Ховд аймгийн засаг даргын тамгын газар

Institute of Geography and geoecology, MAS

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Asia-Pacific Network for global change research

PROJECT MEETING

"Strengthening local adaptation plan through integrating socio-economic vulnerability assessment and policy gap analysis in Mongolia and China" Project /APN/
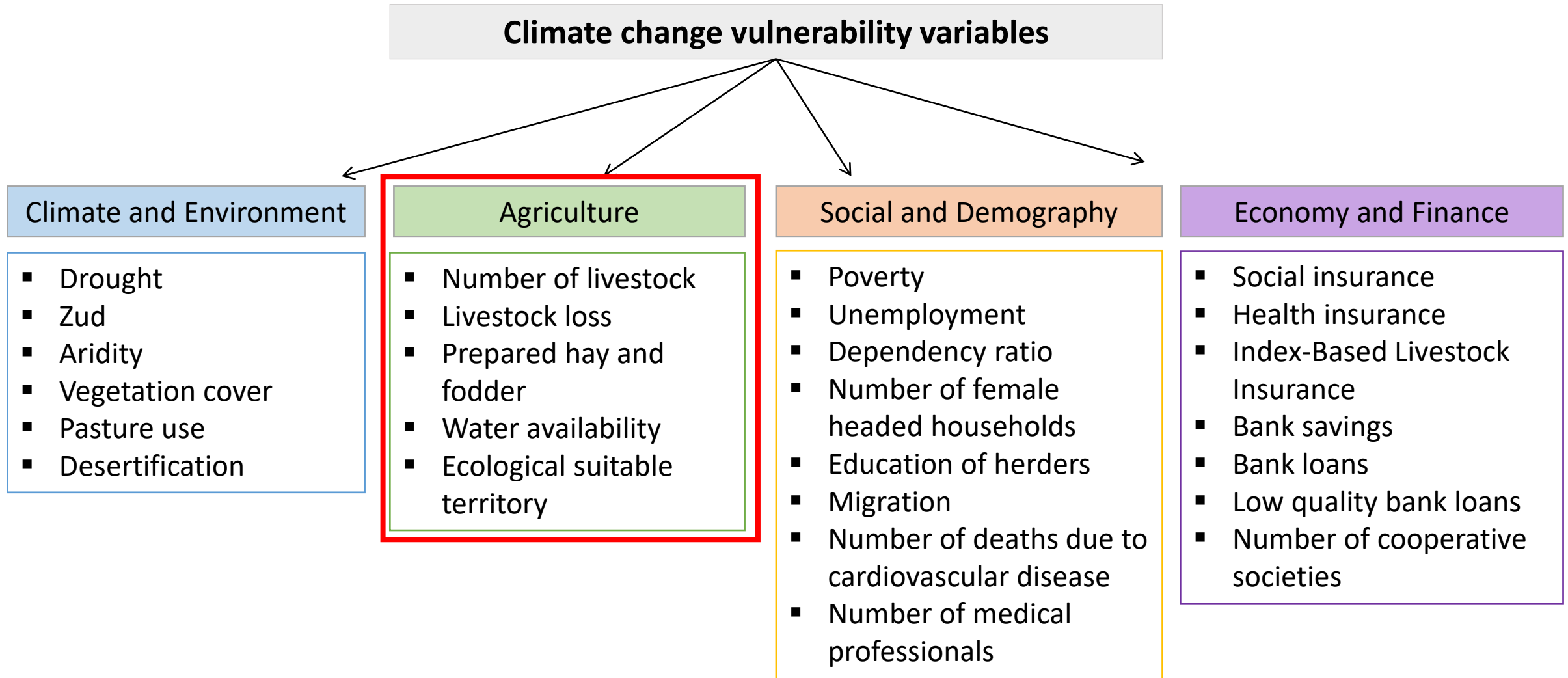
Agriculture sector variables of climate change vulnerability assessment in Mongolia

Researcher, Divisions of Socia-Economic Geography,
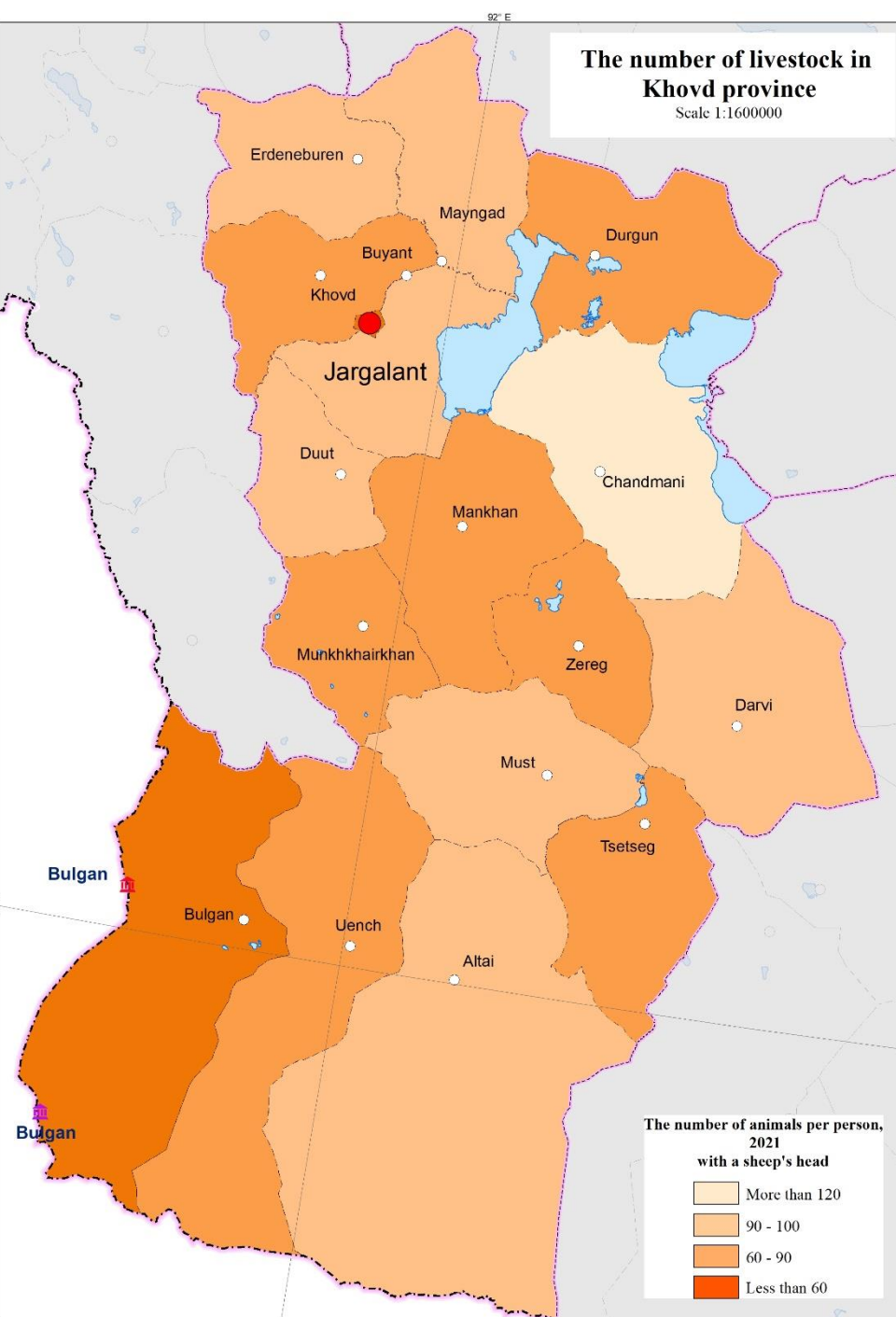**G. Urantamir**

