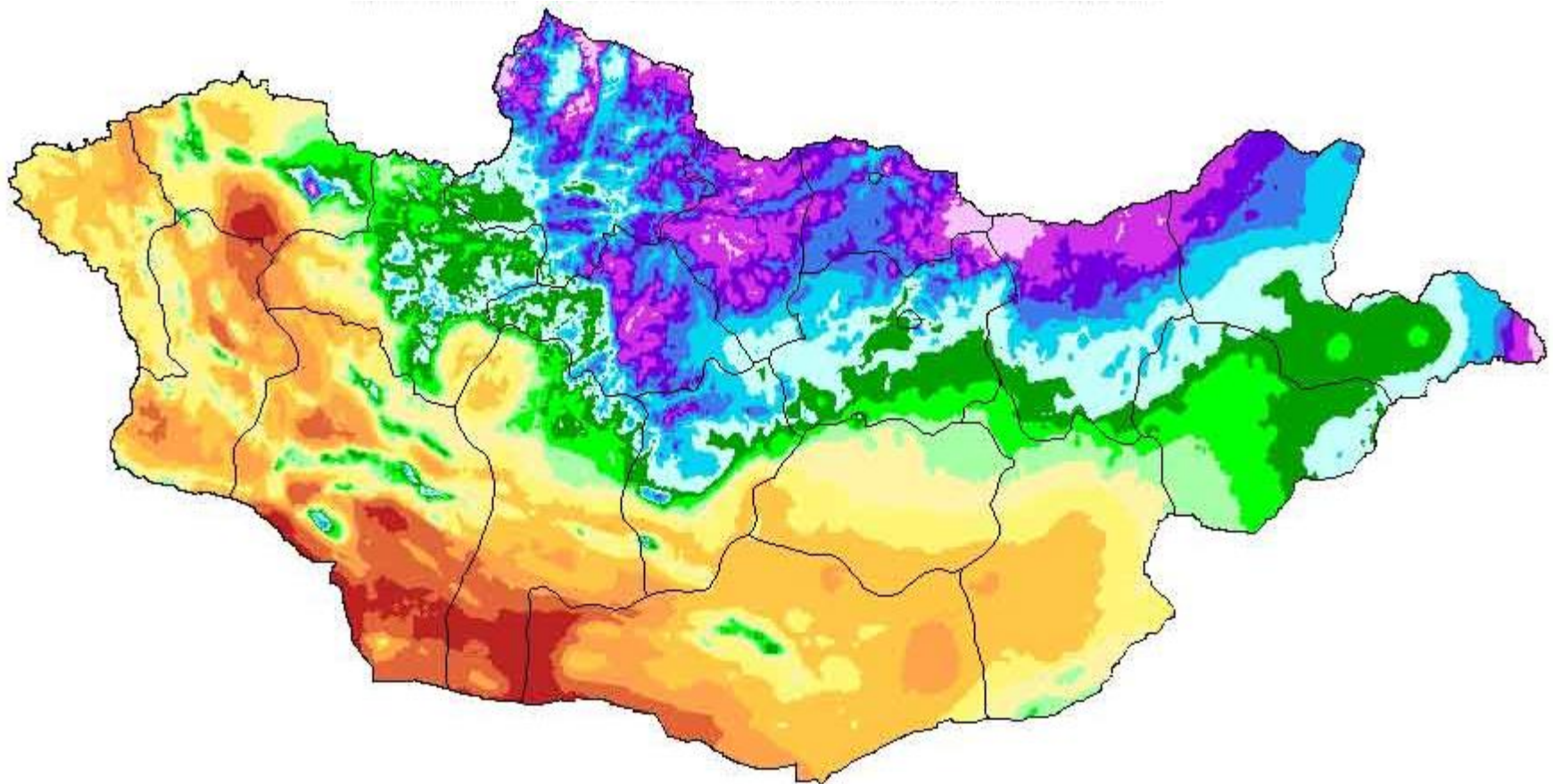
Topographic and temperature



PRISM 1961 - 1990 January Mean Minimum Temperature, Mongolia



Annual precipitation



120 60 0 120 Kilometers

Map Created: November 2002

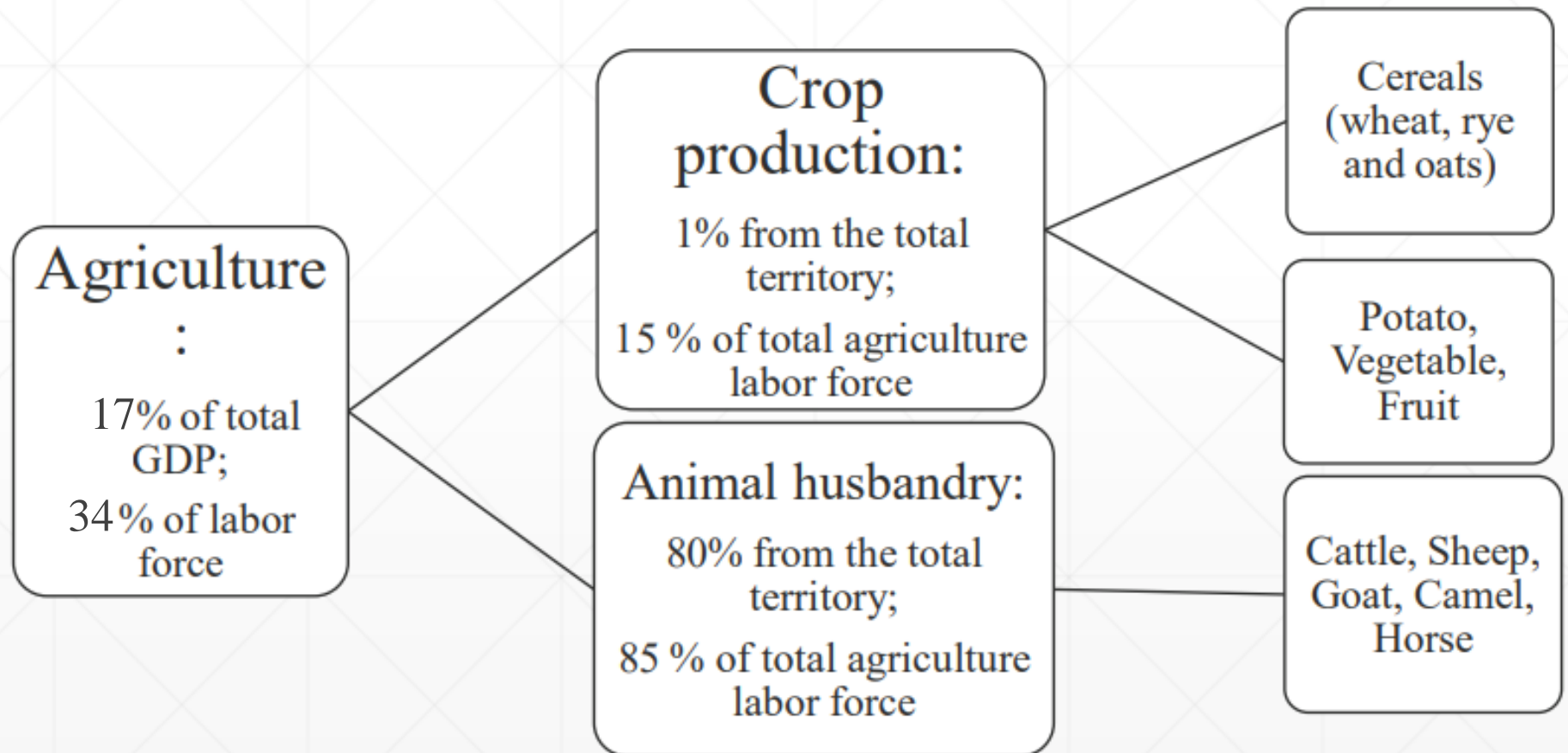


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The Climate Source, Inc.
www.climate-source.com

