Field report for the National Federation of Pasture User Groups

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Field survey from 26 August 2019 to 02 September 2019

August 2020 report

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I. INTRODUCTION

This study was carried out by Régis Peltier, forestry expert at Cirad (Centre de coopération internationale en recherche agronomique pour le développement) and by Annaêl Barnes, master student in agronomy at Montpellier SupAgro, France, as part of her end-of-studies internship in the Research Unit Selmet (« Système d'ELevage Méditerranéens et Tropicaux ») of CIRAD.

The field part of this report was carried out in the Dundgobi Province in the Gobi Desert in Mongolia. This study was prepared with the National Federation of Pasture Users Group. Gerlee Puntsag, an official of the Department of Land Management, provided assistance, especially as an interpreter, but also for the ethnobotanical part of our study.

Interviews with 12 herders were conducted to study the livestock systems of the study site, the perception of herders of their pastoral environment, and to gather the opinion of the herders regarding planting projects as a solution to pasture degradation. Their botanical knowledge were also studied thank to an ethnobotanical survey, in order to identify species of interest for the herders, in cases of plantation or sustainable management of natural pastures. In addition, measurements in natural saxauls (*Haloxylon ammondendron*) forests were carried out in Olziit soum, in order to measure the natural density of saxauls, to be able to estimate an appropriate planting density adapted to the conditions of the Gobi.

II. MATERIAL AND METHODS

1. STUDY SITES

The two study sites are located in the Gobi Desert, in the Dundgobi aimag, in two different soums:

- Gurvansaikhan soum, where surveys of soum herders were conducted;
- Olziit soum, where measurements in natural saxauls forests were carried out.

Their location is shown in « Figure 1: location of the study areas, the Gurvansaikhan and Olziit soums (satellite image background: Bing) »

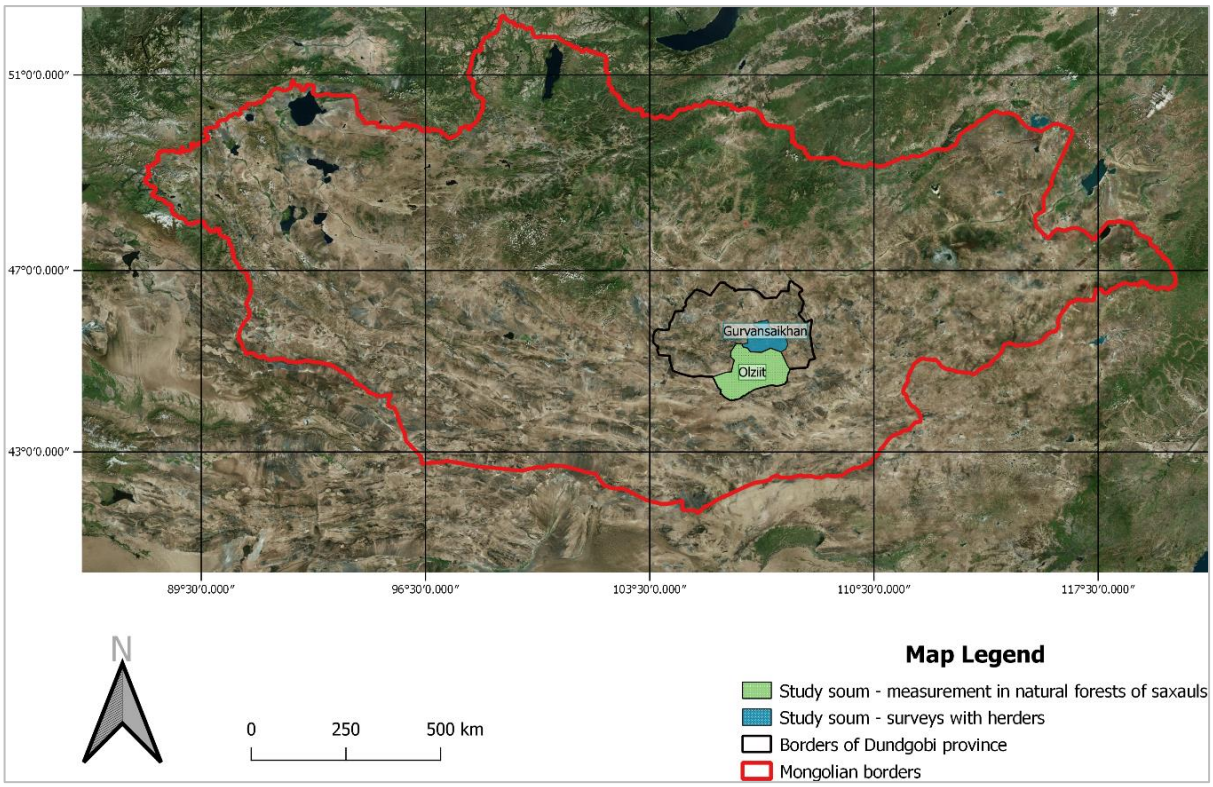

Figure 1: location of the study areas, the Gurvansaikhan and Olziit soums (satellite image background: Bing)

2. SURVEY OF GURVANSAIKHAN SOUM HERDERS

a. The Gurvansaikhan herders

We wanted to carry out interviews in an area of the Gobi Desert region where plantation projects have already taken place. This is the case of the Gurvansaikhan soum according to Mühlenberg et al. 2006. Thus, it should be possible to determine whether herders who have already heard of or interacted with plantations have a positive perception of them. Twelve herders from Gurvansaikhan soum were thus met during the field study from 26/08/19 to 02/09/19 (for their location, see « Figure 2: location of interviewed herders' summer camps around Gurvansaikhan (satellite image background : Bing) »).

Due to the limited time we had for the field study, our sampling consists mainly of a selection of herders based on the knowledge of a resource person in the field: Erduseren, a local expert in charge of plantations in Gurvansaikhan.

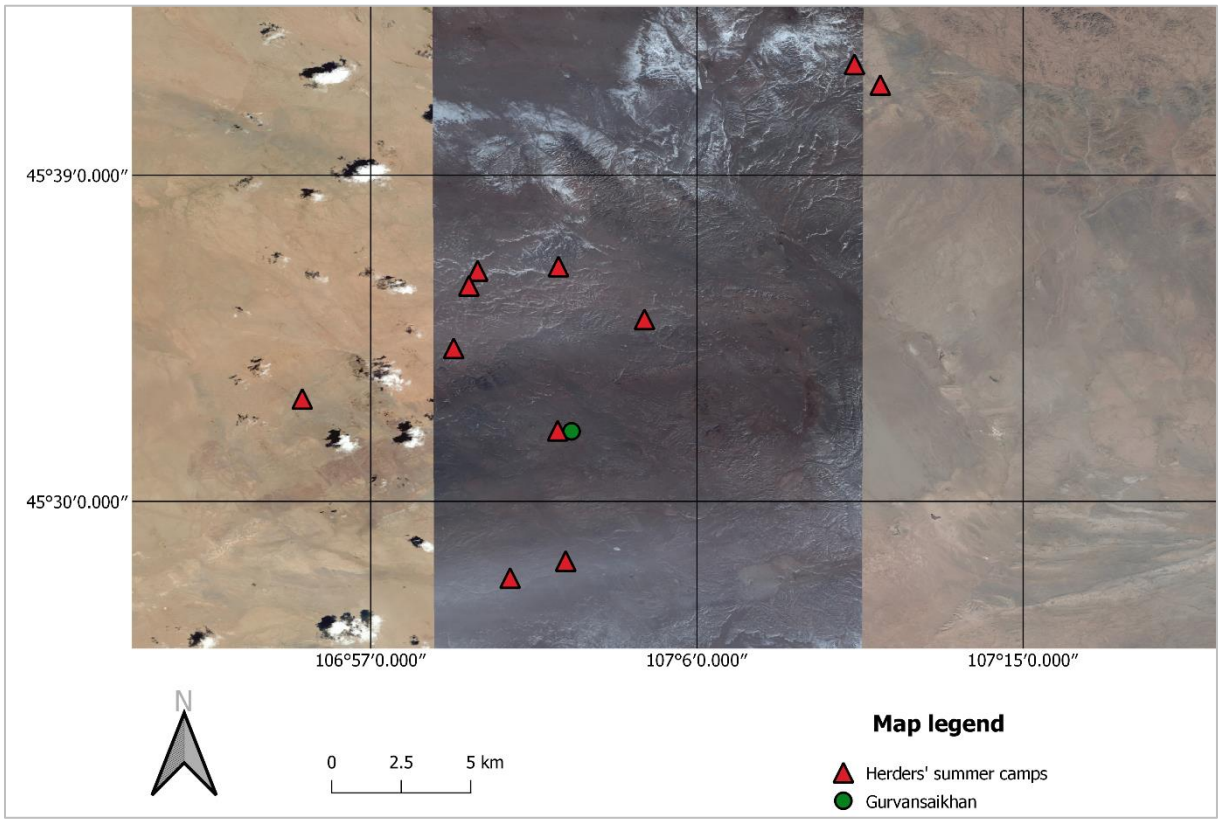

Figure 2: location of interviewed herders' summer camps around Gurvansaikhan (satellite image background : Bing)

