“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

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1. Determine vulnerability variables

**Climate change vulnerability variables**

**Climate and Environment**
- Drought
- Zud
- Aridity
- Vegetation cover
- Pasture use
- Desertification

**Agriculture**
- Number of livestock
- Livestock loss
- Prepared hay and fodder
- Water availability
- Ecological suitable territory

**Social and Demography**
- Poverty
- Unemployment
- Dependency ratio
- Number of female headed households
- Education of herders
- Migration
- Number of deaths due to cardiovascular disease
- Number of medical professionals

**Economy and Finance**
- Social insurance
- Health insurance
- Index-Based Livestock Insurance
- Bank savings
- Bank loans
- Low quality bank loans
- Number of cooperative societies
## 1. Number of livestock

<table>
<thead>
<tr>
<th>Variable</th>
<th>Number of livestock</th>
</tr>
</thead>
<tbody>
<tr>
<td>indicator</td>
<td>Number of livestock per person, by sheep head</td>
</tr>
<tr>
<td>Units</td>
<td>Sheep head/man</td>
</tr>
</tbody>
</table>

### 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

\[
1 \text{XHMT} = \frac{\text{Number of livestock (Sheep head)}}{\text{Population}}
\]

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 per person in Khovd province, by sheep, 1991-2021

As of the year 2021
Population – 90,333
Number of livestock – 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 livestock per person. These soums are vulnerable.
## 2. Livestock loss

<table>
<thead>
<tr>
<th>Variable</th>
<th>Livestock loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>indicator</td>
<td>The proportion of loss livestocks in the total livestocks (according to the amount of animals counted at the end of the previous year)</td>
</tr>
<tr>
<td>Units</td>
<td>Percentage</td>
</tr>
<tr>
<td>Definition and Current Status of Variables, Impacts of Climate Change</td>
<td>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 lost in Mongolia, and <strong>23.4 percent</strong> of the first year's livestock or <strong>10.3 million livestocks</strong> were killed. In the 100 years since 1918, considering the excessive loss of large livestock, there were <strong>16 large-scale zud</strong>, each of which resulted in the <strong>loss of more than 2 million livestock</strong>, causing considerable damage to the livelihood of herder families [24].</td>
</tr>
<tr>
<td>Rationale for conditionalizing variable vulnerability</td>
<td>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]. <strong>11 million head of livestock</strong> were killed by the <strong>drought and zud of 2000-2002</strong>, and <strong>rural poverty increased by 33%</strong> 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.</td>
</tr>
<tr>
<td>Methodology</td>
<td>The proportion of loss livestocks in the total livestocks (according to the amount of animals counted at the end of the previous year)</td>
</tr>
</tbody>
</table>
| | \[
| \text{TMЗБХ} = \frac{\text{Number of losses of adult livestocks}}{\text{Number of first livestocks of the year}} \times 100
|\]
| Used data | - Number of livestock  
- **losses of adult livestocks**, by types |
| Date period | 1991-2021, soums level |
The proportion of loss livestocks in the total livestocks in Khovd Province, 1991-2021

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Prepared hay and fodder</th>
</tr>
</thead>
<tbody>
<tr>
<td>indicator</td>
<td>Feed supply or the amount of prepared hay per livestocks (as transferred to feed units)</td>
</tr>
<tr>
<td>Units</td>
<td>Thou.tonn/sheep head</td>
</tr>
</tbody>
</table>

### 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.

$$ \text{БХТ} = \frac{\text{Prepared hay and fodder (feed units)}}{\text{Number of livestock (sheep head)}} $$

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

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

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Sufficiency and suitability of pastures for 4 seasons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indicator</td>
<td>Pasture ratio for 4 seasons</td>
</tr>
<tr>
<td>Units</td>
<td>Ratio expressed as a percentage of summer, autumn, winter and spring areas</td>
</tr>
</tbody>
</table>

### 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 geoeccological 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

$$\text{Пропорция of seasonal pastures} = \frac{\text{pastures in winter, spring, summer and autumn}}{\text{total area of soum}} \times 100$$

$\text{УБЭХ} - \text{Пропорция of seasonal pastures}$

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
- National Atlas of Mongolia, 2009
The proportion of ecologically suitable territory (pastures of 4 seasons) for Sums of Khovd Province

<table>
<thead>
<tr>
<th>Season</th>
<th>Territory</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>13534</td>
<td>17.4</td>
</tr>
<tr>
<td>Summer</td>
<td>16784.7</td>
<td>21.6</td>
</tr>
<tr>
<td>Winter</td>
<td>17868.8</td>
<td>23.0</td>
</tr>
<tr>
<td>Autumn</td>
<td>22279.2</td>
<td>28.6</td>
</tr>
<tr>
<td>Protected area</td>
<td>7303.52</td>
<td>9.4</td>
</tr>
<tr>
<td>Total</td>
<td>77770.22</td>
<td>100.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Variable</th>
<th>Water availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>indicator</td>
<td>Percentage of land with water availability in agricultural land</td>
</tr>
<tr>
<td>Units</td>
<td>Percentage</td>
</tr>
</tbody>
</table>

### Definition and Current Status of Variables, Impacts of Climate Change

In Mongolia, wells, springs, rivers, lakes, and ponds are used for pasture water supply. The water supply of pastures varies from region to region. According to the ground 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 livestock 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).

\[
\text{Water supply area} = \frac{\text{УХТЭХ}}{\text{Аgricultural area}} \times 100
\]

### Used data

- Spatial information of wells, springs, rivers, lakes, and ponds (shapefile)

### Date period

Agency for land administration and management, geodesy А, 2018 он
### Water availability for pastures of sums of Khovd province

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

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