Agriculture in Mongolia

Main Components of Agriculture Mongolia



Livestock census

The total number of livestock is estimated at **66 218 959** thousand by 2017



3 939 813



4 388 455



434 096



30 109 888



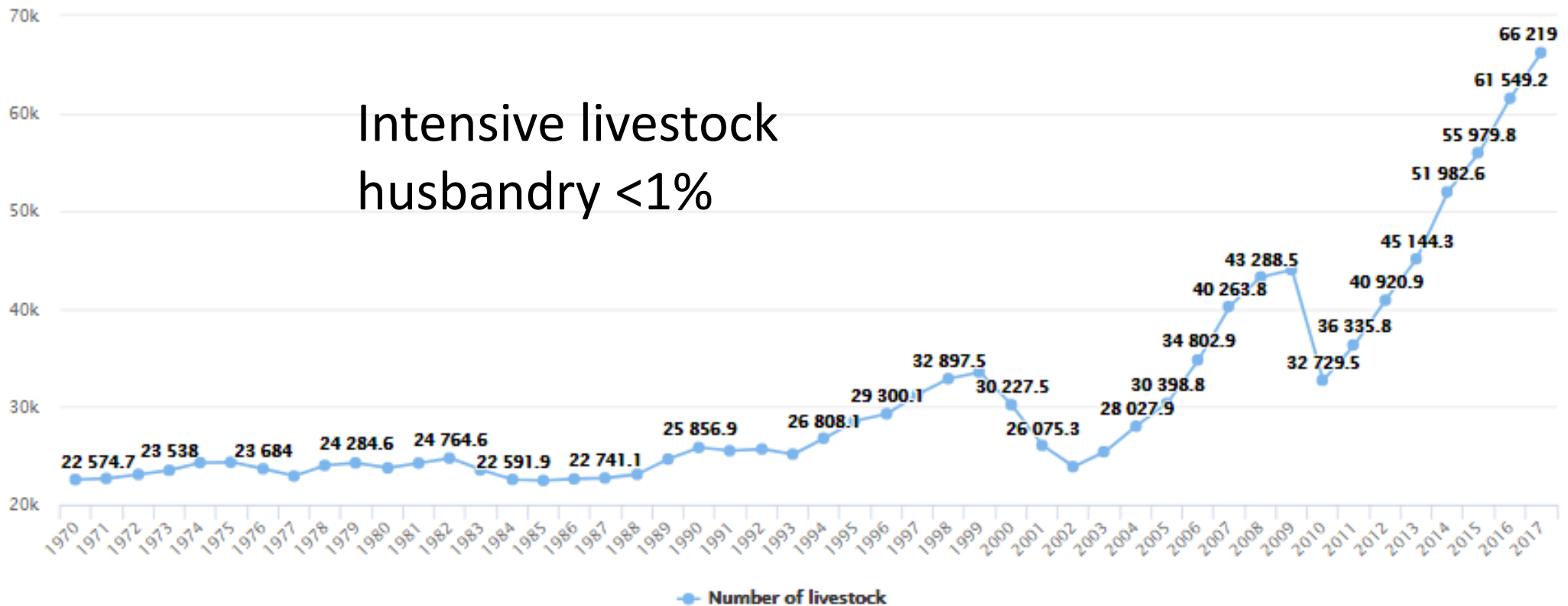
27 346 707

Livestock census

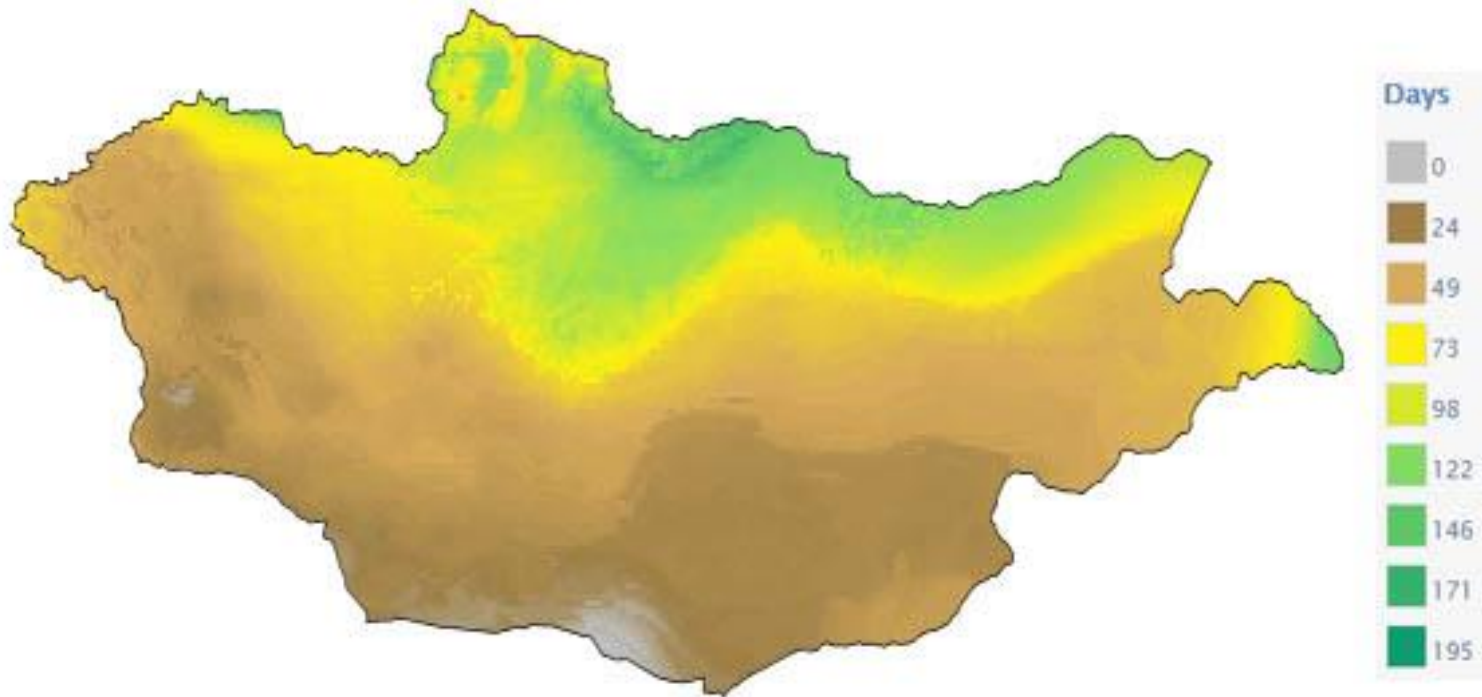
Total number of livestock 1970 – 2017

Source : National Statistical Office

Intensive livestock
husbandry <1%



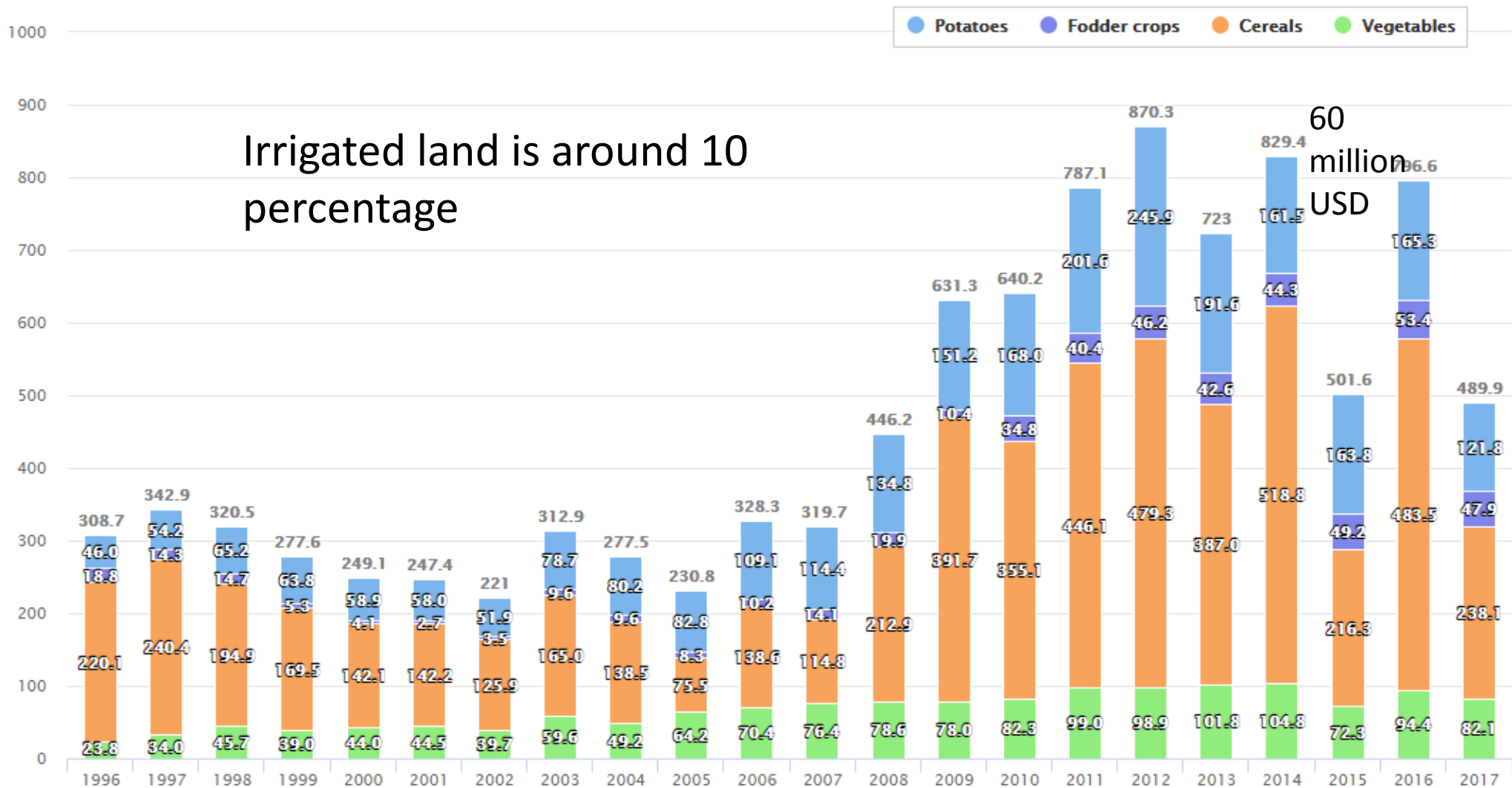
Crop growing season



The cropping duration takes 90-140 days

Crop production

TOTAL CROPS, by type of plants, thousand tons

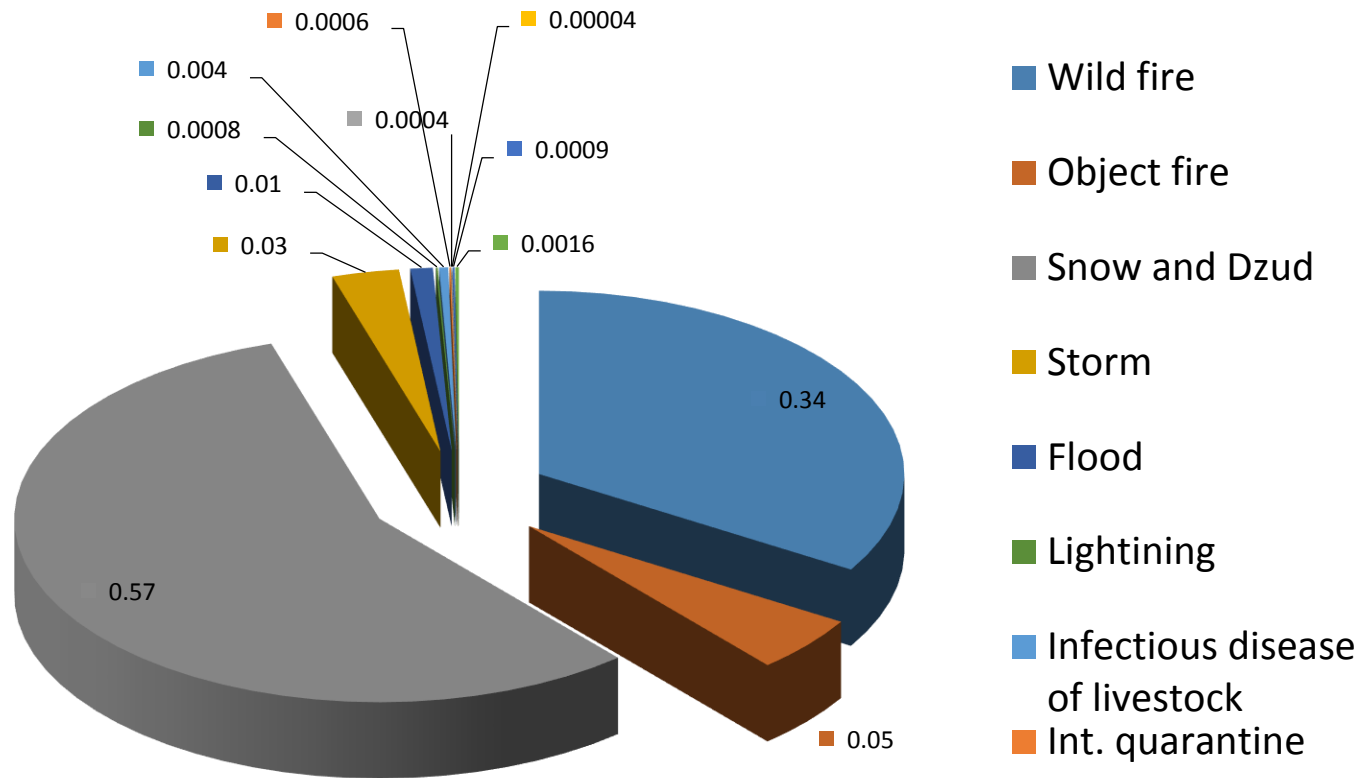


Crop diversification and Domestic supply

Crop	Planted area /000'.ha/	Harvest /000' tn/	Domestic supply, %
Cereals	373,2	475,9	100
Potato	16,2	242,7	100
Vegetables	7,1	98,4	52
Fruits	4,5	1043	0,5

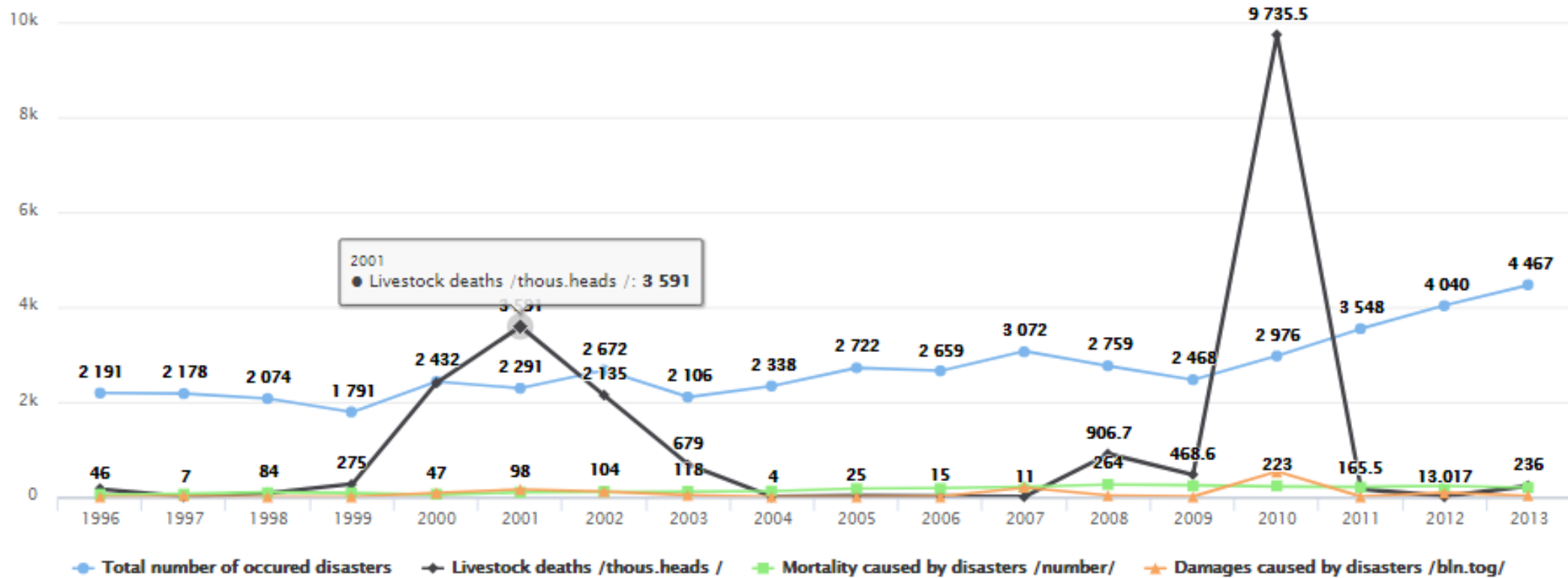
Types of natural hazards in Mongolia

Major hazards	Minor hazards
Drought	Lightning
Heavy snow	Locust infestations
Zud	Plague
Flood (three types)	Epidemic disease
Cold rain, hail	Ecological hazards
Wildfire	Industrial hazards
Dust storm	Toxic chemical
Desertification	Radiation
	Accident (road/air)



Counted damage from the natural disasters

Statistics of natural disaster



Partly inference

- Mongolia's **climate** is characterized by long and cold Winters, dry and hot summers, **low precipitation**, **high temperature** fluctuations.
- Mongolia is **vulnerable** country to disasters. The frequency and magnitude of natural disasters (drought, dzud, fire) have tendency to increase due to climate change and global warming.
- Agriculture still plays the **second major role** in the national economy. The agriculture sector employs 35 percent of the total population, produces 17.9 % of GDP and accounts for 30 percent of the country's export.