b. The interview guide

A survey guide was developed, based on the interview guide produced by Ivana Mardesic (Mardesic, 2018) during her study on the perception of pasture degradation among Mongolian herders. The guide used is structured into two main themes according to the data to be collected: the description of the herder, the herd and the livestock system, followed by his/her perception of the pastoral environment. The interview guide is available in « APPENDIX 1 : INTERVIEW GUIDE »

c. Use of interview data

Interview data will be used as described in Table 1 : expected interview data and associated purpose(s).

Table 1 : expected interview data and associated purpose(s)

Data from the interview	Purpose(s)
Qualitative and quantitative data from the section on the herder, his herd and the management of the livestock	Refining our understanding of the pastoral context of Gurvansaikhan
Ethnobotanical data from questions on animal feeding in terms of species and on the human use of these species	Studying the local botanical knowledge of the herders Identifying potentially interesting species for a plantation
Qualitative and quantitative data on the perception of the pastoral environment and plantations	Studying the perception of the pastoral environment Studying the perception of interest and feasability of plantations Identifying other solution against pastures degradation Studying the perception of plantations according to the perception of the pastoral environment
Feedback on herders' fears and expectations	Collecting the fears and expectations of farmers in the region, not necessarily directly related to the plantation

Figure 3: the team with herders met in Gurvansaikhan (photo credit: Régis Peltier)

3. DENSITY MEASUREMENTS IN NATURAL FORESTS OF SAXAULS

a. Natural forests of Saxauls in the Olziit soum

Plantation projects in the Gobi Desert often involve saxaul, alone or in association (Mühlenberg et al. 2006). As a result:

- density measurements are carried out in the natural forests of saxauls: in our opinion, they represent a good indicator of a plantation density adapted to the conditions of the Gobi;
- although other species are present in the forests, the measurements are targeted only on the saxaul.

Therefore, the sampling was not random: we relied on the knowledge of our partners to find saxaul forests in the Dundgobi aimag, where saxaul forests are rare and degraded. The location of the study sites is shown in « Figure 26: location of survey points and associated saxaul density (satellite background imagery: Bing) ».

b. Use of the Quadrant Center Point Method

The method used in saxauls forests is the "Quadrant Centred Point" method (QCP) (Hiernaux, 2016; Mitchell, 2017). It is shown in « Figure 4: explanatory scheme of the "Quadrant Centered Points" method. »

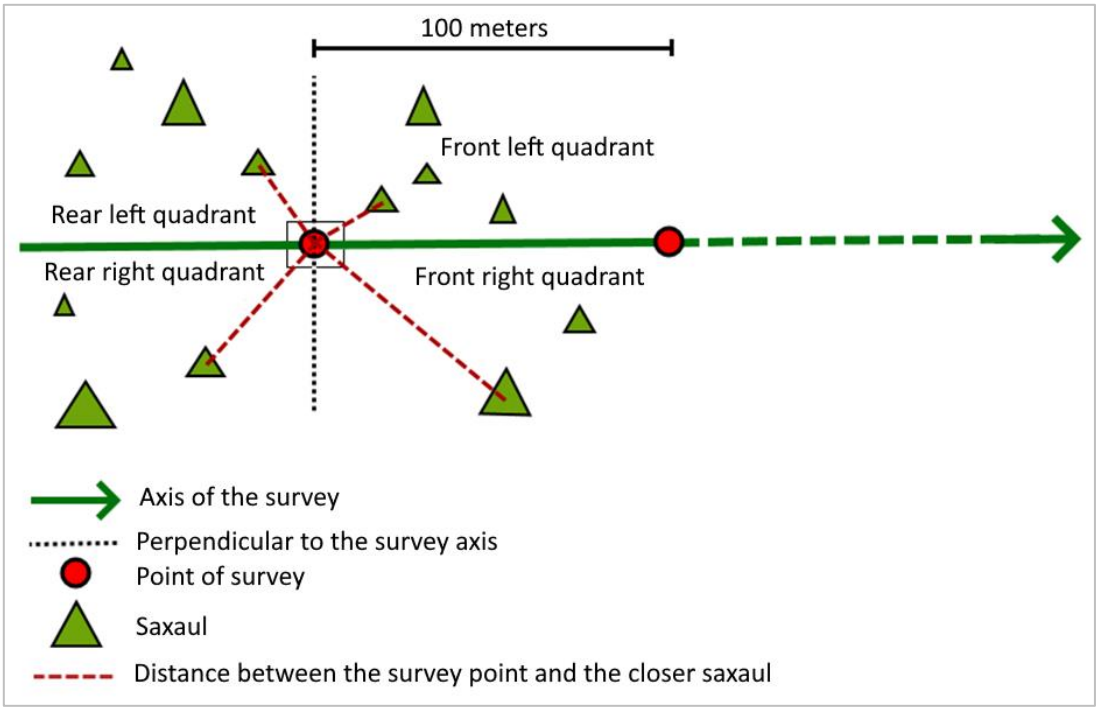

Figure 4: explanatory scheme of the "Quadrant Centered Points" method

Along a survey axis, the procedure is as follows:

1. Choosing a survey axis
2. Points of survey every 100 metres on this axis. In order to stay on the axis and obtain points 100 meters apart, we use a GPS with a compass.
3. At the survey point, draw the perpendicular to the survey axis to obtain 4 quadrants ("rear left", "rear right", "front left" and "front right").
4. At each survey point, the distance between the nearest saxaul and the survey point is measured with the use of a meter. The height of these saxauls is also measured.
5. Repeat the procedure 100 metres further on a new survey point. Because of the potential variability of density, 6 points are established per survey axis, to take into account this variability.

c. Estimated average density along each survey axis

The average density in saxauls/m^2 is calculated according to Pollard's formula (1971) (Mitchell, 2017) (see « Equation 2: Pollard's formula (1971) for calculating estimated average density (source: Mitchell, 2017) »). Its standard deviation is the square root of the variance calculated from « Equation 1: Pollard's formula (1971) for calculating variance (source: Mitchell, 2017) ».

$$\hat{\lambda} = \frac{4(4n-1)}{\pi \sum_{i=1}^{n} \sum_{j=1}^{4} R_{ij}^2}$$

Equation 2: Pollard's formula (1971) for calculating estimated average density (source: Mitchell, 2017)

$$\mathrm{Var}(\hat{\lambda}) = \frac{\hat{\lambda}^2}{4n-2}.$$

Equation 1: Pollard's formula (1971) for calculating variance (source: Mitchell, 2017)

Where **n** = the number of survey points on the survey axis (n = 6), and **R^2i,j** = the distance squared between the survey point i and the saxaul of quadrant j (e.g., j=1 corresponds to the front left quadrant, j=2 to the front right quadrant, j=3 to the rear right quadrant, and j=4 to the rear left quadrant).