Ulaanbaatar, 2023.08.17
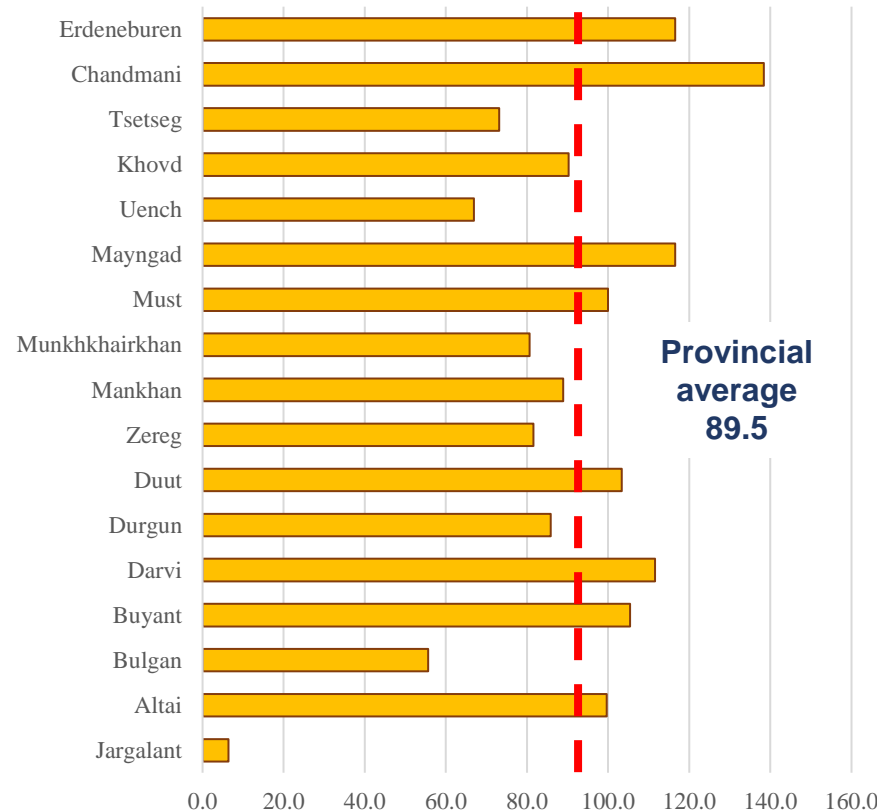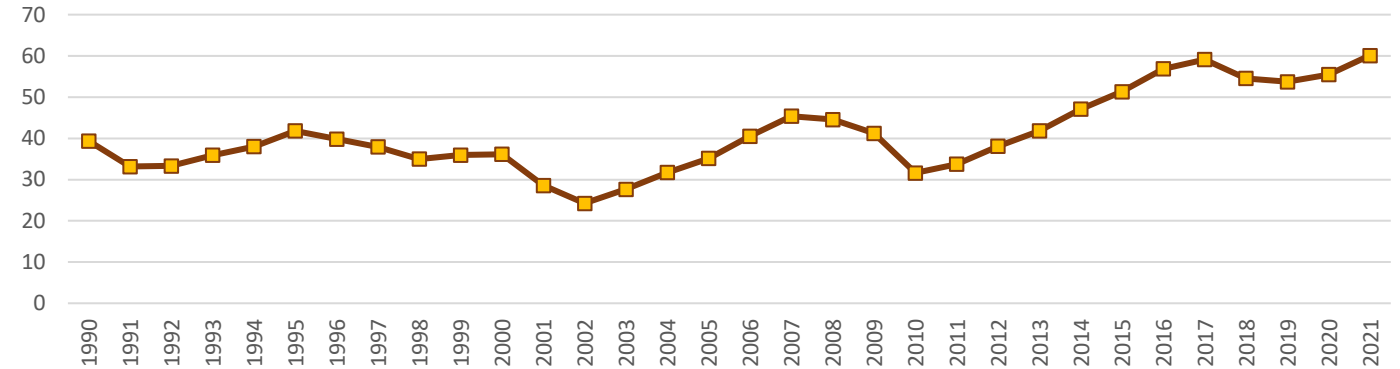
Methodology

1. **Determine vulnerability variables**

Climate change vulnerability variables

Climate and Environment	Agriculture	Social and Demography	Economy and Finance
▪ Drought ▪ Zud ▪ Aridity ▪ Vegetation cover ▪ Pasture use ▪ Desertification	▪ Number of livestock ▪ Livestock loss ▪ Prepared hay and fodder ▪ Water availability ▪ Ecological suitable territory	▪ Poverty ▪ Unemployment ▪ Dependency ratio ▪ Number of female headed households ▪ Education of herders ▪ Migration ▪ Number of deaths due to cardiovascular disease ▪ Number of medical professionals	▪ Social insurance ▪ Health insurance ▪ Index-Based Livestock Insurance ▪ Bank savings ▪ Bank loans ▪ Low quality bank loans ▪ Number of cooperative societies

1. Number of livestock

Variable	Number of livestock
indicator	Number of livestock per person, by sheep head
Units	Sheep head/man
Definition and Current Status of Variables, Impacts of Climate Change	In the last 5 years, the hay pasture area decreased by **0.1-0.7 million** ha in 2016-2020. However, with the transfer to sheep, the number of livestocks has increased to 102.8 million in 2016, 110.8 million in 2017, 111.1 million in 2018, 119.0 million in 2019, and **114.4 million in 2020**. [24]. The increase in the number of livestock and the increase in the carrying capacity of pastures have caused more grazing of pastures[23].
Rationale for conditionalizing variable vulnerability	It has been studied how the scope of poverty depends on the number of livestock per person, **According to the research, when the number of livestock per capita in rural areas increases, poverty steadily decreases. This shows a direct correlation between the number of livestock per capita and the standard of living of the household** [34].
Methodology	$$1\ XHMT = \frac{Number\ of\ livestock\ (Sheep\ head)}{Population}$$ 1 XHMT- Number of livestock per person, sheep head/man
Used data	-Population, -Number of livestock , sheep head
Date period	1990-2021, soum level