DROUGHT

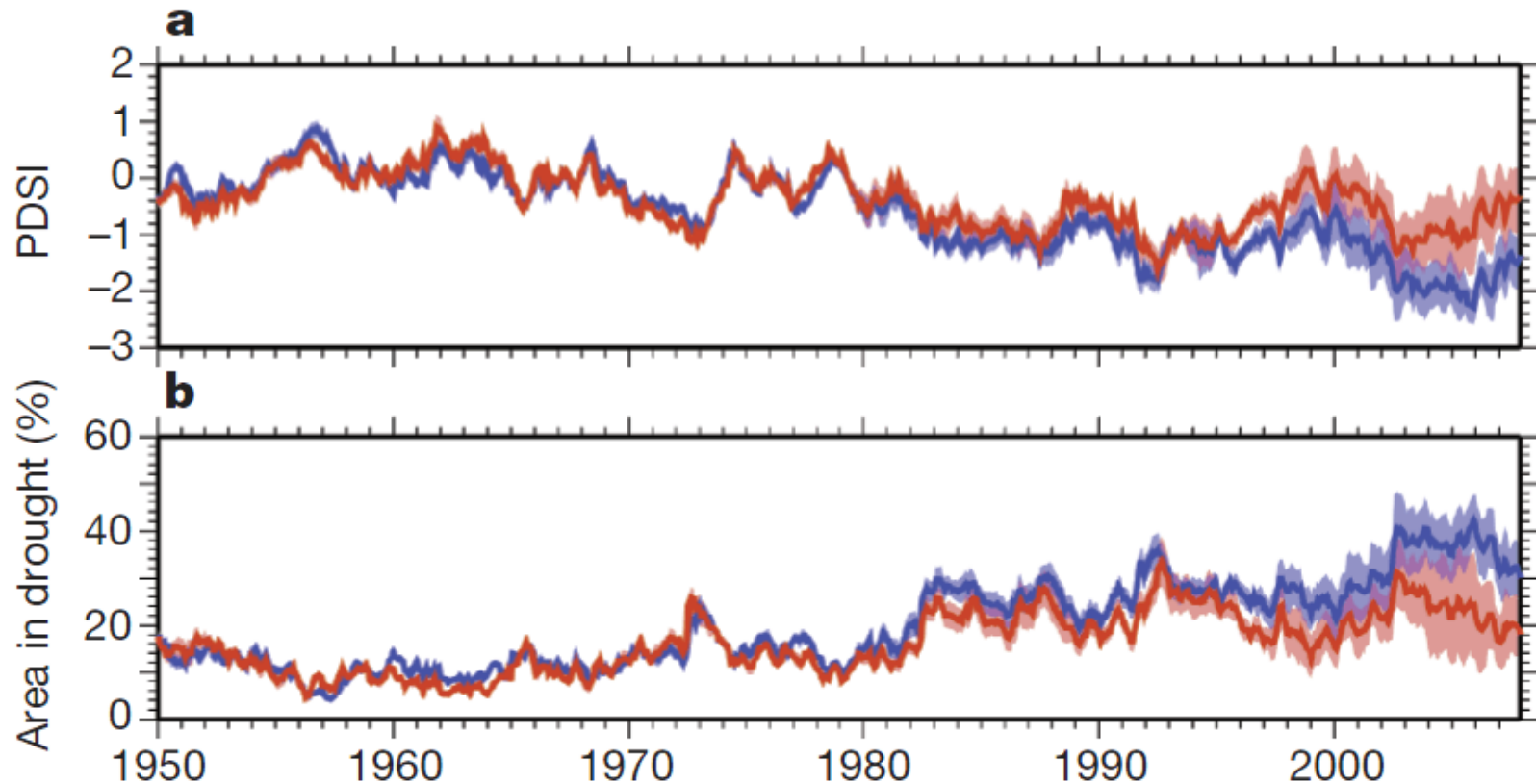


Lun, Tuv aimag, Mongolia 25 July 2017



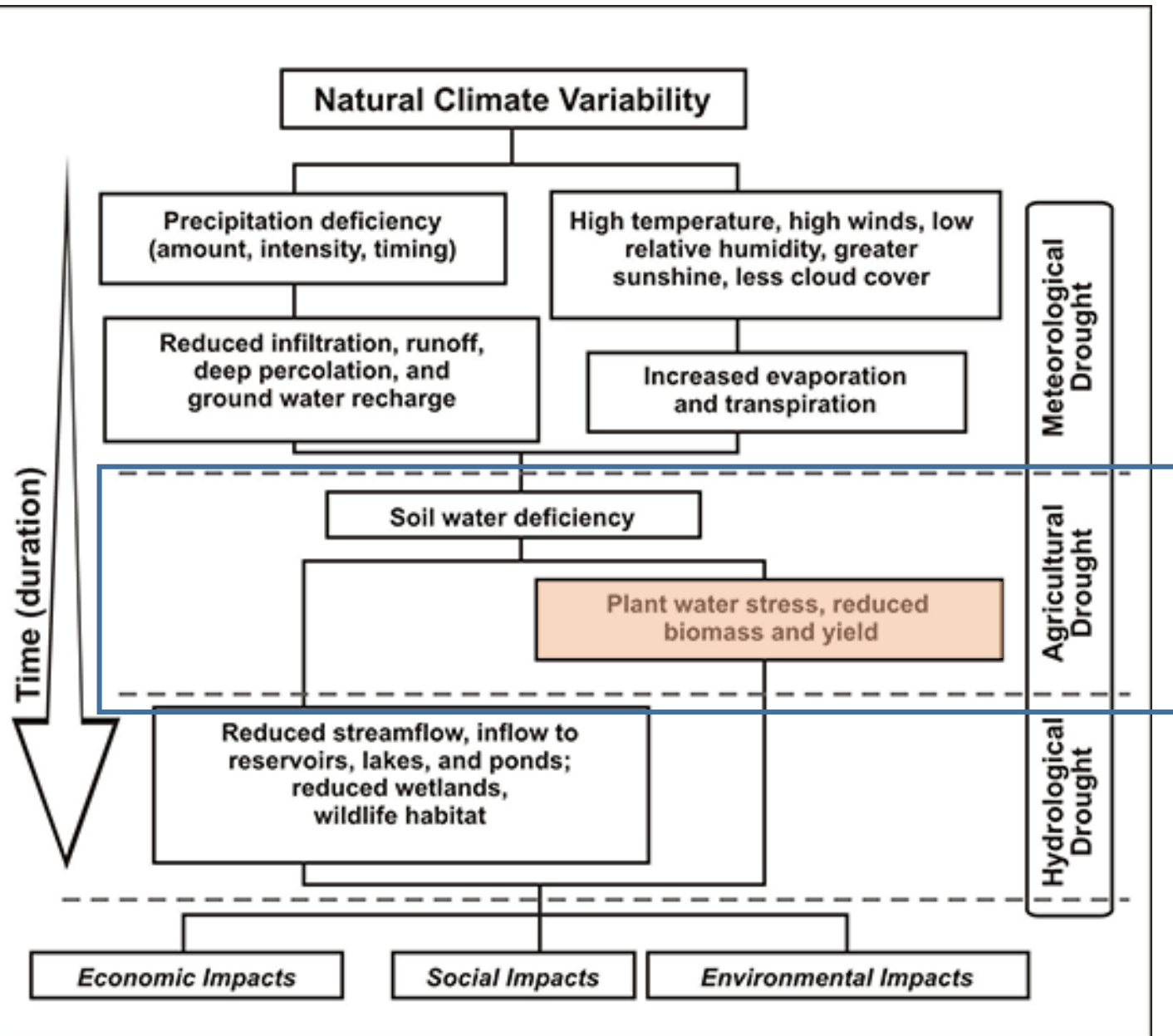
Global drought

Drought is a part of the earth's climate. It occurs every year with no warning, without recognizing borders or economic and political differences. Of all natural disasters, drought affects the largest number of people. During 1967–91, drought affected 51% of the 2.8 billion people were affected by natural disasters (Obassi 1994).



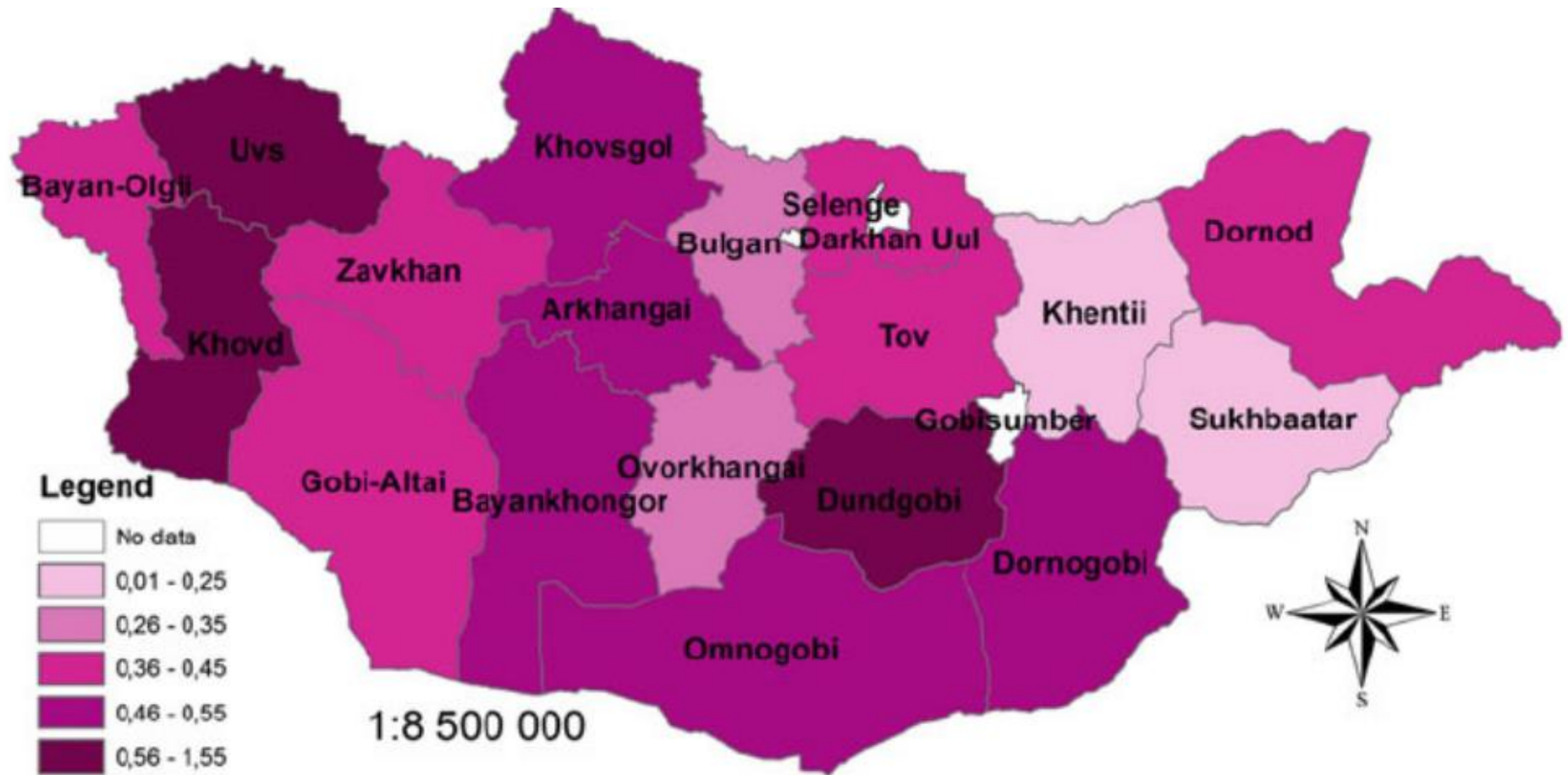
Global average time series of the PDSI and area in drought. The Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC)

Agriculture drought



Source: National Drought Mitigation Center and Bureau of Meteorology, 2005

Vulnerability Assessment of Social-Ecological



Disaster situation in the country

- Major Disaster in Mongolia

Drought, Dzud, (WildFire)

- Dzud- harsh winter(cold + heavy snow)
- **Drought** occurs every year affecting 30 – 70% of total area=> inadequate pasture, hay and fodder.
- Drought in summer followed by dzud in winter => livestock lossess.

Drought event in Mongolia

A phenomenon known in Mongolian as a 'Dzud' - severe summer drought followed by heavy snow and extremely low winter temperatures - has affected 19 of Mongolia's 21 provinces.

During the period from 1999 to 2002, 2007 Mongolia experienced a series of droughts and severe winters that lowered livestock numbers by approximately 30% countrywide. In the Gobi region, livestock mortality reached as much as 50% with many households losing entire herds.

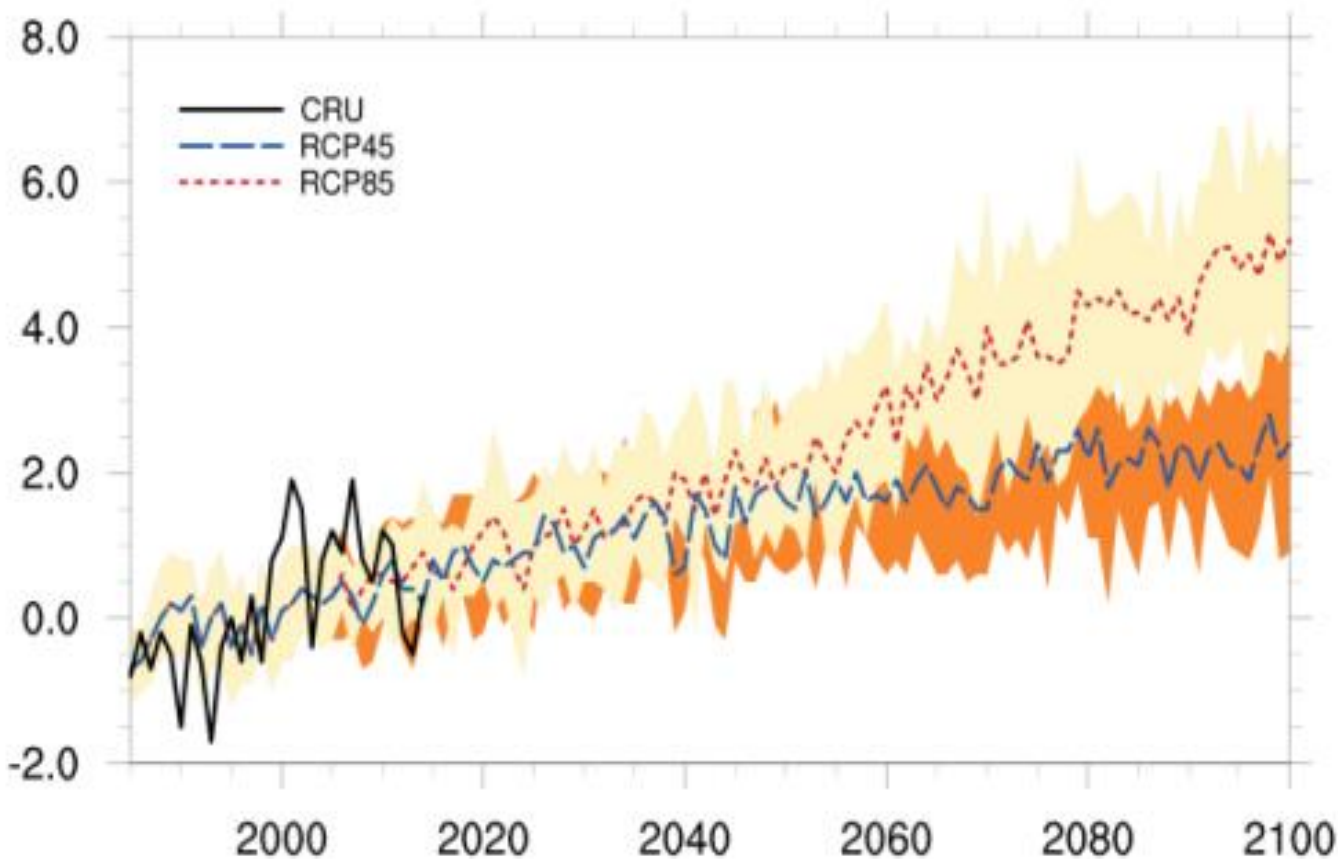
Drought

Poverty

Dzud



Past and Future Drought in Mongolia

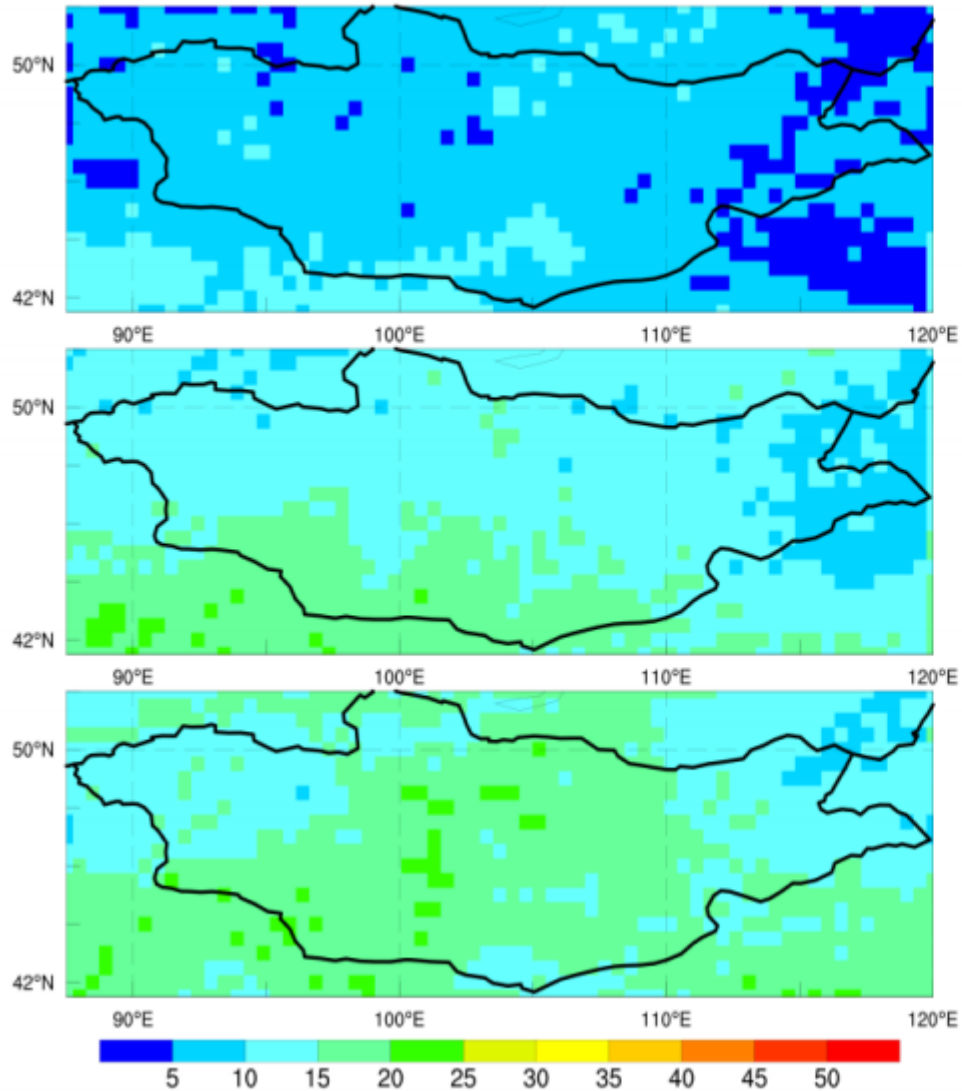


Interannual variations of PDI WI and ZI (Ped) indices
compared to climate period, 1986-2005