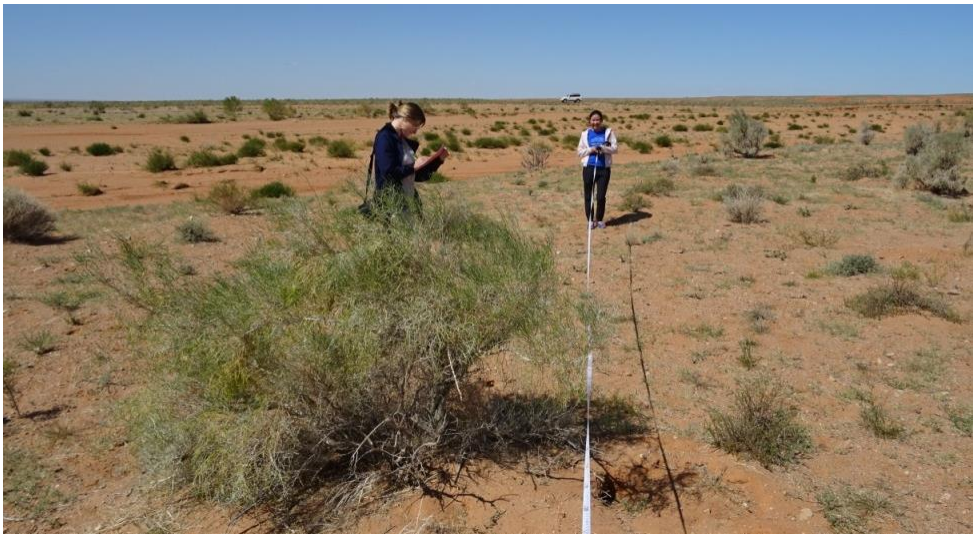

Figure 5: application of the PCQ method in a saxaul forest in Olziit soum (photo credit: Régis Peltier)

4. OTHER MEASUREMENTS

We also carried out measurements in plantations. The aim was to study the factors of success or failure of these plantations in the Gobi Desert. Nevertheless, we do not have enough information about their planting dates, and about their past and present management, if any at all. This part of the study will therefore not be used in this report. However, the data collected during measurements in these plantations are available in « APPENDIX 2 : DATA FROM MEASUREMENTS AMONG PLANTATIONS », and the location of the sites studied is shown in « Figure 6: location of studied planting sites in Gurvansaikhan soum (satellite image background : Bing) ».

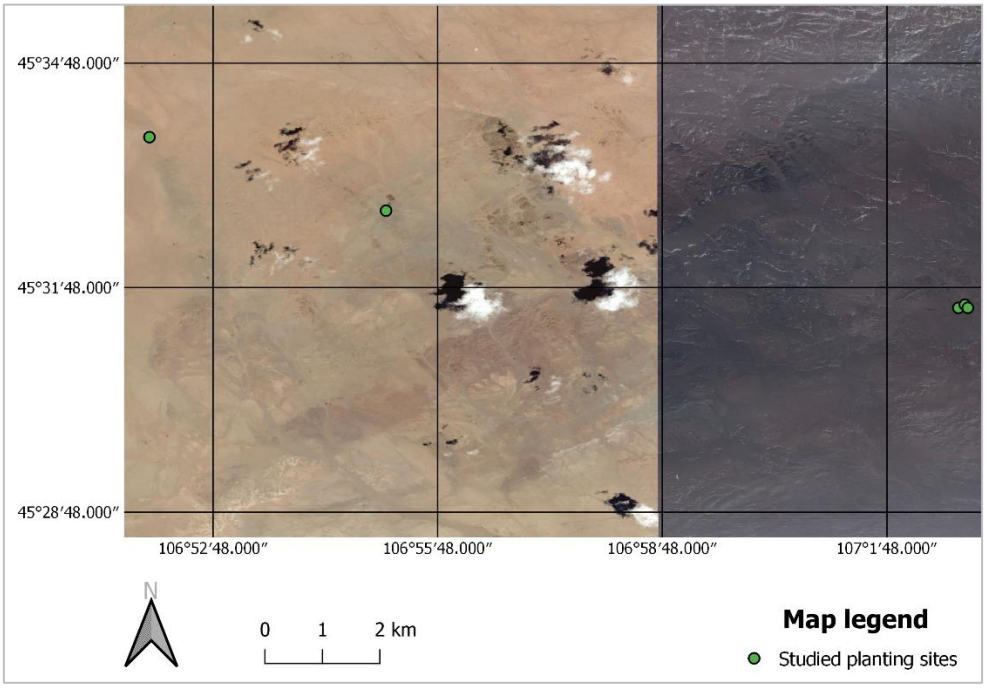

Figure 6: location of studied planting sites in Gurvansaikhan soum (satellite image background : Bing)

The three easternmost sites are 2.8 hectares of government plantations that were carried out in 2018 in Gurvansaikhan. However, no salaries have been paid for the management of these plantations, so no one is in charge of them. There is no irrigation. The two study sites in the west are plantations by herders.

III. RESULTS

Data from the interviews, the ethnobotanical survey, and measurements in the saxauls forest are available in « APPENDIX 3 : DATA FROM THE INTERVIEWS », « APPENDIX 4 : ETHNOBOTANICAL DATA », « APPENDIX 5 : DATA FROM QCP METHODS IN NATURAL SAXAULS FOREST ».

1. DESCRIPTION OF LIVESTOCK SYSTEMS IN GURVANSAIKHAN SOUM

a. The herders

Of the herders interviewed, 7 were women and 5 were men. For the 12 herders interviewed, livestock farming is the main activity, and they do not carry out any other activities in addition to livestock farming.

The number of breeders interviewed per bag is shown in « Figure 7: number of herders interviewed per bag in Gurvansaikhan soum », and the ages of the interviewees in « Figure 8: age classes of the breeders interviewed in Gurvansaikhan soum » and in « Table 2: average, minimum and maximum age of the breeders met in Gurvansaikhan soum »

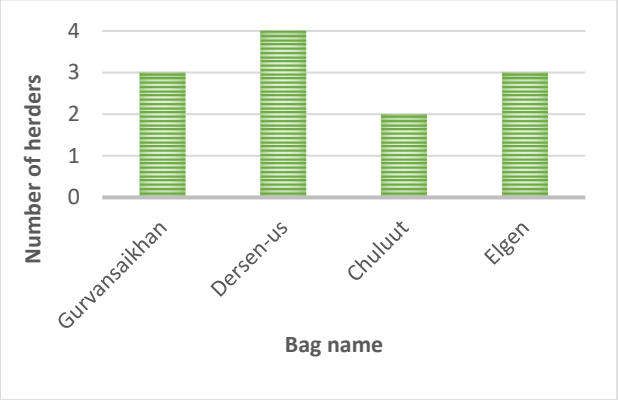

Figure 7: number of herders interviewed per bag in Gurvansaikhan soum

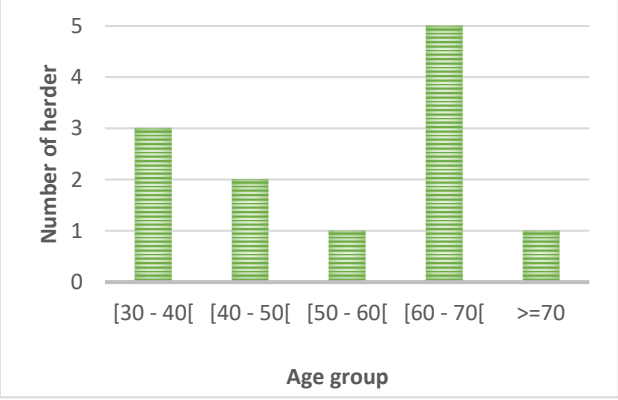

Figure 8: age classes of the breeders interviewed in Gurvansaikhan soum

Table 2: average, minimum and maximum age of the breeders met in Gurvansaikhan soum

N=12	Mean	Standard deviation	Minimum	Maximum
	54	16	30	82

b. The herd

At least two different species are farmed by herders. Figure 9: average number of camels, horses, cows, sheeps and goats of the herders met in Gurvansaikhan Figure 10: average number of camels, horses, cows, sheep and goats, in terms of Livestock Unit, of the herders met in Gurvansaikhan, Table 3: average, minimum and maximum livestock, and average, minimum and maximum number of camels, horses, cows, sheep and goats of the herders met in Gurvansaikhan and Table 4: average, minimum and maximum number of livestock in terms of Livestock Unit, and average, minimum and maximum number of camels, horses, cows, sheep and goats in terms of Livestock Unit, of the herders met in Gurvansaikhan illustrates and describes the average number of camels, horses, cows, sheep and goats in terms of individuals and then in terms of LU.