The number of livestock in Khovd province
Scale 1:1600000

The number of animals per person, 2021 with a sheep's head

	More than 120
	90 - 100
	60 - 90
	Less than 60

The number of livestock per person in Khovd province, by sheep, 1991-2021
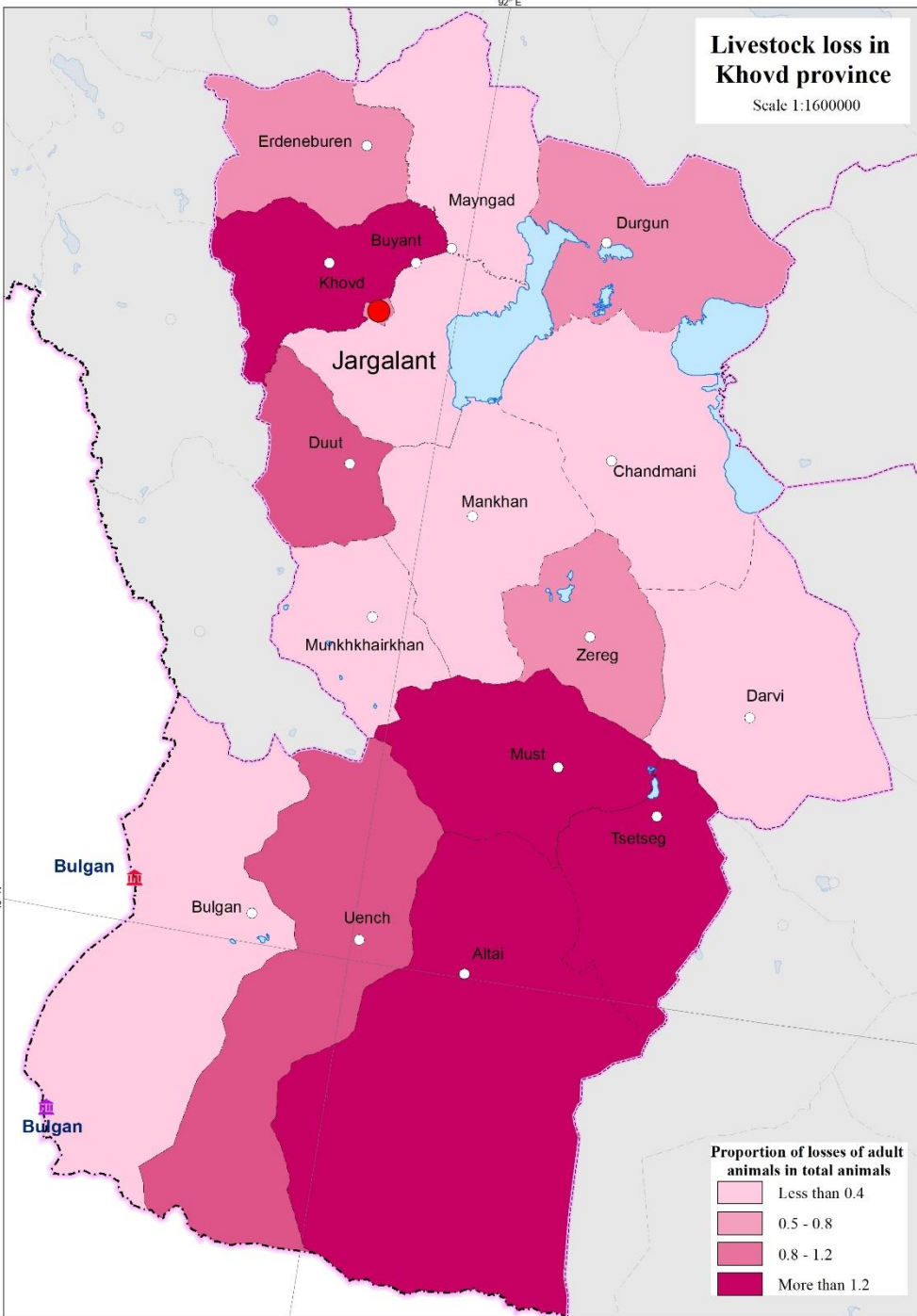

Provincial average 89.5

As of the year 2021
Population – 90,333
Number of livestocks – 3 596 969
By transfer to the sheep's head – 5 430 760
Livestock per person /sheep head/ - 60.1
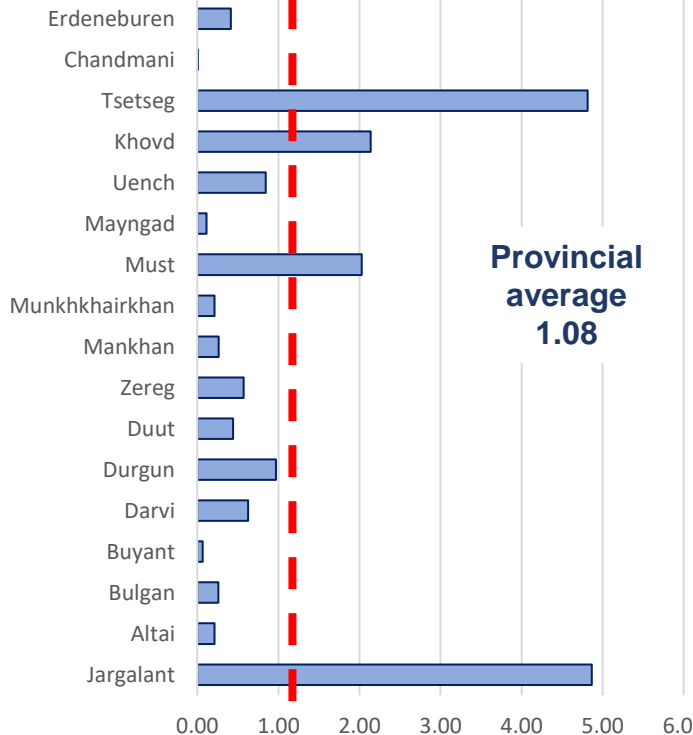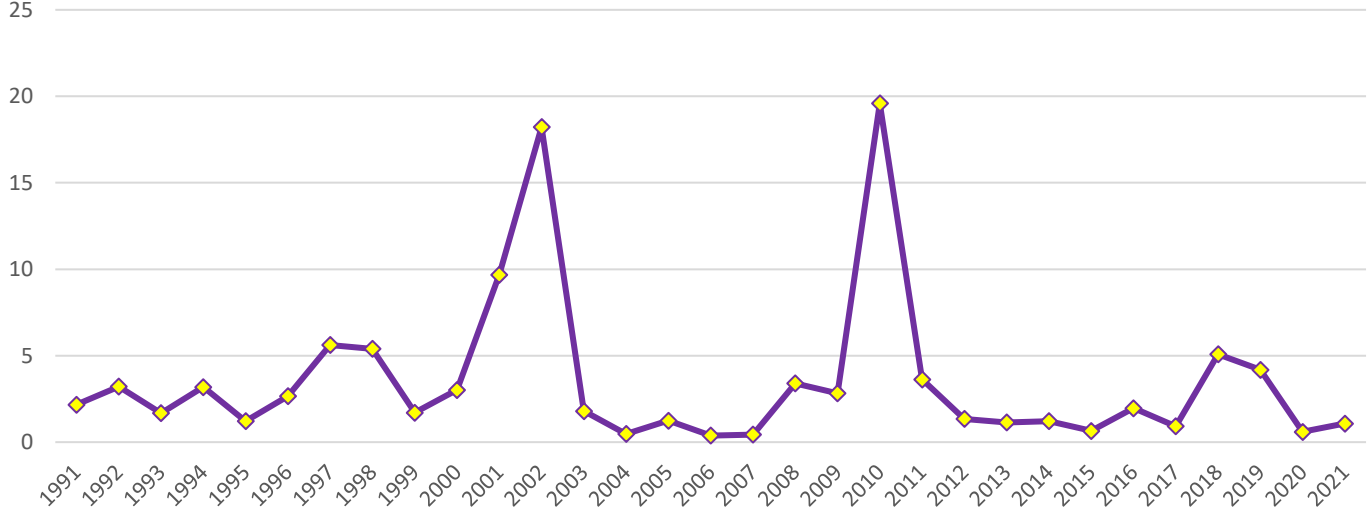**excluding the center of the province - 89.5**