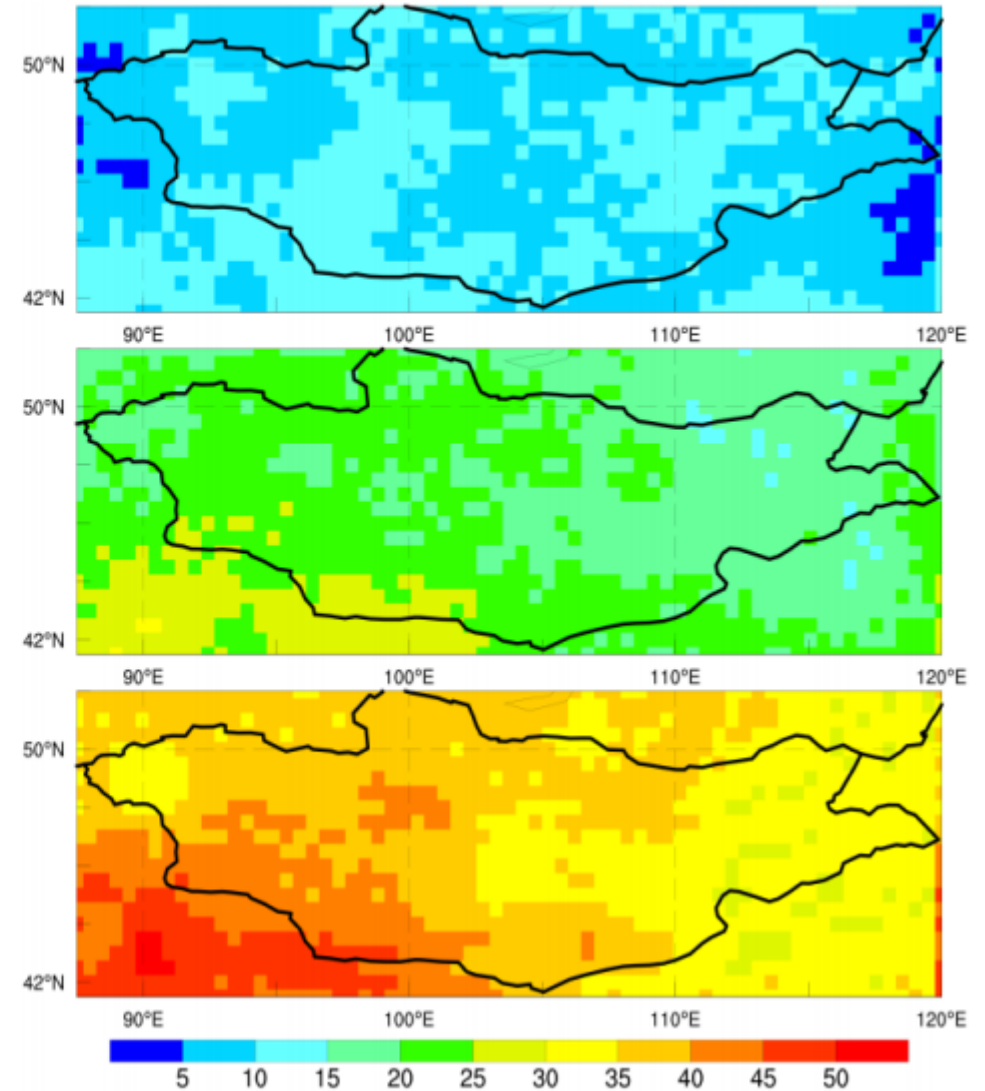
It shows also an increase of intensity of dzud as dominantly dependent on summer drought condition.

Drought frequency is expected to increase by 5-15% under moderate scenarios

a)

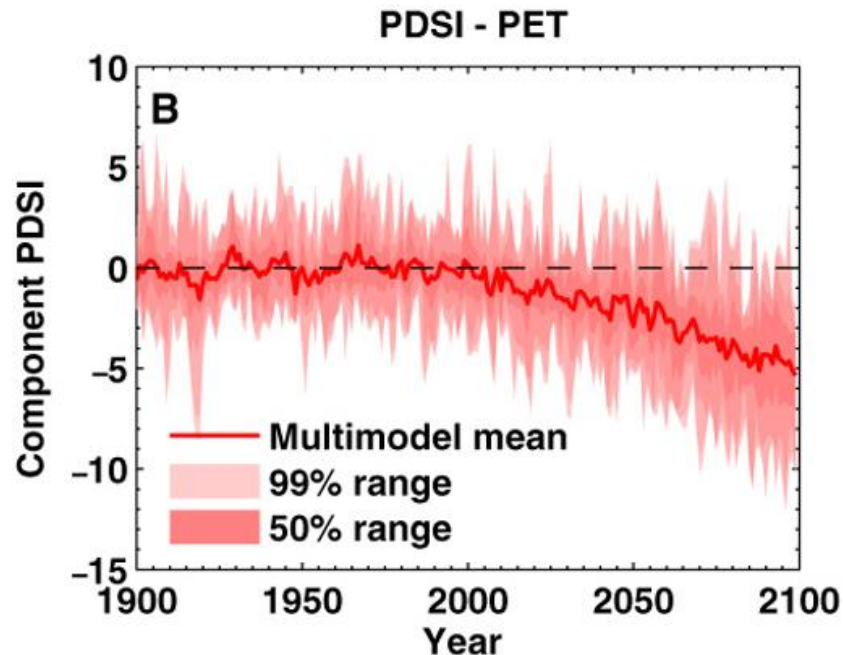
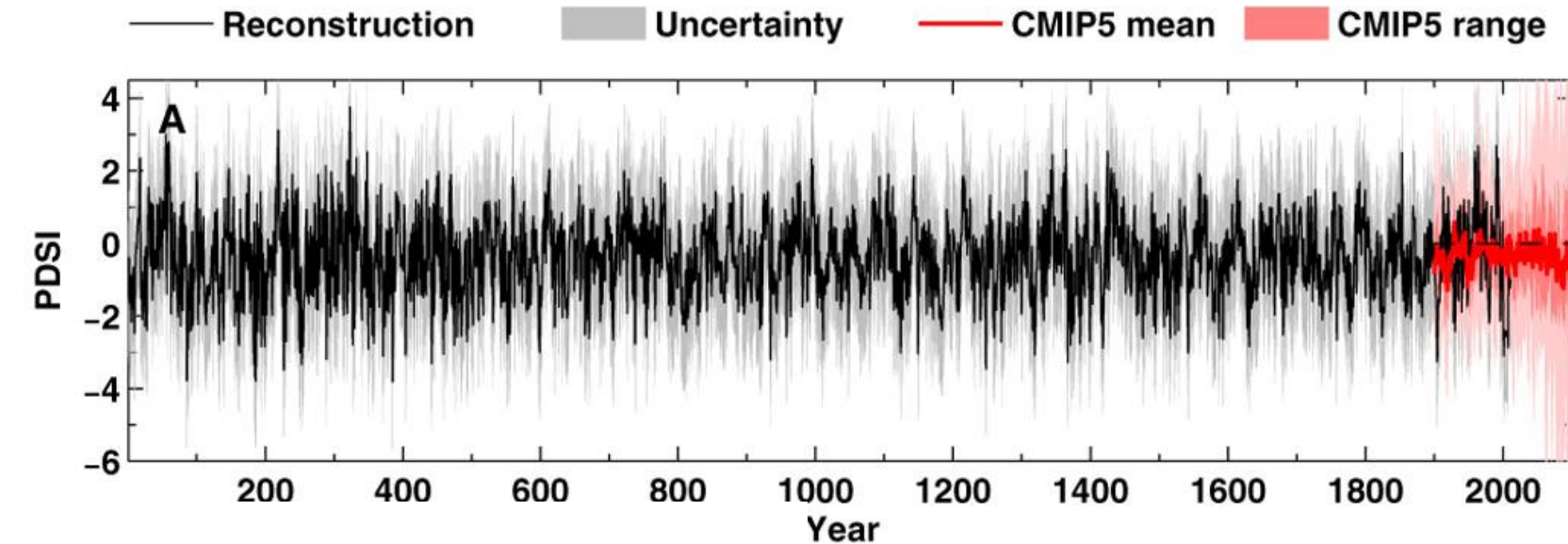


b)



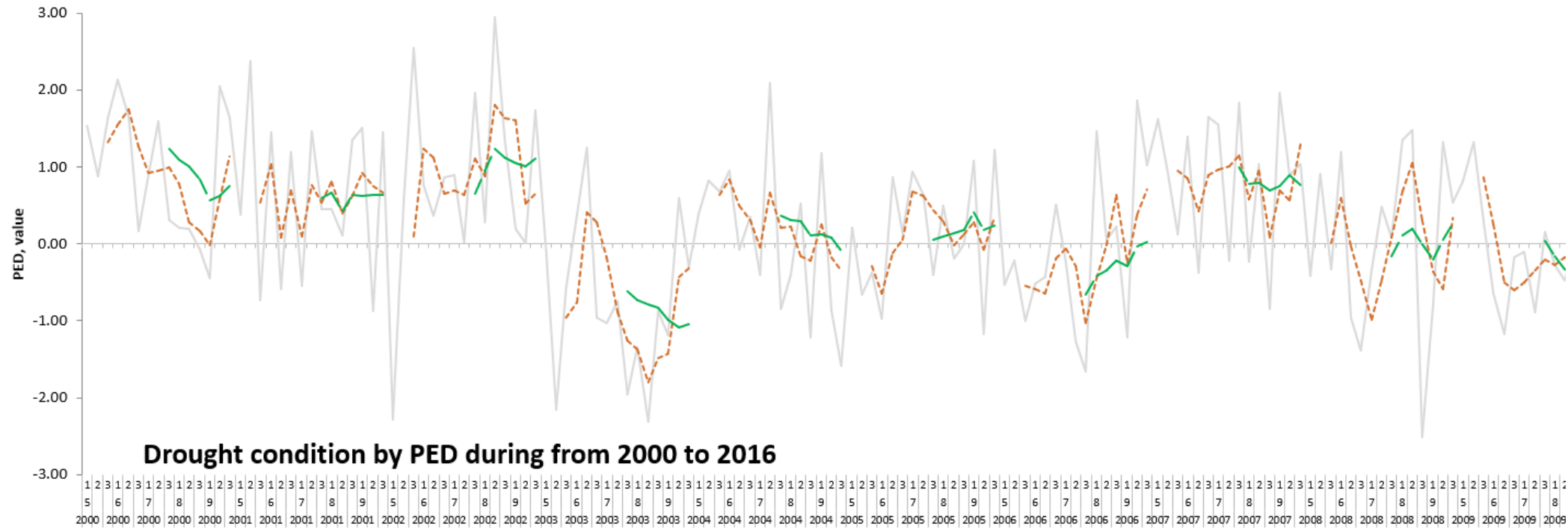
Frequency changes of drought index, PDI estimated by ensemble mean of Global climate models in different periods (2020, 2050 and 2080) a) by the RCP4.5 emission scenario b) by the RCP8.5 scenario

Past and Future Drought in Mongolia



Tree-ring record of past climate in Mongolia to reconstruct what the annual Palmer Drought Severity Index, or PDSI, would have been going back in time 2,060 years and for next 80 years.

Trend of PED index, 2000 - 2017



	Years
Drought	2000, 2001, 2002, 2004, 2007
Wet	2003, 2006, 2009
Normal	2005, 2008