The livestock unit, or LU, is a "reference unit for aggregating livestock of different species and ages using specific coefficients initially established on the basis of the nutritional or dietary requirements of each type of animal" (Foray and Gac, 2018). The livestock studied consisted of camels, horses, cows, goats and sheep. However, large livestock (camels, horses and cows) do not have the same grazing load as small livestock (goats and sheep), which is why we use LUs. On the basis of research advice from the Selmet Research Unit of CIRAD, we use the following values :

- Camels, horses and cows: LU = 1
- Goats and sheeps: LU = 0.15

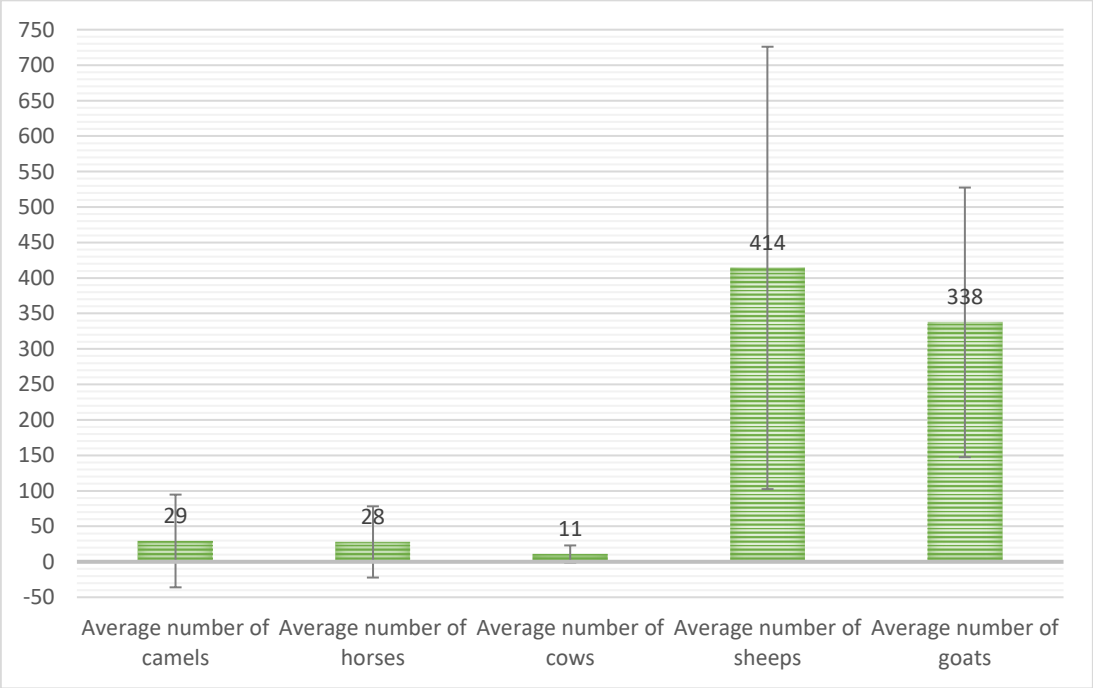

Figure 9: average number of camels, horses, cows, sheeps and goats of the herders met in Gurvansaikhan

Table 3: average, minimum and maximum livestock, and average, minimum and maximum number of camels, horses, cows, sheep and goats of the herders met in Gurvansaikhan

N=12	Mean	Standard deviation	Minimum	Maximum
Total livestock	820	471	140	1661
Camels	29	65	0	220
Horses	28	50	0	150
Cows	11	12	0	35
Sheeps	414	312	0	1100
Goats	338	190	80	700

Figure 10: average number of camels, horses, cows, sheep and goats, in terms of Livestock Unit, of the herders met in Gurvansaikhan

Table 4: average, minimum and maximum number of livestock in terms of Livestock Unit, and average, minimum and maximum number of camels, horses, cows, sheep and goats in terms of Livestock Unit, of the herders met in Gurvansaikhan

N=12	Mean	Standard deviation	Minimum	Maximum
Total livestock	181	121	21	437
Camels	29	63	0	220
Horses	28	48	0	150
Cows	11	12	0	35
Sheeps	62	45	0	165
Goats	51	27	12	105

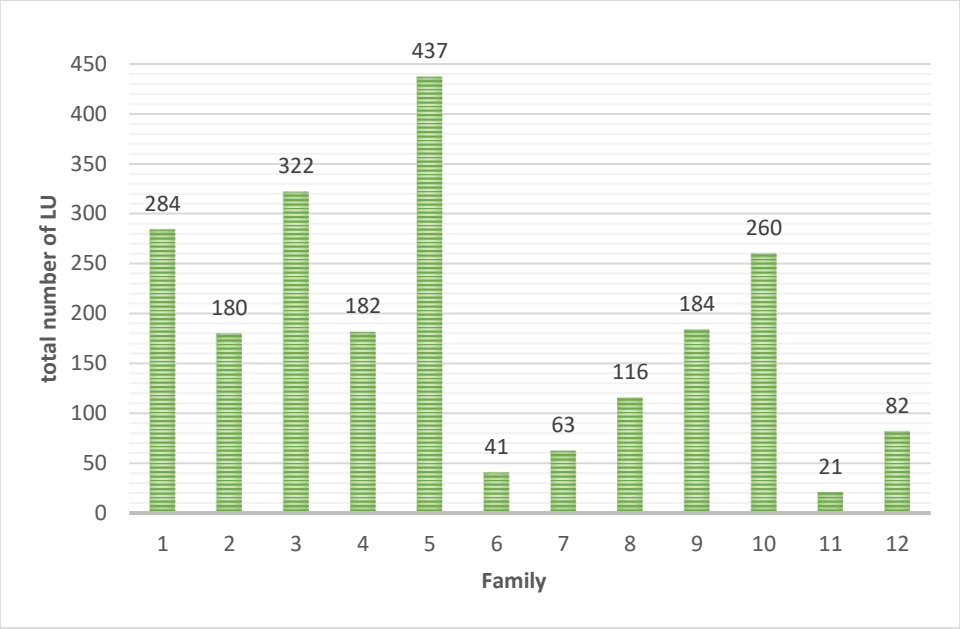

Figure 11: number of Total Livestock Units per family met in Gurvansaikhan

"Small" herds (in our sample, for herds ranging from 140 to 573 heads) are often complementary to a retirement pension received by older herder couples (> 60 years old in our sample). This pension amounts to 6,000,000 ₮ for a couple. Two cases are present in our sample: the herder started herding at the beginning of his retirement to supplement his pension; or the herder decided to reduce his herd after a certain age in order to simply have a herd considered as "sufficient to live on" in addition to the retirement pension. These "small" herds can ensure them food, dried manure for heating (10 m^3 of dried manure for a household during the winter), but also a kind of financial insurance in case of problems.

Figure 12: camel in Gurvansaikhan soum (photo credit: Annaêl Barnes)

Figure 13: goats and sheeps in Gurvansaikhan (photo credit: Annaêl Barnes)

c. The workforce

Livestock farming in Gurvansaikhan is rather a family activity, and few families hire herders from outside the family for livestock activities according to the « Figure 14: distribution between permanent and occasional workforce among the families met in Gurvansaikhan » and « Figure 15: distribution between family and non-family workers among the families met in Gurvansaikhan ». « Table 5: total number of herders, permanent, occasional, family-owned and non-family members involved in livestock activities among the families met in Gurvansaikhan » describes the average, minimum and maximum total, permanent, occasional, family and non-family workforce among the families met in Gurvansaikhan.