Out of the total 16 soums of Khovd Province, **8 soums** have less than the provincial average in terms of the number of livestocks per person. These soums are vulnerable.

2. Livestock loss

Variable	Livestock loss
indicator	The proportion of loss livestocks in the total livestocks (according to the amount of animals counted at the end of the previous year)
Units	Percentage
Definition and Current Status of Variables, Impacts of Climate Change	Losses of adult livestocks: includes animals other than young animals that died due to natural hazards and diseases (Infectious or non-infectious), eaten by wild animals or other reasons[33]. 2010 was the year when the largest number of large livestock was lossed in Mongolia, and **23.4 percent** of the first year's livestock or **10.3 million livestocks** were killed. In the 100 years since 1918, considering the excessive loss of large livestock, there were **16 large-scale zud**, each of which resulted in the **loss of more than 2 million livestock**, causing considerable damage to the livelihood of herder families [24].
Rationale for conditionalizing variable vulnerability	In addition to natural disasters, factors such as wrongful human activities, personal training of provincial and local herdsmen, insufficient resources due to loss of grazing capacity, livestock diseases, veterinary services, loss of appropriate ratio of herd structure, and deterioration of livestock quality are contributing to the loss of livestock[24]. **11 million head of livestock** were killed by the **drought and zud of 2000-2002**, and **rural poverty increased by 33%** in the year after the zuds[28]. Livestock loss is directly related to herdsmen's standard of living. Therefore, vulnerability was selected as one criterion.
Methodology	The proportion of loss livestocks in the total livestocks (according to the amount of animals counted at the end of the previous year) $$ТМЗБХ = \frac{Number\ of\ losses\ of\ adult\ livestocks}{Number\ of\ first\ livestocks\ of\ the\ year} * 100$$ ТМЗБХ-*losses of adult livestocks*
Used data	- Number of livestock - *losses of adult livestocks,* by types
Date period	1991-2021, soums level

Livestock loss in Khovd province

Scale 1:1600000

Erdeneburen
Mayngad
Buyant
Khovd
Durgun
Jargalant
Duut
Chandmani
Mankhan
Munkhkhairkhan
Zereg
Darvi
Must
Tsetseg
Bulgan
Bulgan
Uench
Altai

92° E

46° N

Proportion of losses of adult animals in total animals
- Less than 0.4
- 0.5 - 0.8
- 0.8 - 1.2
- More than 1.2

The proportion of loss livestocks in the total livestocks in Khovd Province, 1991-2021

Erdeneburen
Chandmani
Tsetseg
Khovd
Uench
Mayngad
Must
Munkhkhairkhan
Mankhan
Zereg
Duut
Durgun
Darvi
Buyant
Bulgan
Altai
Jargalant