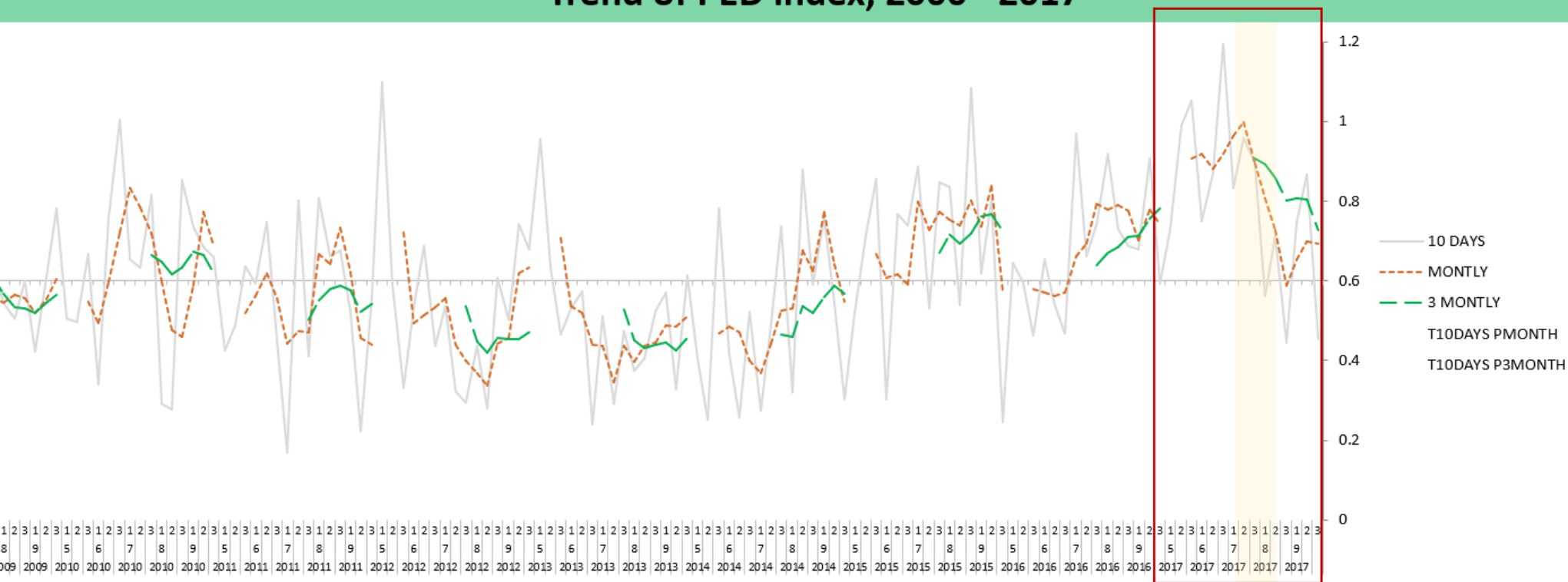
S<0 Normal

S>0.5 slight

S>1 moderate

S>2 serious

Trend of PED index, 2000 - 2017



	Years
Drought	2010, 2015, 2016, 2017
Wet	2009, 2011, 2012, 2013, 2014
Normal	

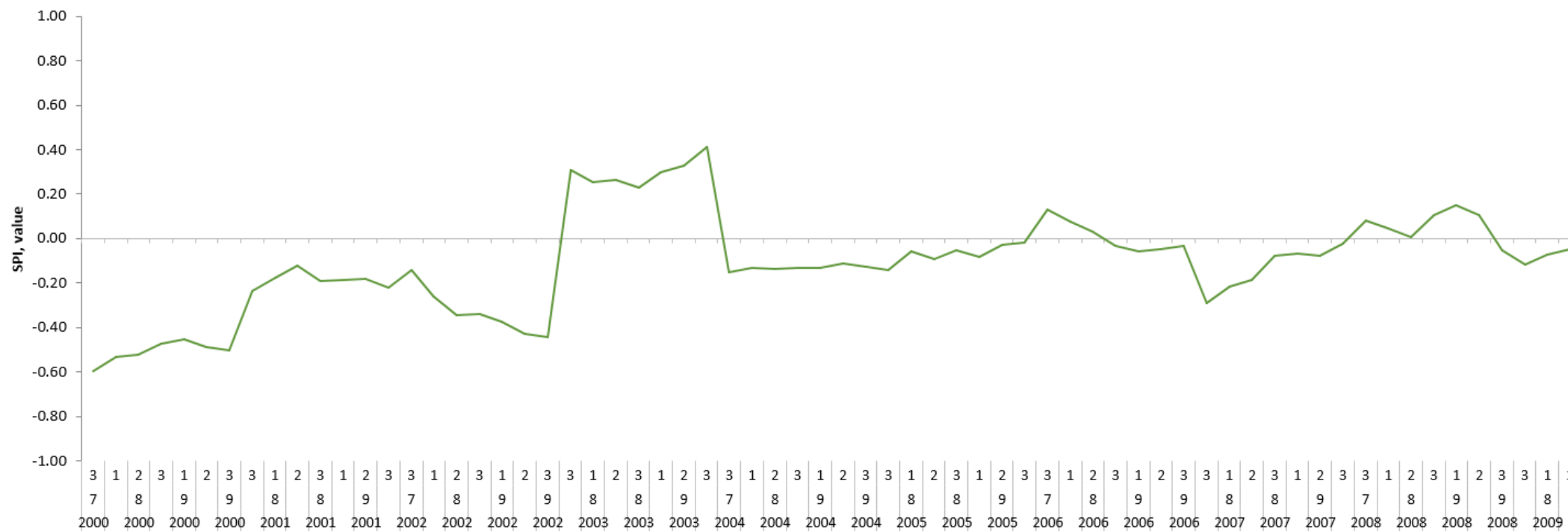
S<0 Normal

S>0.5 slight

S>1 moderate

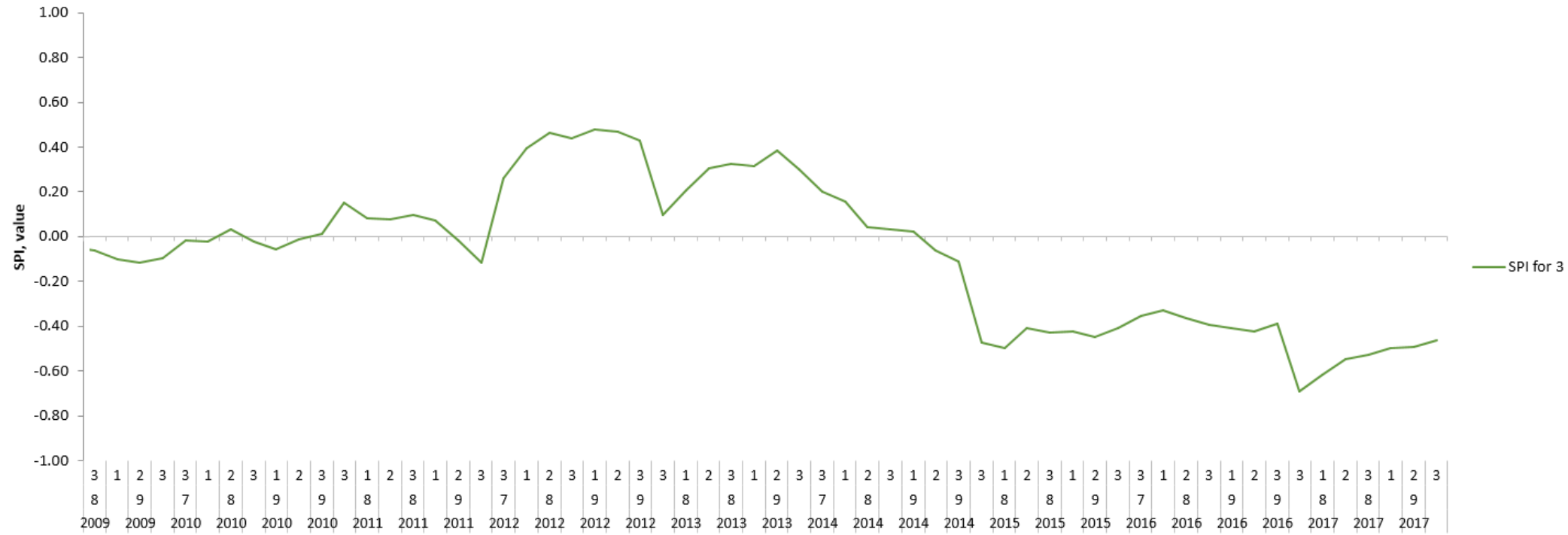
S>2 serious

Trend of SPI index, 2000 - 2017



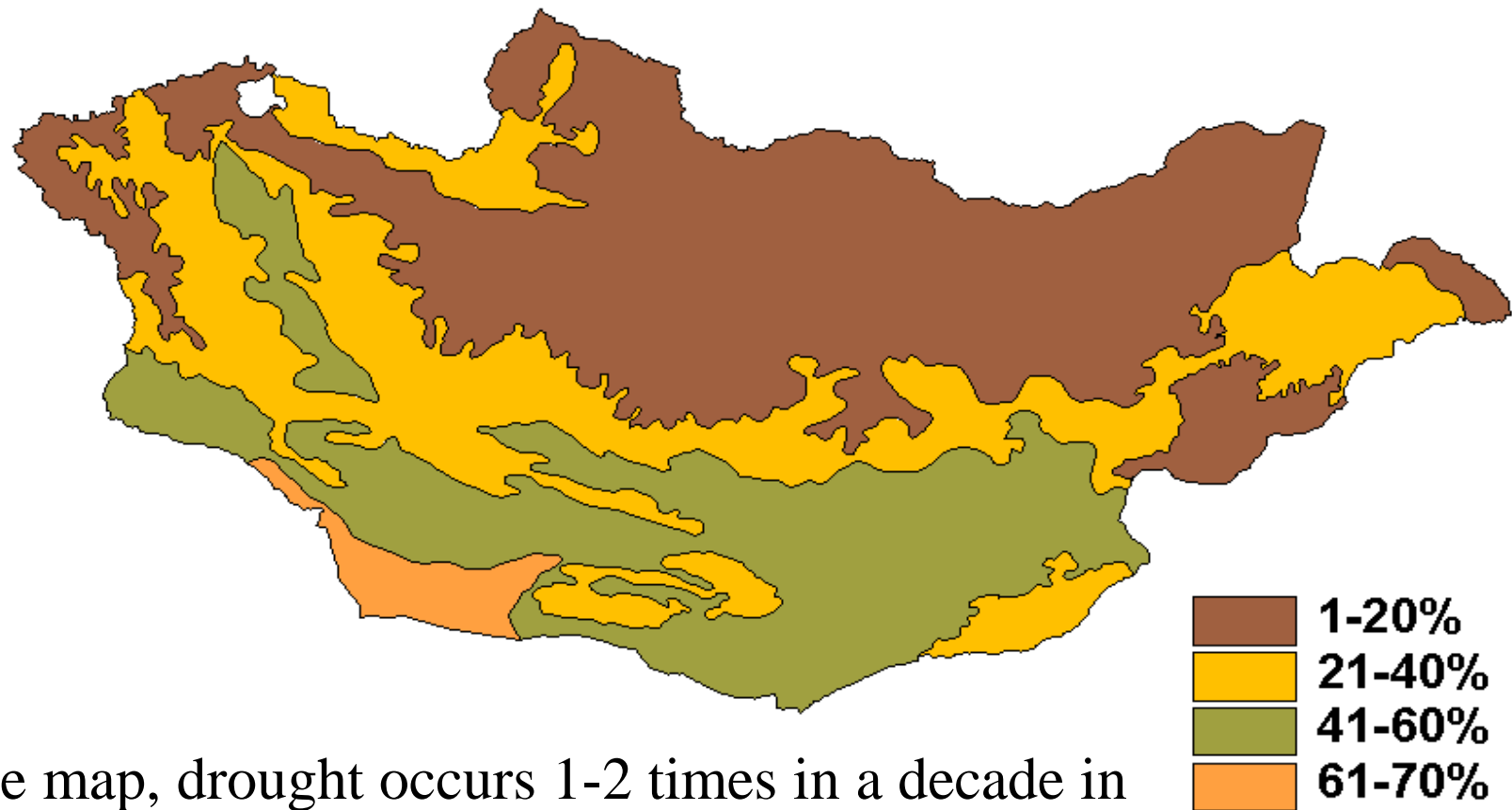
SPI>0 Normal 0=>SPI>-0.5 slight -0.84<S=>-0.5 moderate -0.99<S=>-0.84 serious S<=-0.99 extreme

Trend of SPI index, 2000 - 2017



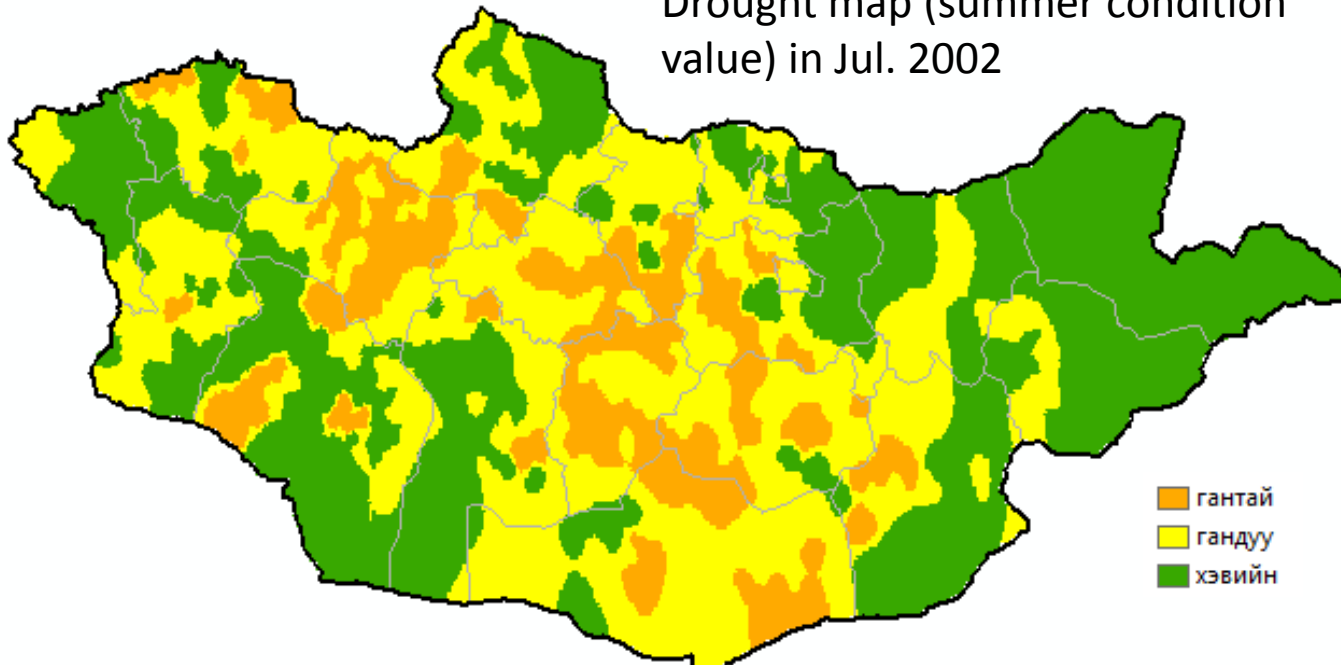
SPI>0 Normal 0=>SPI>-0.5 slight -0.84<S=>-0.5 moderate -0.99<S=>-0.84 serious S<=-0.99 extreme

Drought frequency



From the map, drought occurs 1-2 times in a decade in high mountain and forest steppe regions, 1 out of two years in desert steppe and once in a three years in steppe, some area of desert steppe. (Natsagdorj and Dulamsuren, 2001).

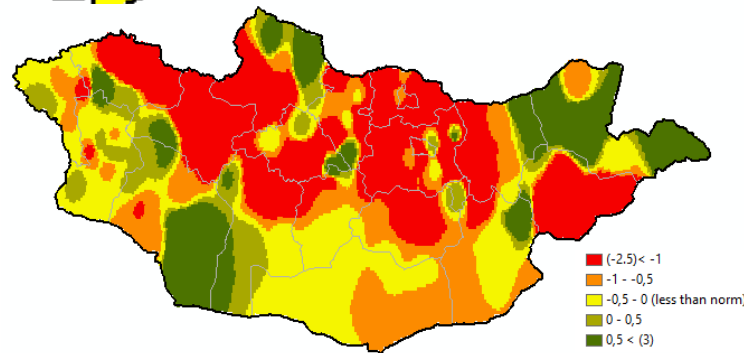
Drought map (summer condition value) in Jul. 2002



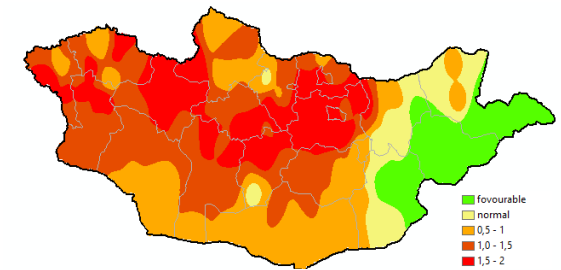
гантай
гандуу
хэвийн

*In this year 77 soums extremely drought, 174 soums involved slightly drought and overall 251 soums affected by drought, such as Uvs, Arkhangai, Zavkhan, Uvurkhangai, souht of Huvsgul, Bulgan, some of Dundgovi, Dornogovi, Umnugovi which was most wide area affected among the last twelve years. Temperature anomaly 1.1-6.2⁰c higher than average in most of territories of the Mongolia (**Vulnerability of livestock on climate change, 2005**. Уур амьсгалын өөрчлөлтөнд мал аж ахуй өртөх байдал, 2005).*

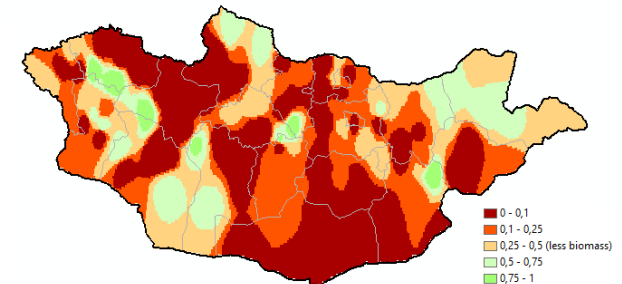
The special drought feature in 2002 has occurred over center and half of west its cutting all over natural zones and land covers.