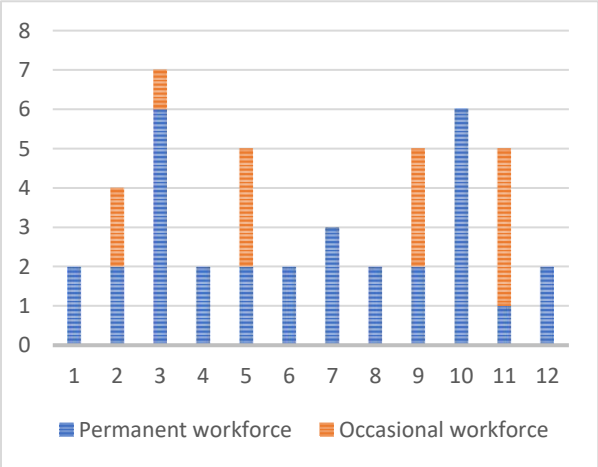

Figure 14: distribution between permanent and occasional workforce among the families met in Gurvansaikhan

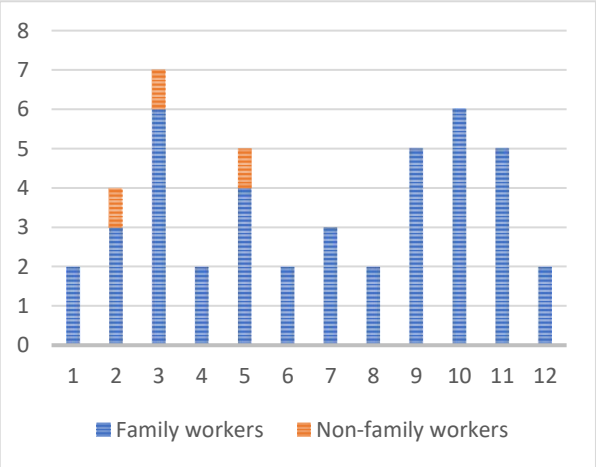

Figure 15: distribution between family and non-family workers among the families met in Gurvansaikhan

Table 5: total number of herders, permanent, occasional, family-owned and non-family members involved in livestock activities among the families met in Gurvansaikhan

N=12	Mean	Standard deviation	Minimum	Maximum
Total workforce	3.8	1.8	2	7
Family workers	3.5	1.6	2	6
Non-family workers	0.3	0.5	0	1
Permanent workforce	2.7	1.6	1	6
Occasional workforce	1.1	1.5	0	4

More specifically, in our sample:

- 5 herders report working only with their wives or husbands ;
- 2 herders report working with their wives or husbands all year round, and receiving help from their children during school holidays ;
- 1 herder reports working with his wife during the year, and receiving help from two men in the family during the summer ;
- 1 herder declares working alone, except during the winter when she gathers with her daughter's family, including her daughter, son-in-law and her 2 grandchildren.

Regarding herders who are not part of the family, only 3 of the 12 herders interviewed said they hire them at certain times of the year, particularly during the spring, i.e. the difficult calving and mowing period. The breeder and the family are bound by a contract, and the breeder may be paid with live animals, or in cash (about $400 per month, and fed directly by the family he works for).

Figure 16: mare milking (son, wife and husband) (photo credit : Régis Peltier)

d. Herd management

Small livestock (goats and sheeps) always graze together. Large livestock (horses, cows and camels) always graze separately from other species. Thus, only sheep and goats are mixed within the herd. For the herders we met, this separation between the small livestock and the large livestock is natural. On the one hand, because camels, horses and cows can move longer distances than sheep and goats, but also because it can be dangerous for small livestock to approach larger animals (e.g. hoof blows). Also, camels may also move further away from watering points and each species has its own food preferences. Finally, near the mountains, herders have reported attacks by wolves on small livestock, which should encourage them to stay close to the camps where they are protected by men and their dogs.

The adult herd is left free on the pastures around the camp, except at milking time. When they are on the pastures, they return to the camp on their own in the evening. In areas where there are no natural watering points, they should return to wells and boreholes at times when farmers can draw water (see « Figure 13: goats and sheeps in Gurvansaikhan (photo credit: Annaêl Barnes) »).

Young animals are sent once a day to the pastures to be fed directly by their mothers. Before then, they are tied up near the camp so that the mothers return to the camp on their own for milking. In the winter, they are left within the fences to be protected from the cold and wind.

The mares are milked 5 times a day, before late afternoon (when the foals are released to be fed by their mothers on the pastures), from July/August to October. Camel milking is carried out during winter and autumn. The cows are milked from October, and the goats from July to September.

e. Food inputs

Very few food inputs are used. The herders we met buy inputs only for periods that are difficult from the point of view of climate, or for animals that are too weak to graze (old animals, females that have given birth, etc.). These inputs can even be vital to the herd during dzud episodes, for example. They are bought in the centre of aimag, or even in Ulaanbataar. More specifically, in our sample :

- 5 herders declare buying hay (4 to 5 tons bought for a herd of 1280 heads ; 10 tons bought for a herd of 1204 heads ; 320 000 ₮ per ton)
- 4 herders declare buying oat (5 000 000 ₮ per ton; about 2 tons bought for a herd of 1204 heads)
- 3 herders report buying bran
- 3 herders declare buying "*bag sar mal*", a mixture enriched in proteins and minerals (2 to 3 tons bought for a herd of 1280 heads).
- 2 herder reports buying wheat
- 1 herder declare buying rye

f. Sales and incomes

According to « Figure 17: animal products sold by herders », the best-selling products are cashmere and sheep wool: they are produced and sold by all the herders we met. « Table 6:

average, minimum and maximum income in Tugrik (₮) of the families met in Gurvansaikhan » shows that there is a wide disparity in terms of income between families

The prices of livestock products, according to the information given by herders, are as follows:

- Camel milk: 2,500 ₮ per litre
- Mare milk: 3,000 to 4,000 ₮ per litre
- Yoghurt: 4,000 to 5,000 ₮ per kg
- Live sheep: 50,000 to 100,000 ₮ per sheep. Up to 200,000 ₮ for a healthy adult sheep.
- Live goat: 50,000 to 100,000 ₮ per goat. Up to 150 000 ₮ for a healthy adult goat.
- Sheep meat: 5,000 to 6,000 ₮ per kg.
- Goat meat: 4,000 to 5,000 ₮ per kg
- Sheep skin: 3,000 ₮ per skin
- Goat skin: 2,000 ₮ per skin
- Cashmere: 100,000 ₮ per kg
- Sheep wool: 500 ₮ per kg
- Horsehair: 4 000 to 8 000 ₮ per kg

Most of the herders' income seems to come from the sale of cashmere. However, cashmere production does not seem to be proportional to the number of goats in the herd, as shown in « Figure 18: Quantity of cashmere produced and sold (kg/year) according to the number of goats in the herd, for the 12 herders met in Gurvansaikhan soum ». According to this graph, except for one herder whose production reaches 300 kg/year, cashmere production caps at 100 kg/year from 400 goats.

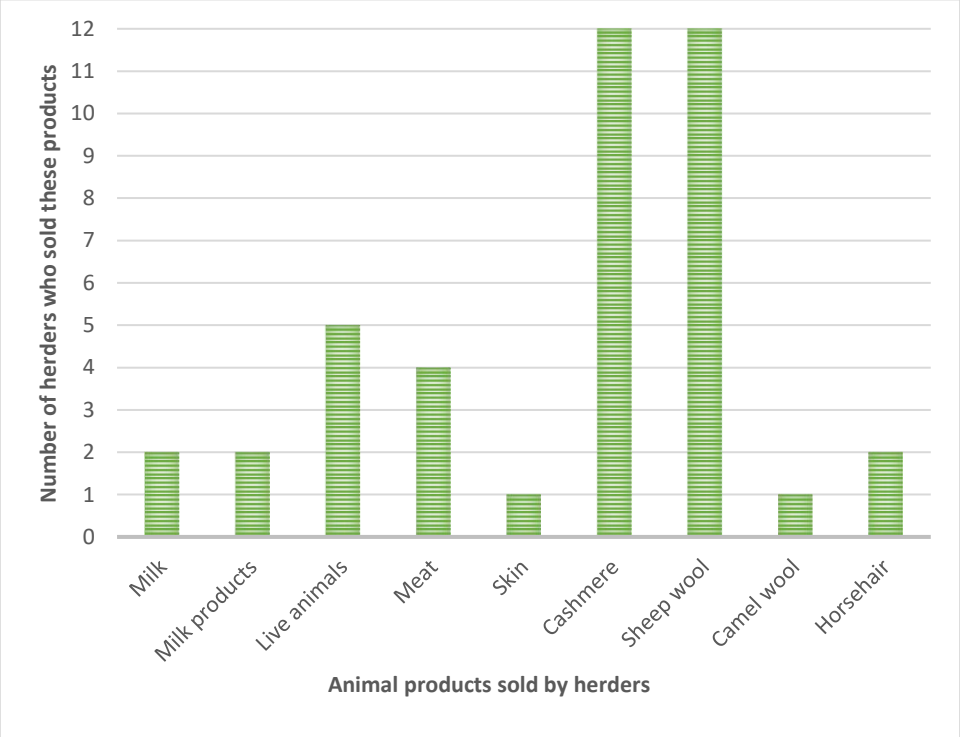

Figure 17: animal products sold by herders

Table 6: average, minimum and maximum income in Tugrik (₮) of the families met in Gurvansaikhan soum