Provincial average 1.08

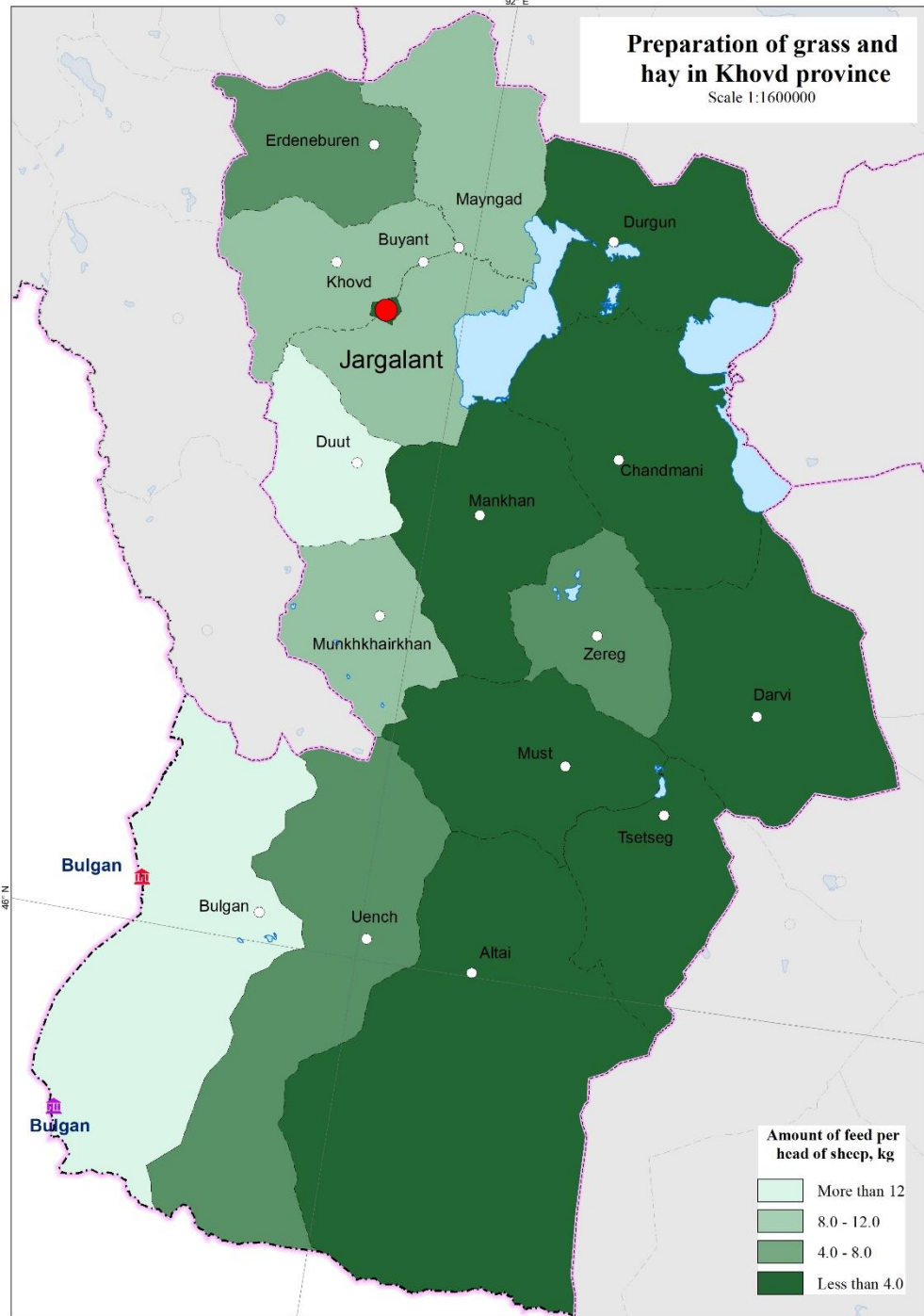0.00 1.00 2.00 3.00 4.00 5.00 6.00

Number of first livestocks of the year – 3 292 578
The number of losses of adults livestocks - 35,462
The share of lose livestocks in the total number of livestocks– 1.08
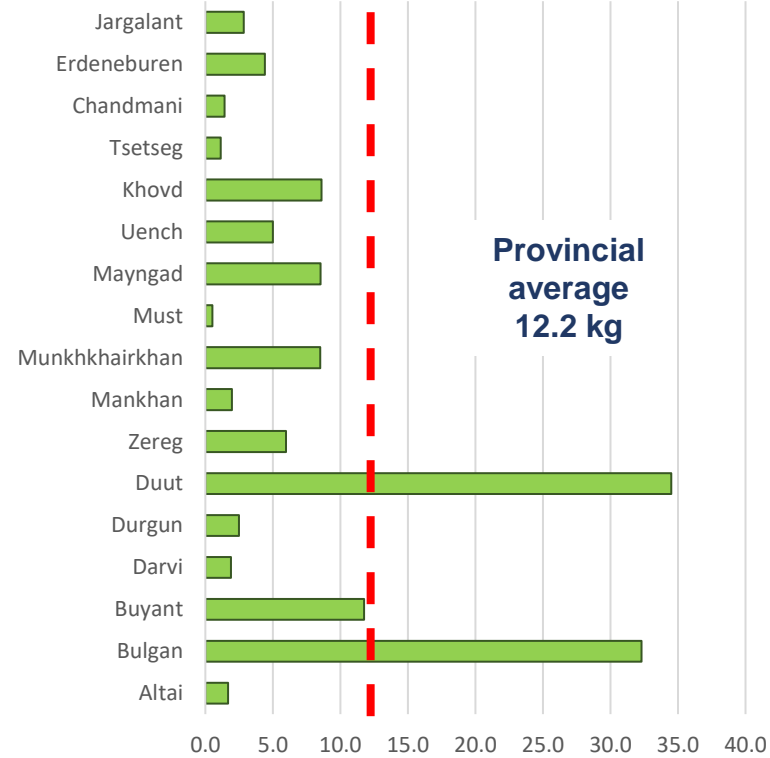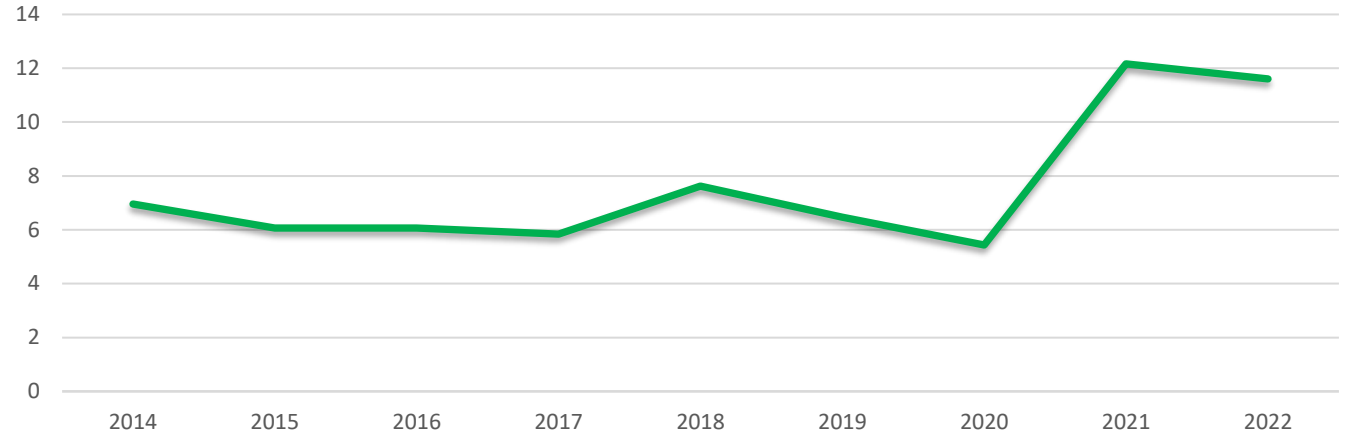
Out of the total 16 soums of Hovd province, the proportion of loss livestocks in the total livestocks is 4 soums with values higher than the average of the province.
These soums are vulnerable.