■ (-2.5) < -1
■ -1 - -0.5
■ -0.5 - 0 (less than norm)
■ 0 - 0.5
■ 0.5 < (3)



■ favourable
■ normal
■ 0.5 - 1
■ 1.0 - 1.5
■ 1.5 - 2



■ 0 - 0.1
■ 0.1 - 0.25
■ 0.25 - 0.5 (less biomass)
■ 0.5 - 0.75
■ 0.75 - 1

EVALUATION OF SUMMER CONDITION

Rating value

1 **worse**

2

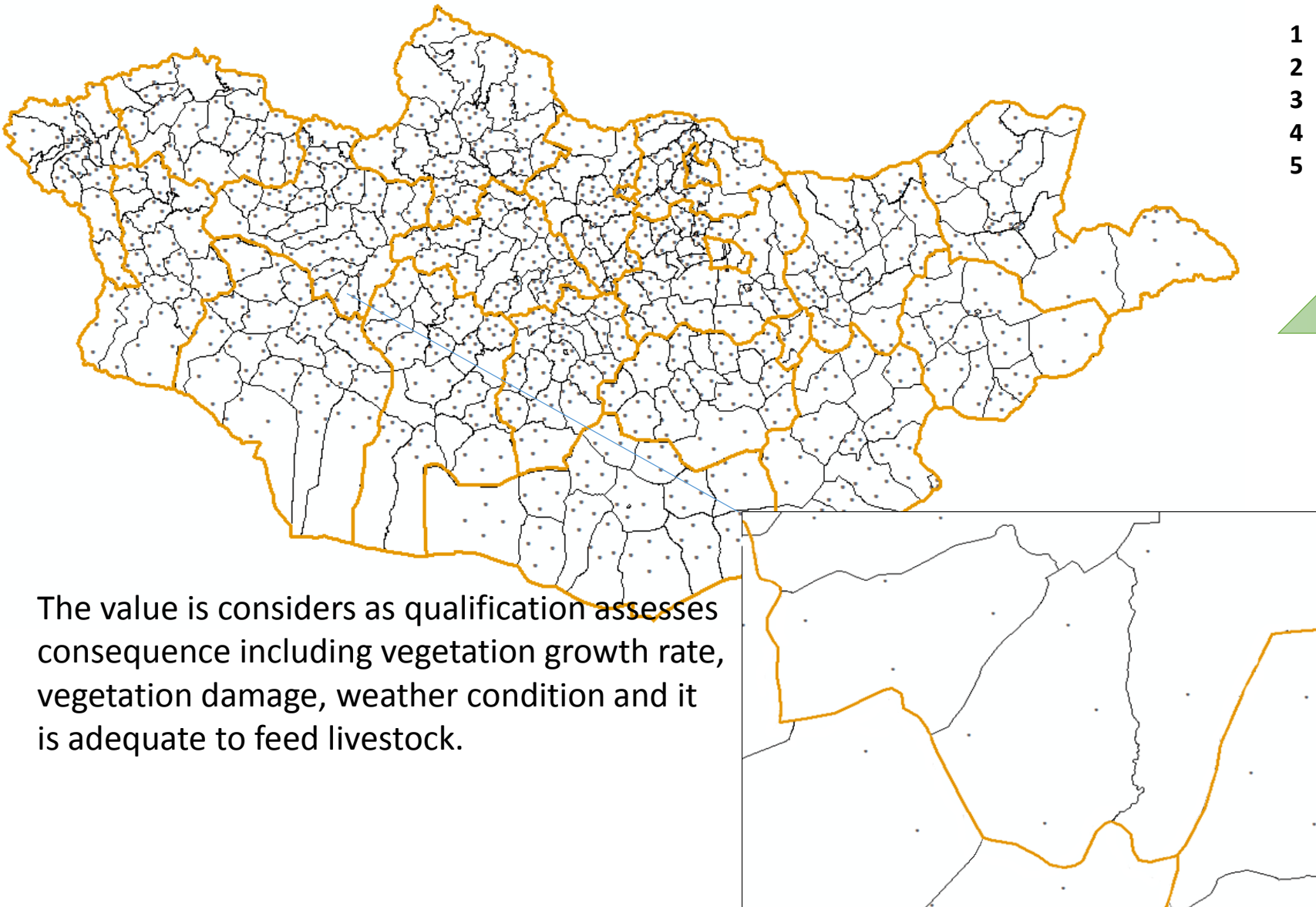
3

4

5 **favorable**

Vegetation condition
Animal condition
Weather condition

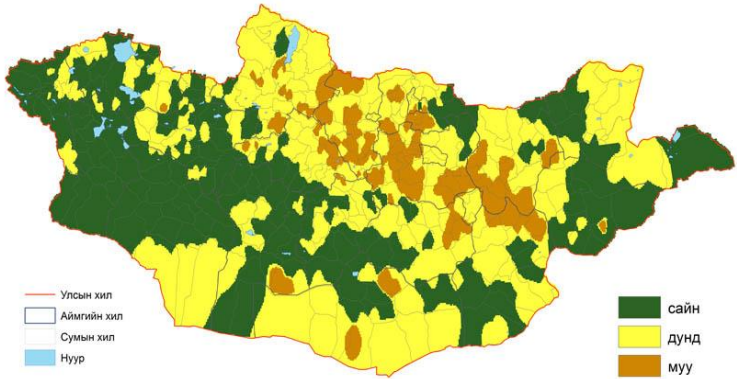
The value is considered as qualification assesses consequence including vegetation growth rate, vegetation damage, weather condition and it is adequate to feed livestock.



Reference table

Value	Reference condition
	Spring
5 (exceptional)	Vegetation peaks earlier than long period average and grow impetuous, no damage, livestock have potentially glut in early
4 (good)	Vegetation peaks at time and growth normal, no damage, livestock have potentially glut
3 (normal)	Vegetation peaks late and growth in adverse condition, possible have damage, livestock have slight glut potential
2 (poor)	Vegetation peaks late and poor growth, most part have damaged, livestock impossible to graze
1 (worse)	Vegetation not peaks or entirely damaged
	Summer
5 (exceptional)	Exceptional favorable summer condition
4 (good)	Vegetation have grew decent, not any wilt of damage, livestock have potentially stoutness
3 (normal)	Vegetation growth not all the same good and slow growth stages and rate, some vegetation have wilt of damage, some kind of livestock have not potentially stoutness
2 (poor)	Vegetation growth is in adverse condition, rate and stage are poor, most vegetations are have damage and wilt, all kind of livestock have no potential stoutness
1 (worse)	All vegetations condition are poor, growth under depression, vegetations complete damaged

MONGOLIAN CONVECTIONAL DROUGHT ASSESSMENT (SUMMER CONDITION)



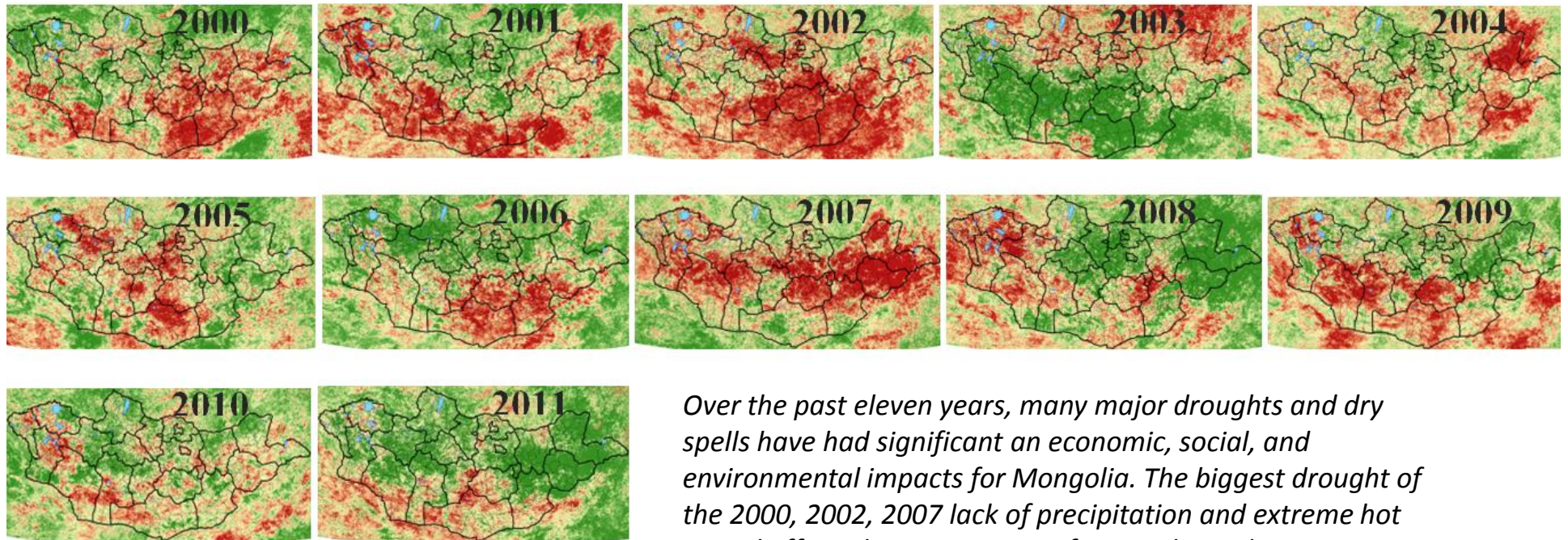
3 дугаар зураг. Зуншлагын байдал
(2015 оны 7 сарын 10-ны байдлаар)

Summer condition conduct an appraisal value that obtains between from 1 to 5 and it has two different period assessments shown in the Table #.

Value	Reference condition
	Spring
5 (exceptional)	Vegetation peeks earlier than long period average and grow impetuous, no damage, livestock have potentially glut in early
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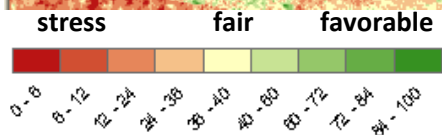
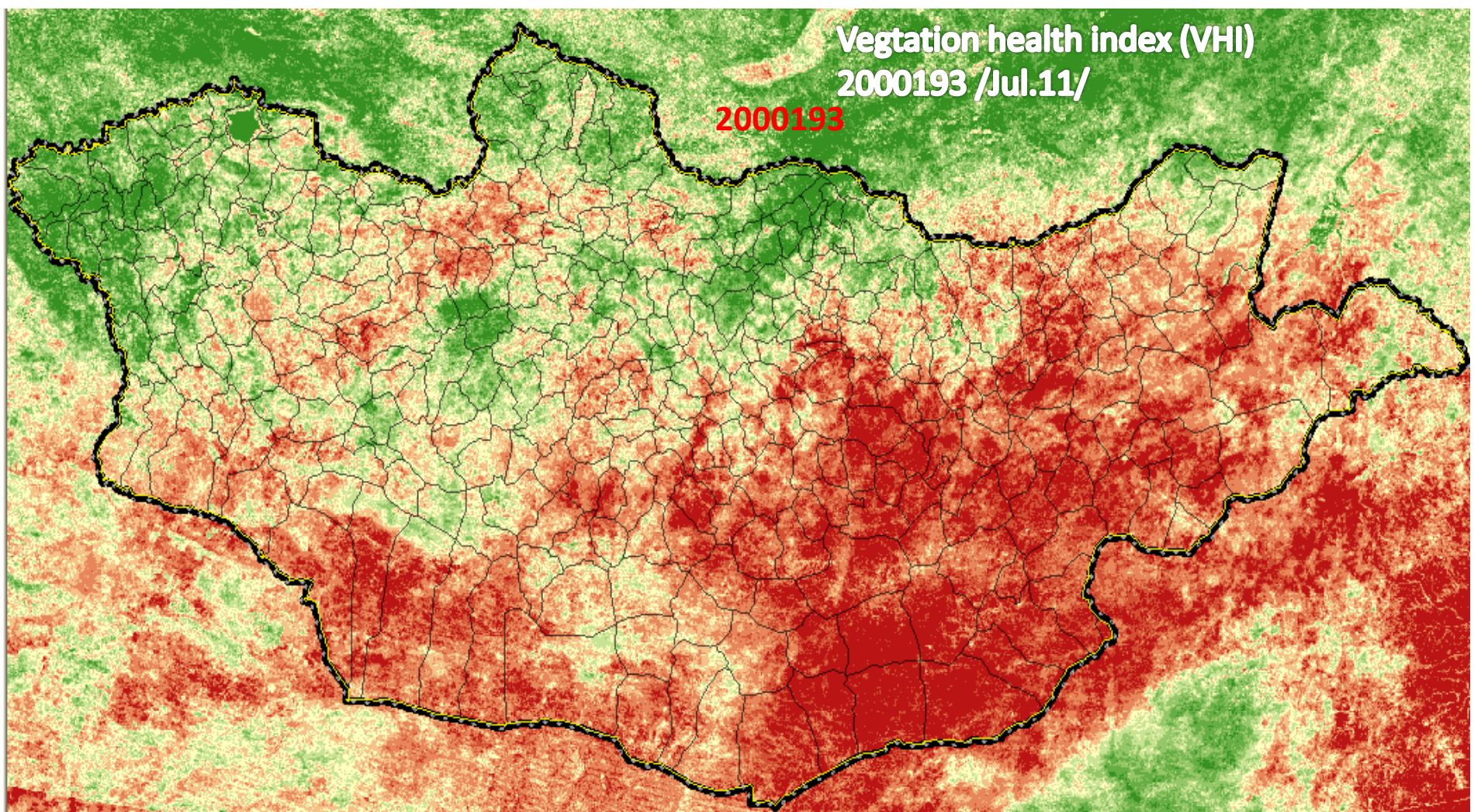
4.3 Vegetation Health Index (VHI)

Vegetation Health products has been calculated only for 193rd Julian day of 2000-2011 from the MHD (Moisture, Heat, Drought) database, which built in this work for a drought assessment purposes. Mentioned that here are only 193rd products composited by eight days were used, therefore it will not express the vegetation health for a month or whole summer (Fig. 7).



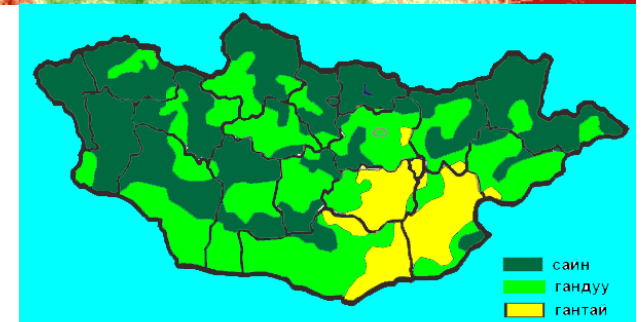
Over the past eleven years, many major droughts and dry spells have had significant an economic, social, and environmental impacts for Mongolia. The biggest drought of the 2000, 2002, 2007 lack of precipitation and extreme hot period affected major regions of Mongolia and its economy for several years.