N=12	Mean	Standard deviation	Minimum	Maximum
	15 788 958	17 261 163	2 900 000	65 000 000

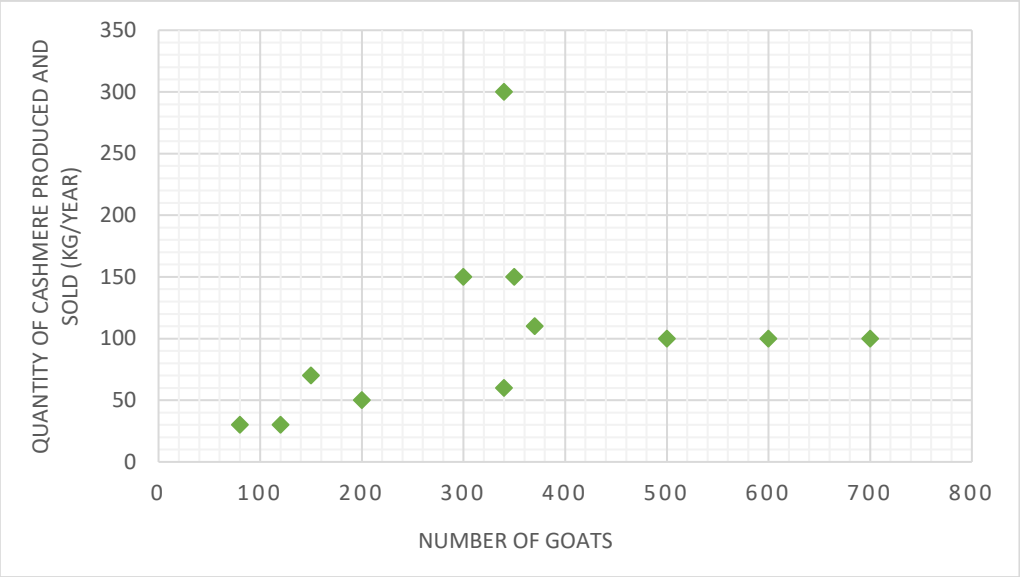

Figure 18: Quantity of cashmere produced and sold (kg/year) according to the number of goats in the herd, for the 12 herders met in Gurvansaikhan soum

Live animals can actually represent a capital that can be mobilized at any time for the families: for example, a herder sold 30 goats and sheep for 6 000 000 ₮ to buy a house; a couple we met informed us that the school fees of one of their children studying in Ulaanbaatar amounted to 1 000 000 ₮/year, an amount they were able to obtain by selling live animals.

g. Mobility

Of the 12 breeders interviewed, only one was not mobile. On average, the herders we met move their camps 4 times a year, over distances of 17 km per trip (see « Table 7: average, minimum and maximum number of annual minimum movements, and average, minimum and maximum distance travelled by pastoralists between camps in Gurvansaikhan »).

Table 7: average, minimum and maximum number of annual minimum movements, and average, minimum and maximum distance travelled by pastoralists between camps in Gurvansaikhan

N=12	Mean	Standard deviation	Minimum	Maximum
Minimum annual number of trips	4	2	0	7
Average trips distance	17	16	0	50

The herders we met travel up to 7 times a year. It depends mostly on the state of the pasture. Mobility is often described as seasonal : there are different camps according to the season.

The winter camp is a permanent camp, often between the mountains. It is well protected from the wind by rocks or by a wall on the north side. It serves to protect the animals from storms, wind, snow and cold. It keeps the herd warm: in particular, the animal excrement on the ground gives off heat. In the morning, the animals in good condition are on the pastures, and in the evening they stay in a fenced enclosure. The period in winter camp is from November to February (more or less one month depending on the herders).

The spring camp is used to welcome births and keep newborns warm, and the surrounding pasture must be suitable for feeding the mothers. Fences can be covered for the young goats and lambs, which are very sensitive to frost. The foals, calves and young camels, when they are strong enough, can go to pasture with their mothers and return in the evening. Fences should be made of wood, as newborn animals can stick to stone fences when it is cold. Herders stay in the spring camp from March to May (more or less one month).

Summer seems to be the time of most travel because the pastures become quickly depleted, on the one hand because the herd needs food to regain strength after the lactation period, and on the other hand because of the lack of rain. The summer period, according to the herders, is from June to September (more or less a month).

Nevertheless, this mobility is flexible. If the climate is favourable and the pasture is of good quality, families can stay in the same camp for several seasons.

2. LOCAL BOTANICAL KNOWLEDGE AND USES

In order to assess local botanical knowledge and uses, herders were invited to freely cite a list of plant species and the uses and/or knowledge they associated with them. In total, they cited 32 different species under their vernacular names. These 32 species are linked to 163 uses and knowledge cited by the herders (see « Table 8: number of plant species, uses and knowledge cited, and percentage of established Mongolian vernacular name - Latin name correspondance ») :

- feeding livestock directly on pasture;
- feeding livestock directly on pasture in winter;
- human use (medicine and/or food);
- undesirable species (in particular because they are not eaten by livestock);
- species harmful to livestock (e.g. toxic in certain quantities);
- purchase during difficult periods to feed livestock;
- planting or trial planting.

The correspondence between Mongolian vernacular name and Latin name was carried out for some species in another study in the Dornogobi, and for species specific to the Dundgobi, it was carried out with the help of Gerlee Punstag and the book « The Flowers of the Mongolian Gobi Desert » (Tungalag, 2016). « Table 9: Mongolian vernacular name and Latin name of the species cited by the herders » associates the Mongolian vernacular names with the Latin names of the species cited by the herders. For wheat, rye and corn, we unfortunatly only have the english and Latin name. Corresponding Latin names (genus and specie) were found for 22 species, resulting

in a 69% correspondence rate (see « Table 8: number of plant species, uses and knowledge cited, and percentage of established Mongolian vernacular name - Latin name correspondance »)

Table 8: number of plant species, uses and knowledge cited, and percentage of established Mongolian vernacular name - Latin name correspondance

Number of plant species cited by breeders	Number of uses and knowledge cited	Percentage of correspondances established between vernacular name and Latin name
32	163	68.75%

Table 9: Mongolian vernacular name and Latin name of the species cited by the herders

Mongolian vernacular name	Genus	Specie
Gyalbar Ders, Ders	*Achnaterum*	*splendens*
Khumuul	*Allium*	*mongolicum*
Taana	*Allium*	*polyrhizum*
Tuutsai	*Allium*	*odorum*
Builds	*Amygdalus*	*mongolica*
Agi	*Artemisia*	*frigida*
Sharilj khonin	*Artemisia*	*anethifolia*
Shulkhii	*Artemisia*	*pectinata*
Umkhii sharilj	*Artemisia*	*adamsii*
Hoshuu budaa	*Avena*	*sativa*
Khargana	*Caragana*	
Luuli	*Chenopodium*	*prostratum*
Suutei nogoo	*Euphorbia*	*humifosa*
Chikher uvs	*Glycyrrhiza*	*uralensis*
Kharmag	*Nitraria*	*sibirica*
Ulias	*Populus*	
Budargana	*Salsola*	*passerina*
Gashuun	*Saussurea*	*amara*
Havisgana	*Scorzonera*	*parviflora*
(rye)	*Secale*	*cereale*
Saiirin hyalgana, Mongol	*Stipa*	*glaerosa*
Stipa, Goviin hyalgana	*Stipa*	*gobica*
(wheat)	*Tricitum*	
(corn)	*Zea*	*mays*
Burjnuur		
But		
Khailas		
Mukhii uvs		
Nokhoi-sivee		
Sharilj		
Teemen but		
Ukher-shulkii		

« Figure 19: occurrence of species among herders' citations and associated uses and knowledge » shows the percentage of herders among the 12 herders surveyed who cited these species, as well as the proportions of uses and knowledge cited by the herders associated with each species. The best-known and used species (>50%) are (whose Latin name was found): « *Budargana* » (*Salsola passerina*), « *Agi* » (*Artemisia frigida*), « *Khumuul* » (*Allium mongolicum*), « *Stipa* »/ « *Goviin hyalgana* » (*Stipa gobica*) and « *Taana* » (*Allium polyrhizum*). *Budargana* and *Agi* are woody, the others are perennial herbaceous plants (FloraGREIF, 2010; Tungalag, 2016; eFloras). Technical and feasibility issues aside for the moment, these 5 species may be potentially interesting species for plantation or in the context of a more sustainable management of natural pastures, being known species and used mostly for livestock feed.