3. Prepared hay and fodder

Variable	Prepared hay and fodder
indicator	Feed supply or the amount of prepared hay per livestocks (as transferred to feed units)
Units	Thou.tonn/sheep head
Definition and Current Status of Variables, Impacts of Climate Change	**It is determined by the amount of hay and fodder prepared by enterprises and households.** As of 2020, 1369.2 thousand tons of hay, 9.4 thousand tons of straw, 58.4 thousand tons of hand feed, 121.3 thousand tons of prepared mineral feed, and 11.1 thousand tons of used grain waste have been prepared. If it is transferred to the **feed unit, a total of 849.7 thousand tons** of hay was prepared[55]. **In 2019, 7.1 kg** of hay and fodder were used **per head of sheep**, while **in 2020, it was 6.5 kg**, a decrease of 0.6 kg from the previous year[24] .
Rationale for conditionalizing variable vulnerability	In pastoral livestock farming, natural pastures and hay are the main source of animal feed. Depending on the climate and ecosystem of Mongolia, there is a lack of opportunities to harvest and prepare hay and fodder in a natural manner throughout the entire area[21]. Also, in **winter and spring, the nutrient quality of pasture grass and plants decreases by 2-3 times,** so additional feed is necessary for livestock[23]. Preparing hay and fodder at the national level, thereby increasing the supply and availability of hay and fodder for livestock, is one of the important factors for the survival of livestock in the year and reducing the vulnerability of pastoralism. Therefore, it is necessary to strengthen the ability to overcome and adapt to natural disasters such as drought, drought, and drought caused by climate change, and to ensure the stability of the livestock industry, within the framework of government regulation and planning, there is a need to increase grass, hay, fodder preparation, production, and cultivation.
Methodology	**Feed supply is calculated by comparing the amount of hay and fodder transferred to the unit to the number of livestocks transferred per head of sheep.** Feed includes prepared hay, hand feed, cultivated feed, and straw. When transferred to the **feeding unit**, it was transferred based on the coefficient issued by the National Statistics Office. $$БХТ = \frac{\text{Prepared hay and fodder (feed units)}}{Number\ of\ livestock\ (sheep\ head)}$$
Used data	- Prepared hay and fodder - Number of livestock, by sheep head
Date period	2014-2021, (hay, hand feed, cultivated feed, and straw), soum level

Preparation of grass and hay in Khovd province
Scale 1:1600000

Amount of feed per head of sheep, kg
- More than 12
- 8.0 - 12.0
- 4.0 - 8.0
- Less than 4.0

The amount of prepared hay per livestocks of Khovd province, 2014-2022, by feed units

Provincial average 12.2 kg

As of the year 2021
Hay – 122313.9 tonn
Hand feed – 10303.1 tonn
Cultivated feed – 1970.5 tonn
Straw – 110.5 tonn
Feed per sheep – 12.2 kg

Out of the total 16 soums of Hovd Province, 14 soums have a lower value than the provincial average in terms of availability of hay.
These soums are vulnerable.
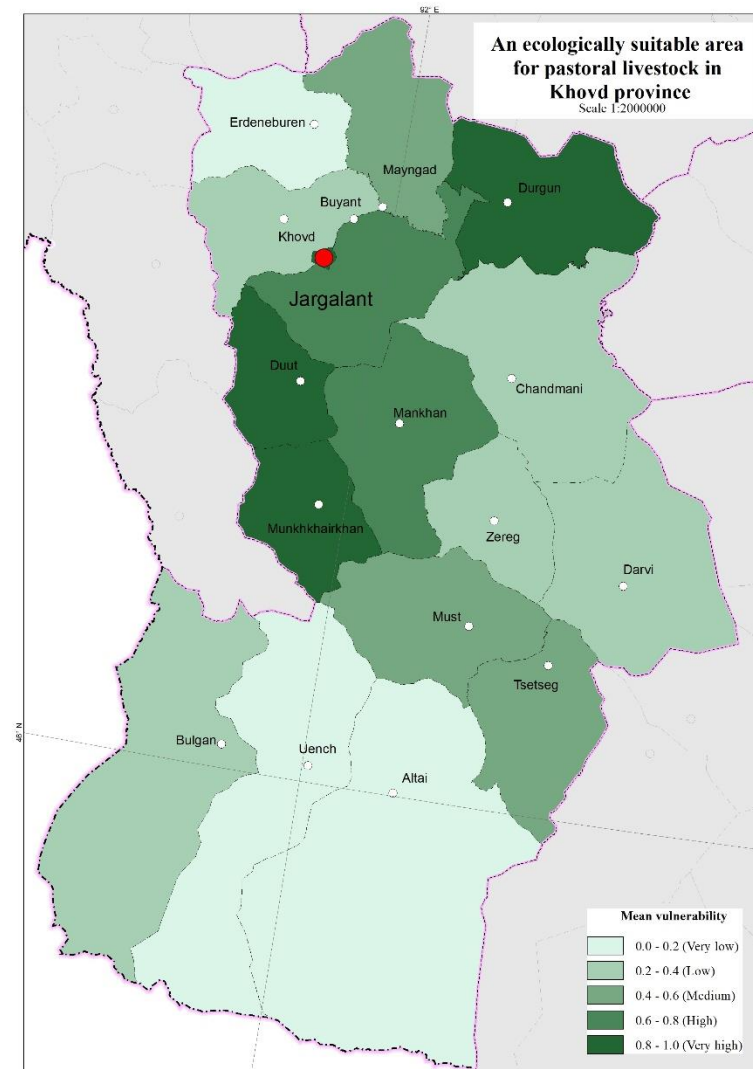
5. Ecological suitable territory

indicator	Sufficiency and suitability of pastures for 4 seasons
indicator	Pasture ratio for 4 seasons
Units	Ratio expressed as a percentage of summer, autumn, winter and spring areas
Definition and Current Status of Variables, Impacts of Climate Change	One of the ways to prevent and protect livestock from unexpected and unavoidable natural risks is the proper use and protection of pastures. In the natural geoecological conditions, the bioecology of pastoral livestocks is regulated by migration, which is the conscious labor of herdsmen, and the four-season area with complex characteristics with geographical boundaries, where reproduction is carried out, is called **"ecologically suitable territory"** for pastoral livestocks. **120 out of all sums in Mongolia lack pasture for 1-2 seasons**. The pattern of the four seasonal regions alternates when one region has positive conditions for grazing, while the other three become negative. That's why it's important to use seasonal pastures correctly[14].
Rationale for conditionalizing variable vulnerability	Due to the fact that some administrative units are too small in terms of territory [7], there is a situation where the ecologically suitable area for grazing livestocks is not complete [15]. Snow melts early and grass grows longer, reducing herdsmen's migration [57], violation of animal husbandry techniques, causing them to spend winter, spring, and summer pastures in the same place. The side effect of this is that animals cannot gain full fatness, resulting in a decrease in the productivity and endurance of livestocks, and a tendency to become overweight. Furthermore, it is a basic condition for livestock to die during drought and zud [6].
Methodology	The proportion of suitable pastures in winter, spring, summer and autumn in the total area of Sum $$\text{УБЭХ} = \frac{\text{pastures in winter, spring, summer and autumn}}{\text{total area of soum}} * 100 \qquad \text{УБЭХ} - Proportion\ of\ seasonal\ pastures$$ It was considered that 25 percent of the total land area used for one pasture is an appropriate ratio for the 4 seasons. Therefore, a vulnerability threshold value of 25 percent was considered. The index was calculated for each quarter and calculated by arithmetic mean.
Used data	Map of ecological suitable territory in pastural livestock, scale 1:5000000
Date period	National Atlas of Mongolia, 2009

The proportion of ecologically suitable territory (pastures of 4 seasons) for Sums of Khovd Province