Differences in the VCI and TCI dynamics were further investigated during the several years with the extreme values of the biomass at the Darkhan station where average a biomass 10.1 centner/ha is during these eleven years (green background is express an amount of biomass).

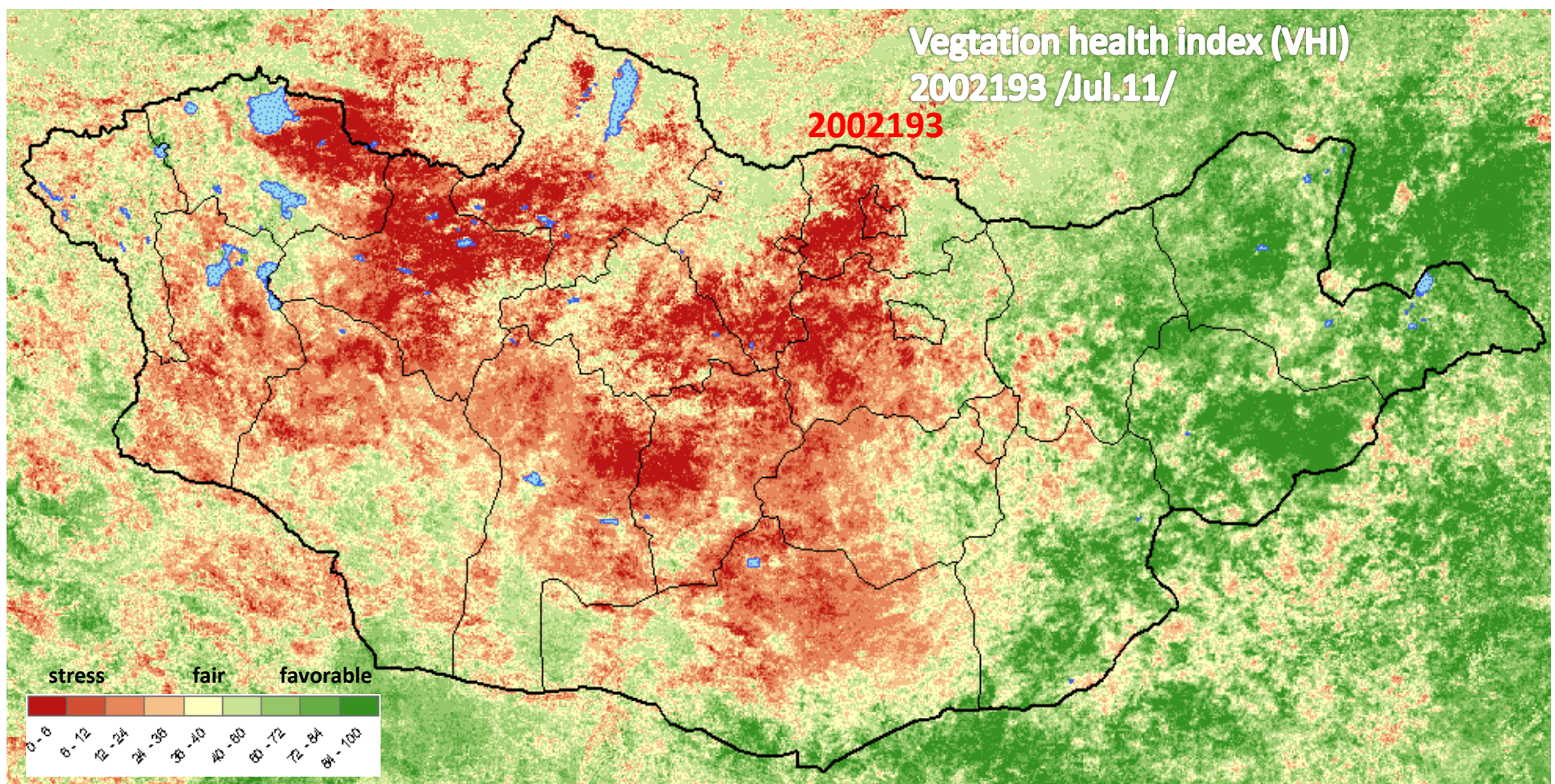


In this year highest damage caused in agricultural, pasture among 1999-2005. lost 15.3% of livestock equal to 3.5 million.

Figure 11. VHI and summer condition evaluation in 11 July 2000 (dry, lack of precipitation).

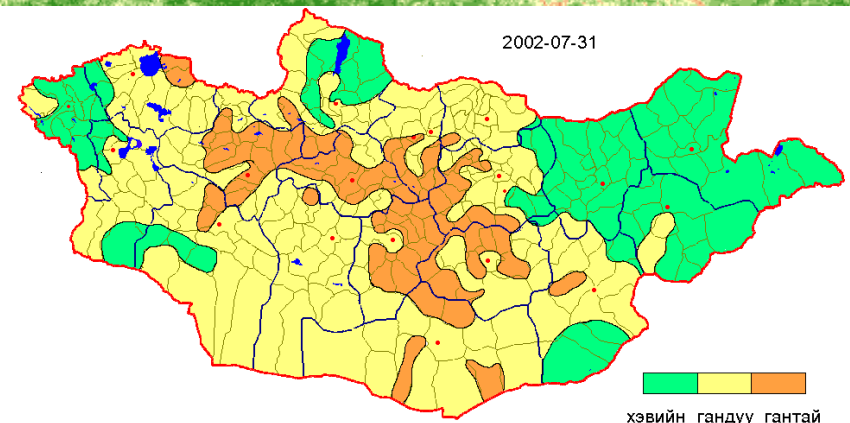


3 дугаар зураг. Зуншлагын байдал. /2000 оны 7 сарын 10-ны байдлаар/
Vegetation cover over Mongolia /10.July.2000/



In this year 77 soums extremely drought, 174 soums involved slightly drought and overall 251 soums affected by drought, Temperature anomaly 1.1-6.2⁰c higher than average in most of territories of the Mongolia (Уур амьсгалын өөрчлөлтөнд мал аж ахуй өртөх байдал, 2005).

Fatalities more than 2 million



Зуншлагын байдал

Vegetation health index (VHI)

2008193 /Jul.11/

2008193

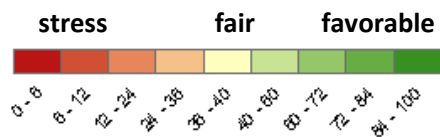
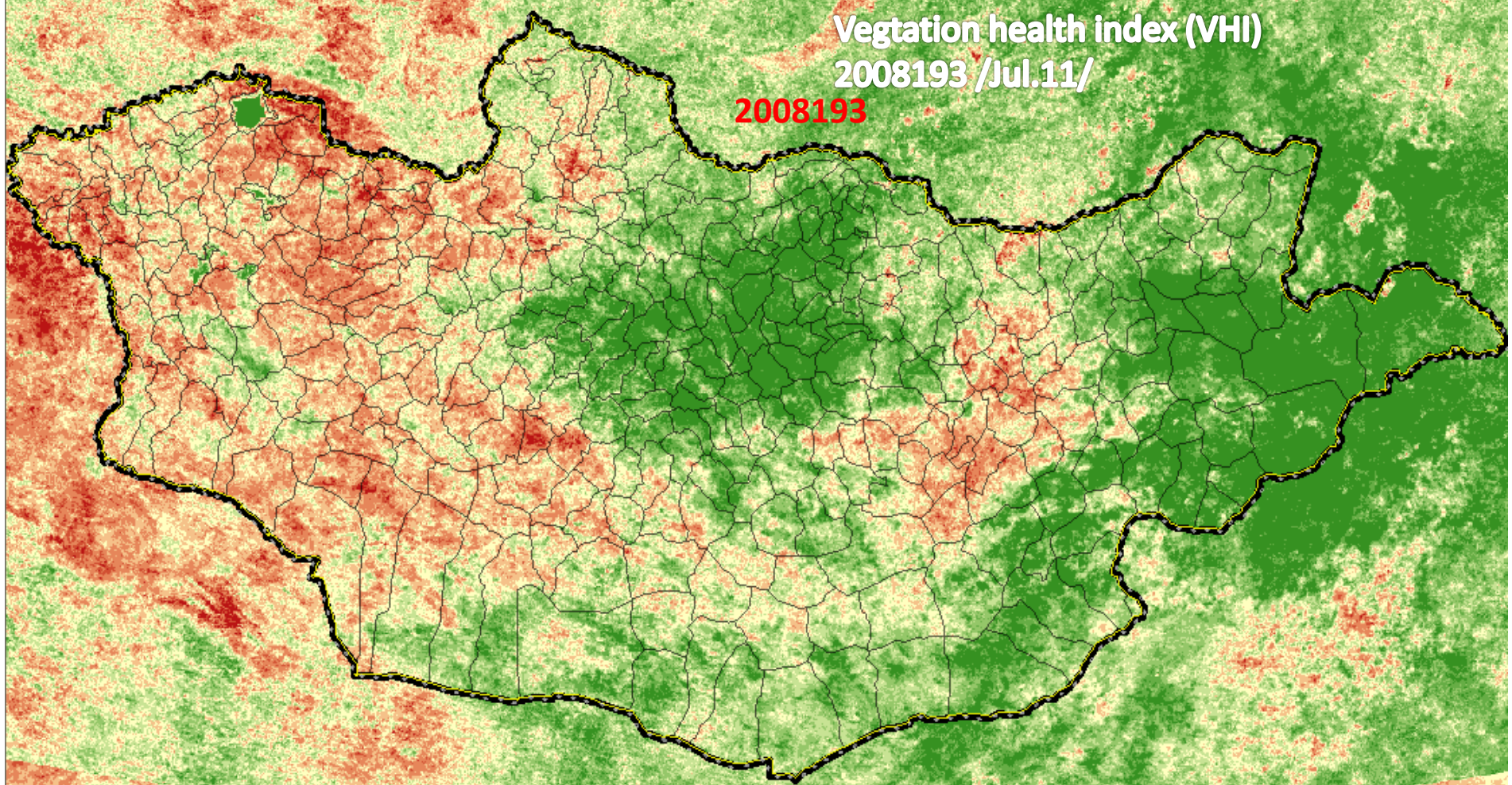
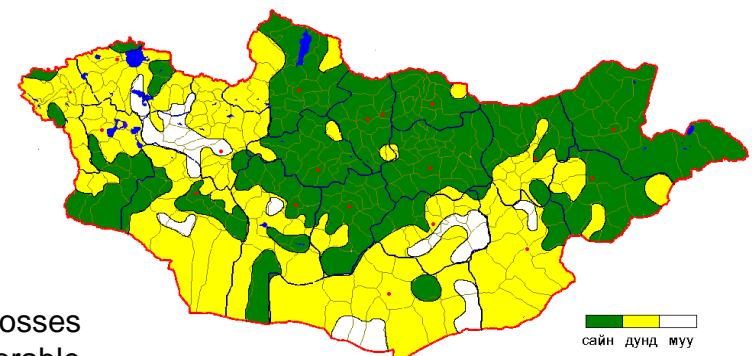


Figure 11. VHI and summer condition in 11 July 2008 (relatively favorable with high precipitation and chilly).



If the indices are below 40 indicating different levels of vegetation stress, losses of crop and pasture products might be expected or if the indices above 60 (favorable condition) might be expected plentiful products.

3 дугаар зураг. Бэлчээрийн ургамлын ургалтын байдал /2008 оны 7 дугаар сарын 10-ны байдлаар/

Vegetation health index (VHI)

2011193 /Jul.11/

2011193

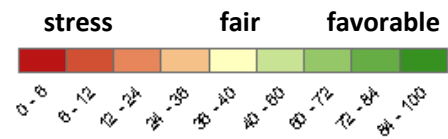
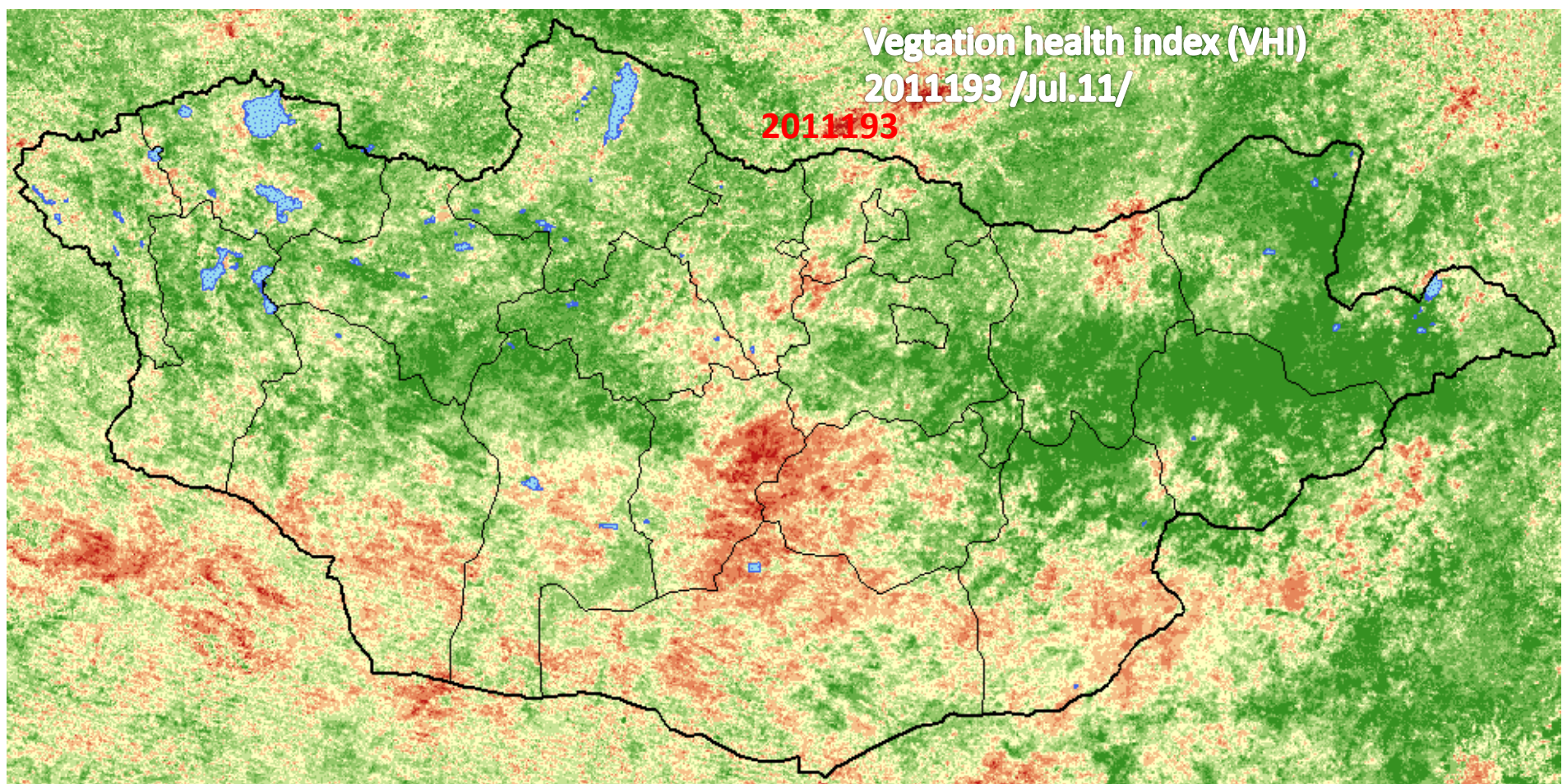
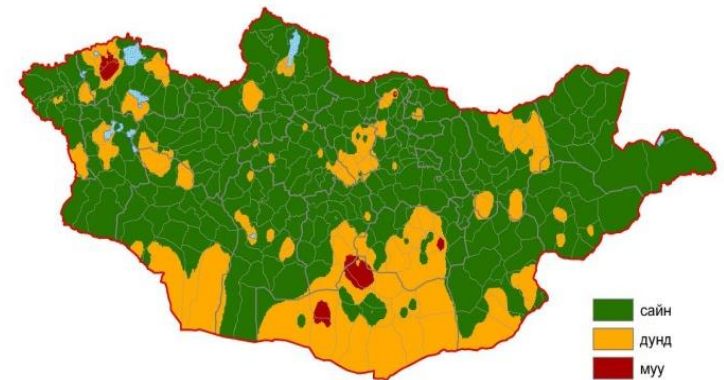


Figure 11. VHI and summer condition in 11 July 2011.