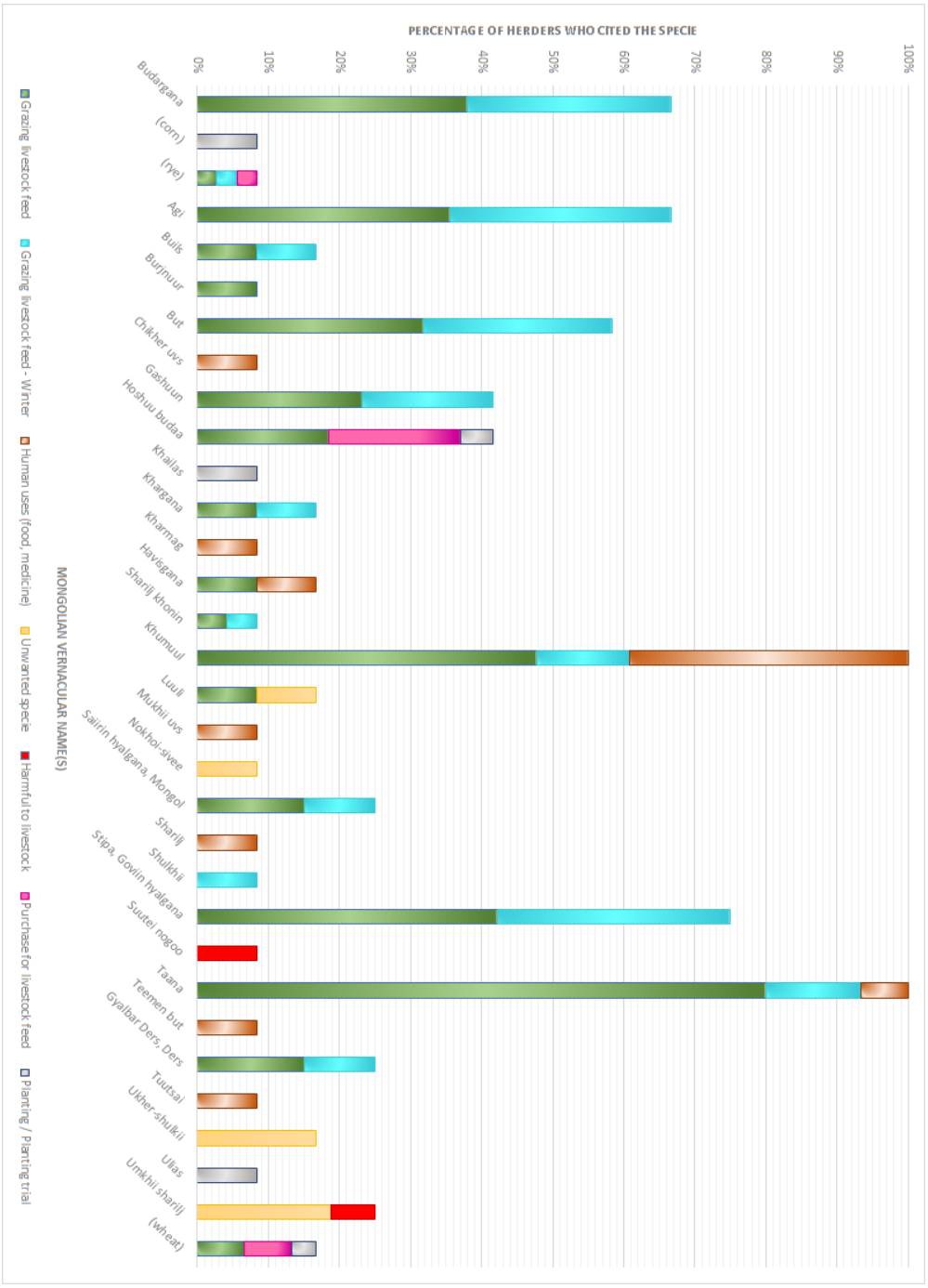

Figure 19: occurrence of species among herders' citations and associated uses and knowledge

3. PERCEPTION OF THE PASTORAL ENVIRONMENT

a. Perception of the condition of the pasture in Gurvansaikhan soum

The 12 herders interviewed answered the following questions:

- « Is the condition of the pastures satisfactory for the livestock ? ». The aim here is to consider the current state of the pastures, without comparison with previous years.
- « Does the condition of the pastures have improved, is it stable, or does it have deteriorated ? ». The aim here is to assess the evolution of the pastures.

« Figure 20: perception of the current pasture conditions » and « Figure 21: perception of the change in pasture conditions » illustrate the responses of livestock farmers to these first two questions.

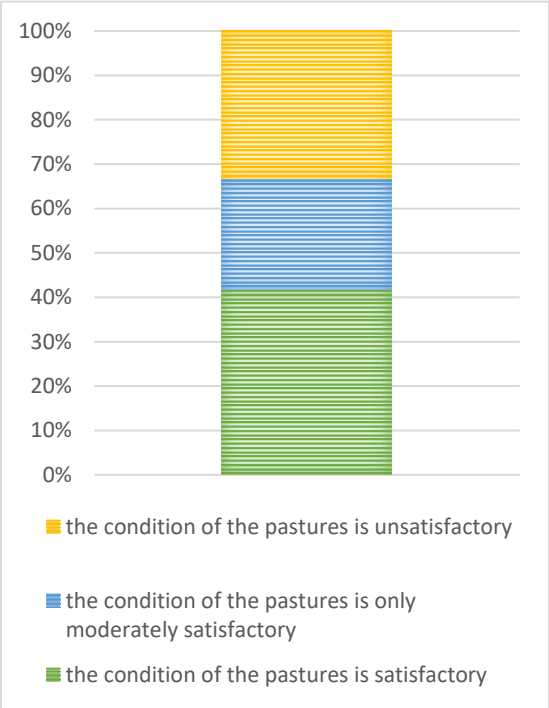

Figure 20: perception of the current pasture conditions

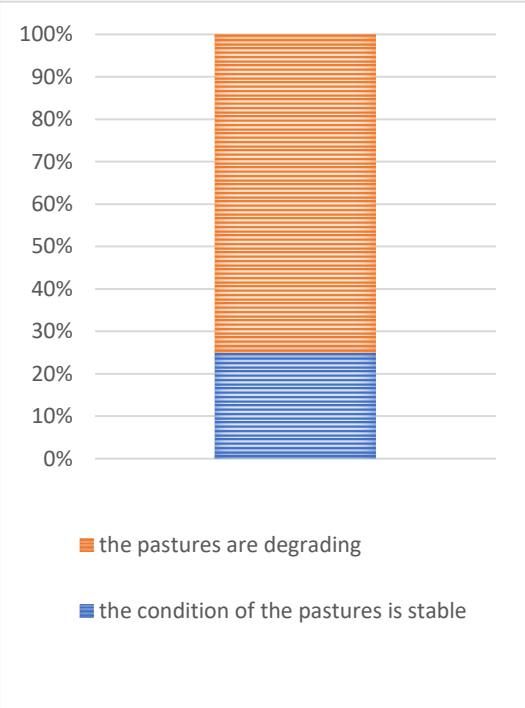

Figure 21: perception of the change in pasture conditions

According to these figures, although the majority of herders (75%) consider that the pastures are deteriorating, 42% of the herders interviewed consider that the state of the pastures remains satisfactory for feeding livestock, compared to 33% of herders stating that the state of pastures does not.

b. Evidence of pasture degradation

When herders consider that pastures are degrading, they are invited to indicate freely how they see that the condition of the pastures is deteriorating. « Figure 22: indicators of pasture degradation according to herders of Gurvansaikhan soum » illustrates the different answers obtained, with the understanding that a herder could give more than one answer.