An ecologically suitable area for pastoral livestock in Khovd province
Scale 1:2000000
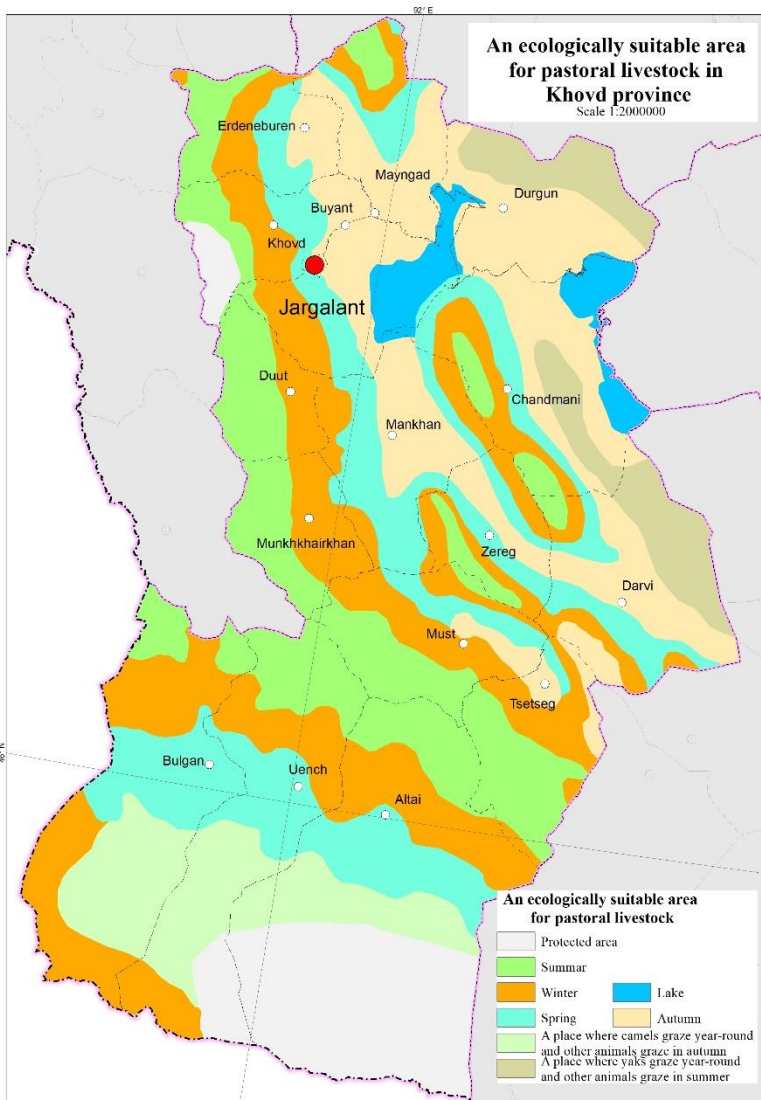
	Territory	Percentage
Spring	13534	17.4
Summer	16784.7	21.6
Winter	17868.8	23.0
Autumn	22279.2	28.6
Protected area	7303.52	9.4
Total	77770.22	100.0

	Spring	Summer	Winter	Autumn	Protected area
Altai	14.6	10.3	15.7	15.0	44.4
Bulgan	24.2	9.7	38.3	27.9	-
Buyant	17.4	2.1	19.8	60.6	-
Darvi	19.8	29.9	11.9	38.4	-
Durgun	0.3	37.4	-	62.4	-
Duut	-	70.8	29.1	0.0	0.1
Jargalant	35.9	-	-	64.1	-
Zereg	29.9	14.7	33.1	22.3	-
Mankhan	41.9	0.4	21.4	36.4	-
Munkhkhairkhan	2.2	52.7	45.1	-	-
Must	15.2	39.0	36.9	8.9	-
Mayngad	20.4	10.4	14.4	54.8	-
Uench	18.9	19.2	26.0	25.8	10.1
Khovd	17.7	20.5	26.5	15.6	19.6
Tsetseg	3.0	51.3	32.7	13.0	-
Chandmani	16.6	21.2	15.0	47.2	-
Erdeneburen	23.7	28.2	25.1	23.0	-
Total	17.4	21.6	23.0	28.6	9.4

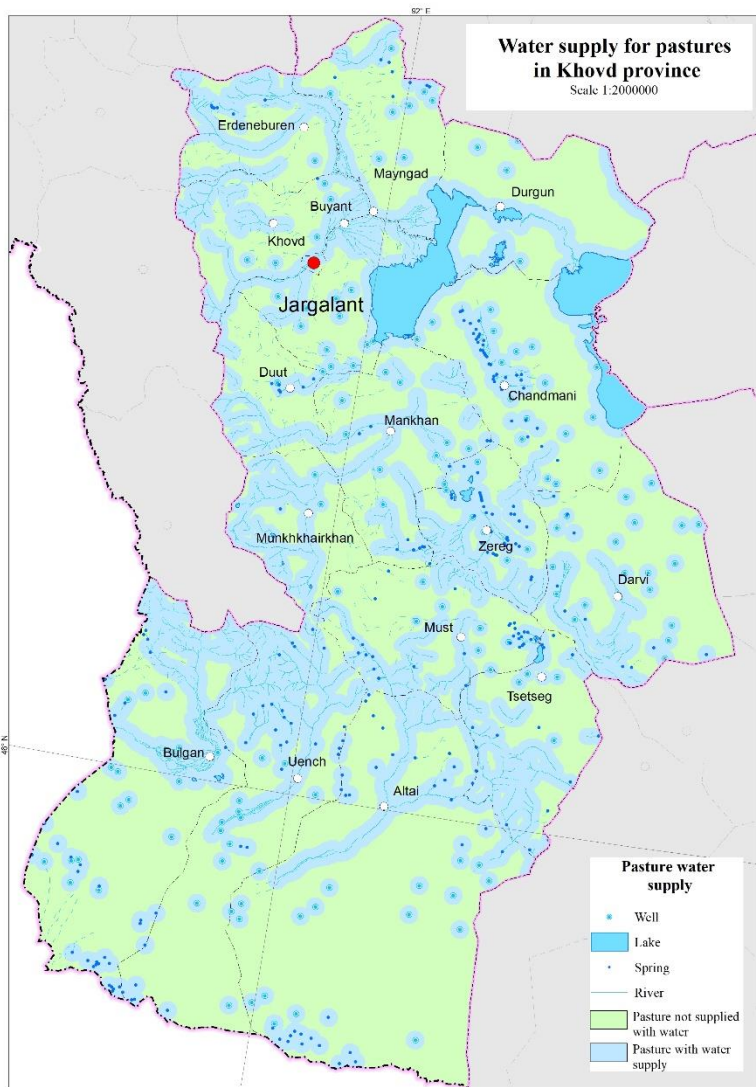An ecologically suitable area for pastoral livestock in Khovd province
Scale 1:2000000

Out of 16 soums of Khovd Province, 12 soums are vulnerable in terms of access to pastures.