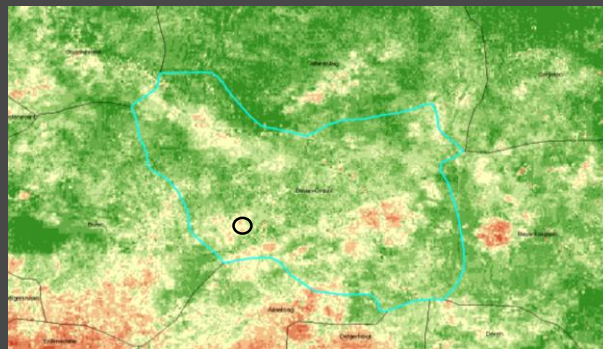


Зуншлагын байдал
(2011 оны 7 сарын 31-ний байдлаар)

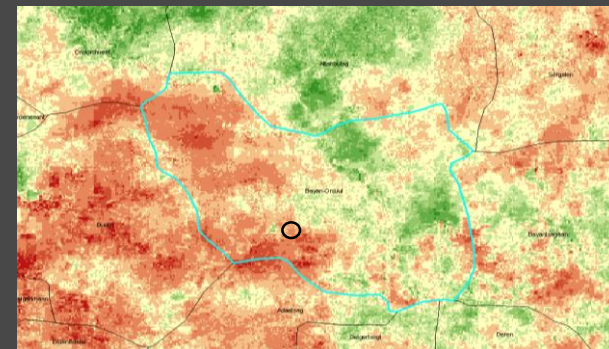
сайн
дунд
муу

Drought field study

**2011
.Sep**



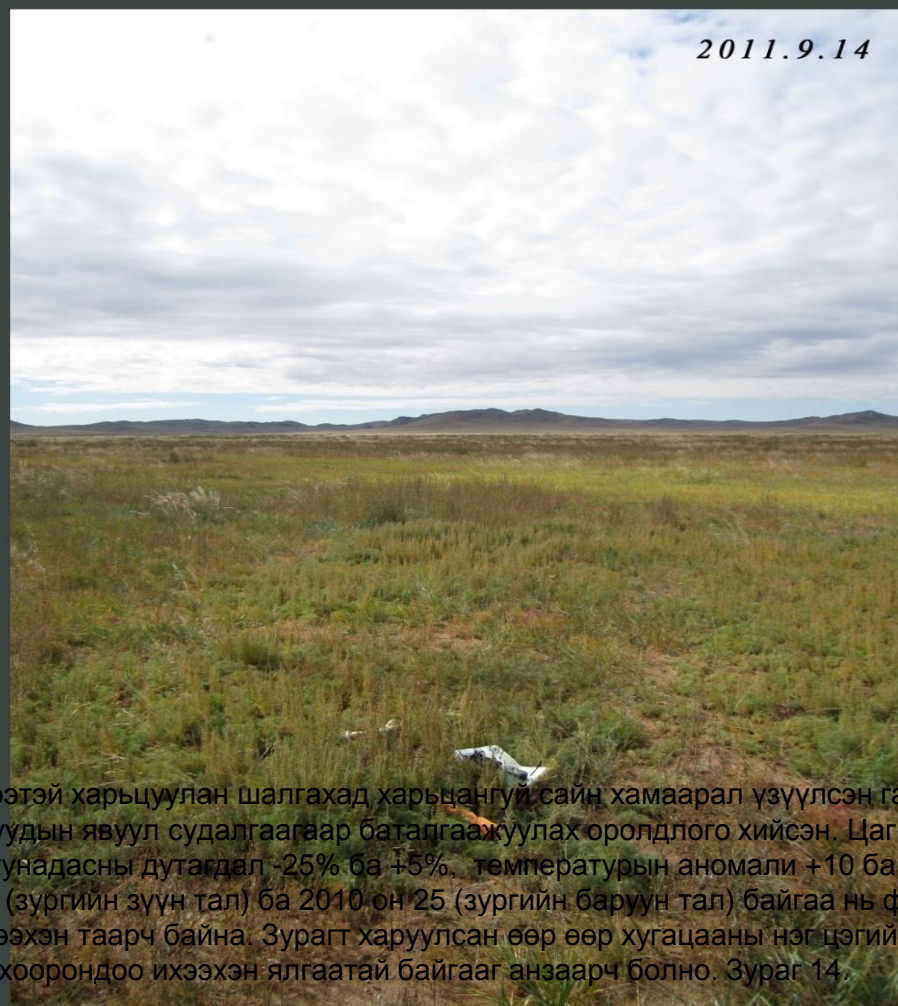
**2010
.Aug**



Soil sensor



Biomass



2011.9.14

*Баян-Өнжүүл сумын төвөөс
омно зүг 60км.*

Хадат Толгой



2010.8.18

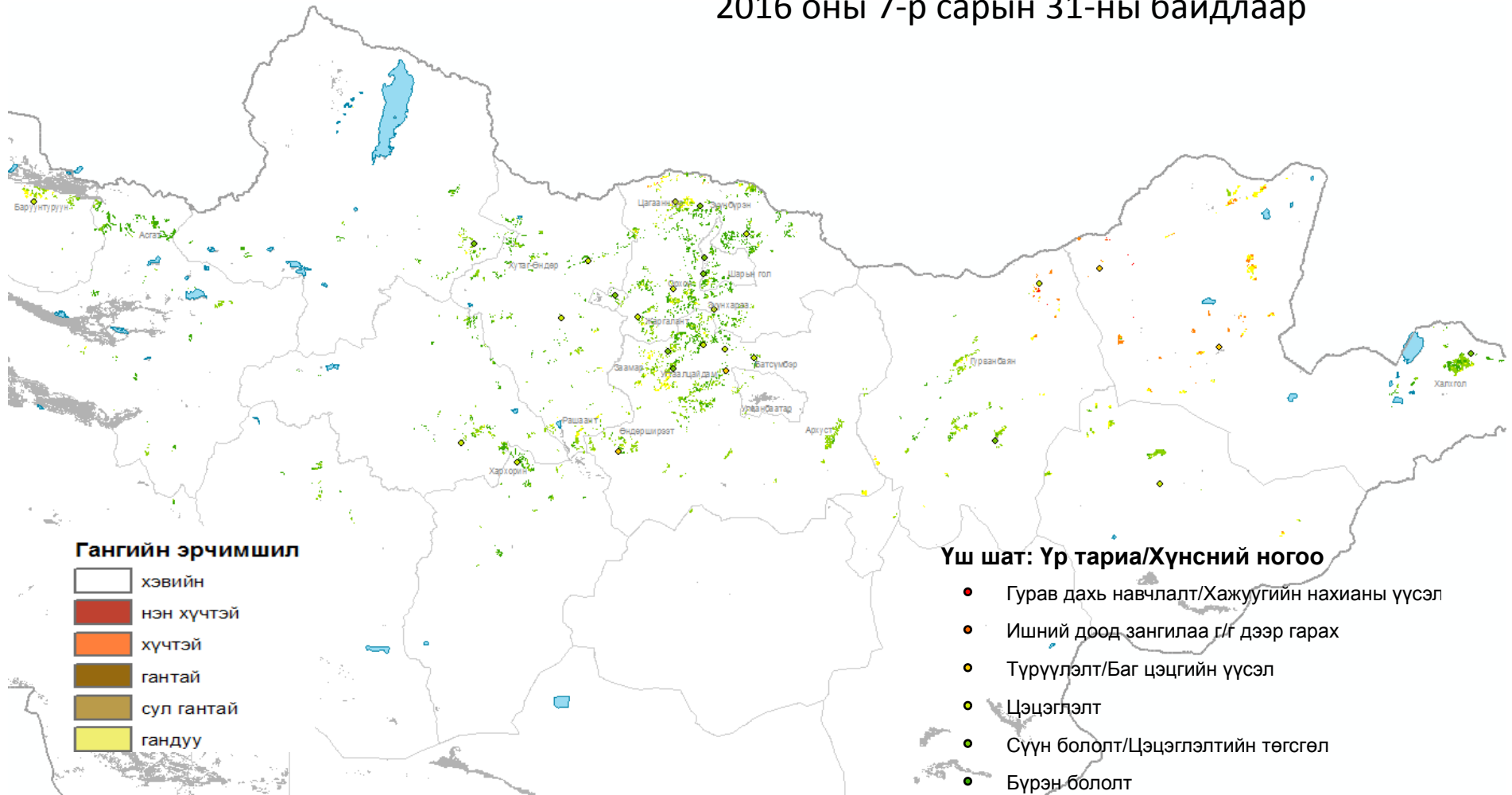
Зуншлагын байдлын үнэлгээтэй харьцуулан шалгахад харьцангуй сайн хамаарал үзүүлсэн гангийн үнэлгээг Төв аймгийн Баян-Өнжүүл суманд 2010, 2011 онуудын явуул судалгаагаар баталгаажуулах оролдлого хийсэн. Цаг агаарын нөхцөл байдлаас үзэхэд 2010 ба 2011 онд тус бүр хур тунадасны дутагдал -25% ба +5%, температурын аномали +10 ба дунджийн орчим байв.

2011 он VHI үнэлгээгээр 80 (зургийн зүүн тал) ба 2010 он 25 (зургийн баруун тал) байгаа нь фото зурагт харуулсан ургамал, цаг агаарын нөхцөл байдалтай ихээхэн таарч байна. Зурагт харуулсан өөр өөр хугацааны нэг цэгийн төлөв байдлыг илэрхийлсэн боловч ургамал ургалтын нөхцөл өөр хоорондоо ихээхэн ялгаатай байгааг анзаарч болно. Зураг 14.

**THANK YOU FOR
GIVING ATTENTION**

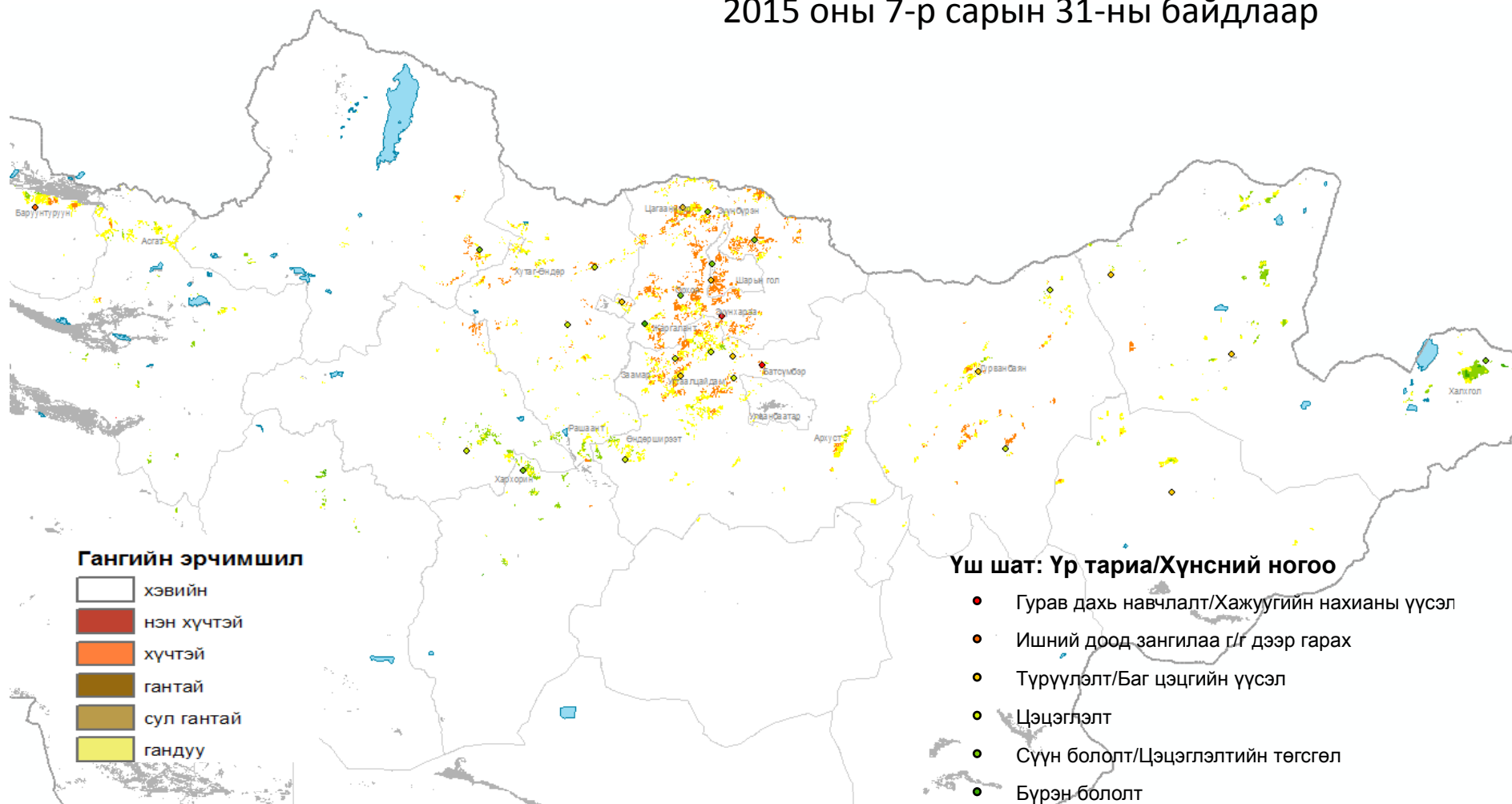
ГАЗАР ТАРИАЛАНГИЙН ГАНГИЙН БҮТЭЭГДЭХҮҮН

2016 оны 7-р сарын 31-ны байдлаар



*Дээрхи зурагт үзүүлсэн үе шат нь зөвхөн тухайн цэг дээрхи талбайн ургамлын хувьд үнэн болно.

2015 оны 7-р сарын 31-ны байдлаар



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Conclusion

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