2. Water availability

Variable	Water availability
indicator	Percentage of land with water availability in agricultural land
Units	Percentage
Definition and Current Status of Variables, Impacts of Climate Change	**In Mongolia, wells, springs, wells, rivers, lakes, and ponds are used for pasture water supply.** The water supply of pastures varies from region to region. According to the **grassland water supply survey, pastures not supplied with water account for 58 million hectares or 52% of the total grasslands.** Census of fences and wells is conducted by NSC every 3 years together with livestock census. In 2016, 263 of the 5,585 rivers and streams included in the census were dry, 774 of the 11,420 springs and ponds included in the census were dry and 106 were recovered, and 346 were dry and 31 were recovered out of the 2,214 lakes included in the census. **According to the 2018 census, a total of 48,400 wells and 629 reservoirs for drinking purposes for people and livestocks were counted.** Of these, there are 19.1 thousand engineered wells, 29.3 thousand ordinary mine wells, and the total number of wells located in pastures is 18.8 thousand wells.
Rationale for conditionalizing variable vulnerability	Due to the influence of climate change, the water level of steppes, dry steppes, barren steppes and Gobi lakes will decrease and the intensity of drought is expected to increase[2]. In the natural conditions of summer-autumn with low rainfall and winter-spring with little snow, grazing livestock is a condition of lack of water for livestock. As a result, increasing the risk of natural disasters, as well as creating a concentration of animals in one water point, many rivers and streams dry up due to warming, causing water shortages, and grazing pastures.
Methodology	Grazing animals can graze at a certain distance depending on the species [16], and on the other hand, the grazing distance varies depending on the natural region. Therefore, depending on the natural zone, the area with water supply was calculated by drawing a radius of **2.5 km** in the high mountain area, **3.5 km** in the steppe area, and **4 km** radius in the valley and desert area **[Chogdon]** from the water point(wells, springs, rivers, lakes). $$\text{УХТЭХ} = \frac{Water\ supply\ area\ (\text{га})}{Agricultural\ area\ (\text{га})} * 100$$
Used data	Spatial information of wells, springs, rivers, lakes and ponds (shapefile)
Date period	Agency for land administration and management, geodesy A, 2018 он

Water availability for pastures of sums of Khovd province

Water supply for pastures in Khovd province
Scale 1:2000000

Pasture water supply
- Well
- Lake
- Spring
- River
- Pasture not supplied with water
- Pasture with water supply

	number
Well	147
Spring	255
River	344
Lake	18

Soum name	Total area	Agricultural land	Area with water supply	Percentage of agricultural land	Percentage of total area
Altai	13438.3	8309.0	3467.11	41.7	25.8
Bulgan	8335.7	5211.0	3466.62	66.5	41.6
Buyant	3759.5	2011.0	2614.92	130.0	69.6
Darvi	5646.4	4939.0	2258.33	45.7	40.0
Durgun	4221.7	3735.0	1578.74	42.3	37.4
Duut	2201.5	2123.0	1029.35	48.5	46.8
Jargalant	69.3	0.0	61.13	0.0	88.3
Zereg	2578.5	2490.0	1927.33	77.4	74.7
Mankhan	4426.2	3598.0	2347.21	65.2	53.0
Munkhkhairkhan	2625.5	1680.0	1580.38	94.1	60.2
Must	4066.6	3881.0	1983.81	51.1	48.8
Mayngad	3350.3	3128.0	1296.6	41.5	38.7
Uench	7591.4	3021.0	3638.15	120.4	47.9
Khovd	2885.6	2363.0	1685.93	71.3	58.4
Tsetseg	3554.6	2558.0	2092.77	81.8	58.9
Chandmani	6183.3	5269.0	3123.95	59.3	50.5
Erdeneburen	2837.8	1624.0	1767.33	108.8	62.3
total	77772.3	55940.0	35919.66	64.2	46.2

Water supply for pastures in Khovd province
Scale 1:2000000

Proportion of water-supplied area in agricultural land
- More than 76.1
- 64.1 - 76
- 52.1 - 64
- Less than 52
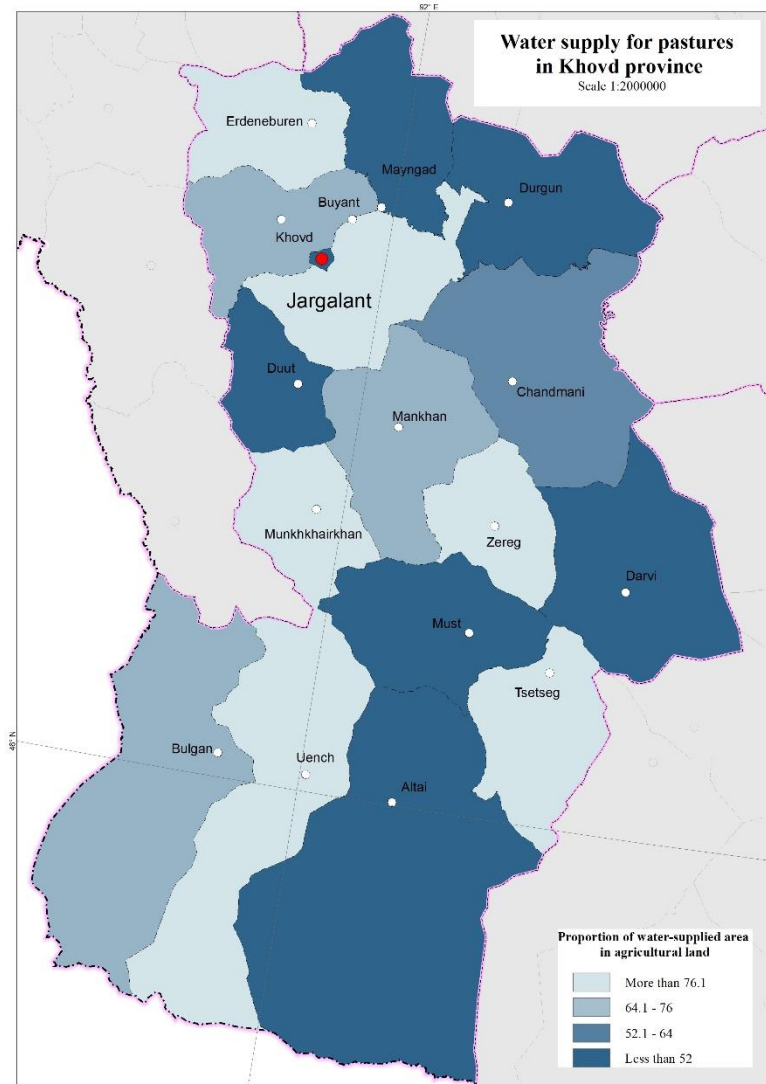
Out of the total 16 sums of Khovd province, 8 sums have a value lower than the average of the province in terms of water supply for pastures.
These soums are vulnerable.

Thank you for your attention