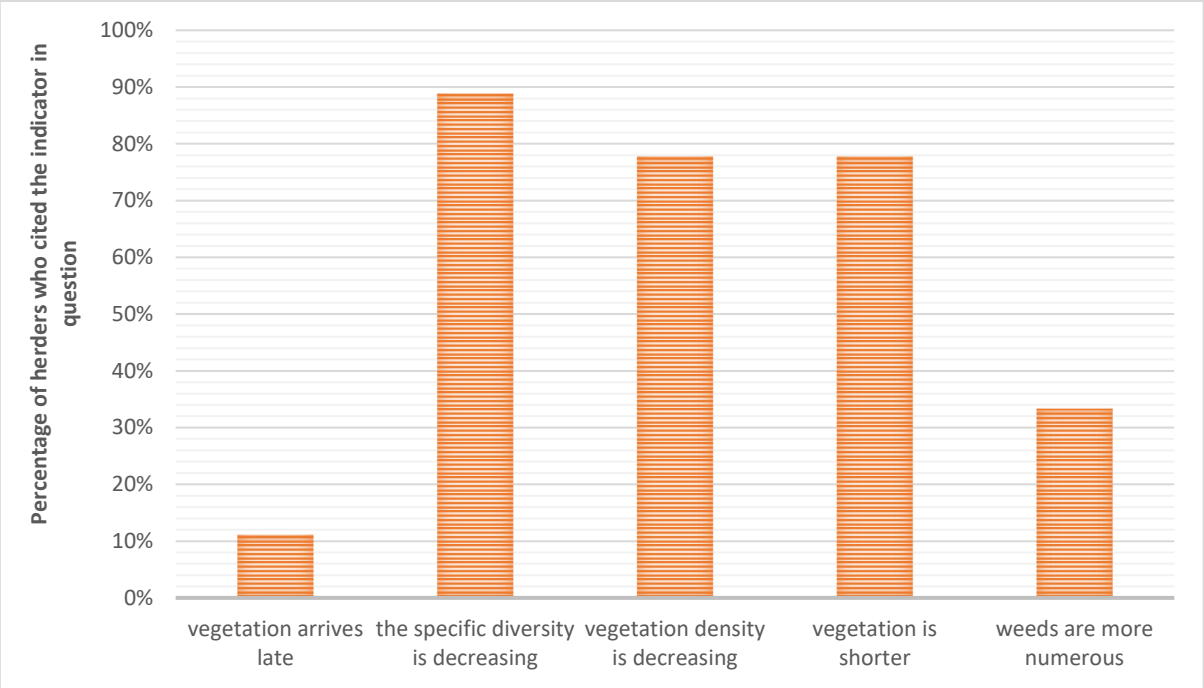

Figure 22: indicators of pasture degradation according to herders of Gurvansaikhan soum

The 3 main indicators of pasture degradation are, according to « Figure 22: indicators of pasture degradation according to herders of Gurvansaikhan soum », the decrease in specific diversity, the decrease in vegetation density, and the fact that the vegetation is not as high as it used to be.

Concerning the criterion "**The specific diversity is decreasing**", some herders claim that certain plant species are no longer present on the pastures, or at least in lesser quantities (especially among those that were useful for livestock). Some herders do not know the names of these species, but others cited :

- « *Hazaar uvs* », cited by 3 herders as extinct and by 2 herders as almost extinct;
- « *Ders* » (*Achnaterum splendens*), cited by 2 herders as nearly extinct;
- « *Luuli* » (*Chenopodium prostratum*), cited by 2 herders as nearly extinct;
- « *Teemen but* », cited by 1 herder as extinct. It is an annual species that this herder used to eat, known for its virtues against cancer;
- « *Mangir* », cited by 1 herder as nearly extinct;
- « *But* », cited by 1 herder as nearly extinct.

Concerning the criterion "**weeds are more numerous**", the weeds cited by the herders are :

- « *Umkhii sharilj* » (*Artemisia adamsii*), cited by 2 herders;
- « *Ukher shulkii* », cited by 1 herder: no animal can eat it, the smell is repulsive and it replaces good feed for livestock;
- « *Nokhoi shivee* », cited by 1 herder: like ukher shulkii, no animal can eat it, the smell is repulsive and it replaces good feed for livestock.

c. Causes of pasture degradation

When herders consider that the pastures are deteriorating, they are then asked to give their opinion on the possible causes of this degradation. « Figure 23: causes of the pasture degradation, according to the herder of Gurvansaikhan soum » illustrates the answers to this question, with the understanding that a herder could give more than one answer.

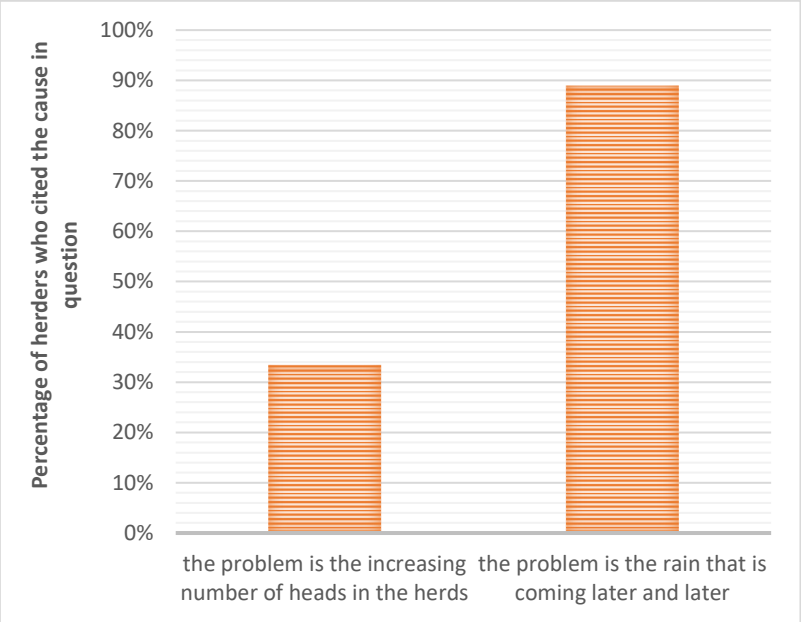

Figure 23: causes of the pasture degradation, according to the herder of Gurvansaikhan soum

The majority of herders consider that the rain, which comes later and later, is responsible for the degradation of the pastures. One herder informs us that rain usually arrives in July, and for some of the last few years, it is said to arrive "after *Naadam*", i.e. after July 15, which is unusual. According to another herder, 2009 and 2019 were bad years in terms of rainfall and thus pasture conditions, but they would have had good years in between: 2018, for example, was still a good year from these perspectives. Thus, the herders are aware that the climate has changed in recent years, yet rainfall is still sufficient in some years.

To a lesser extent, some herders consider that the increase in livestock numbers is responsible for the degradation of pastures. Those case illustrates the "tragedy of the commons" theory (Garret Hardin, 1968) : herders are aware that the increase of their herd leads to overgrazing and

pasture degradation, but this increase remains one of the strategies adopted by herders seeking financial security, since livestock is a capital that can be mobilized at any time.

d. Interest and feasibility of planting in the Gobi

Once the perceptions of the pastoral environment have been collected, pastoralists are invited to give their opinion on the implementation of plantations in Dundgobi Province. The first step is to find out whether the realization of plantations, which would serve as fodder in difficult years when there is not enough pasture, could be of interest to the herders. The second step is to obtain their opinion on the feasibility of such a project. « Figure 24: plantation feasability, according to herders of Gurvansaikhan soum » and « Figure 25: plantation interest, according to herders of Gurvansaikhan soum » illustrate the comments collected.

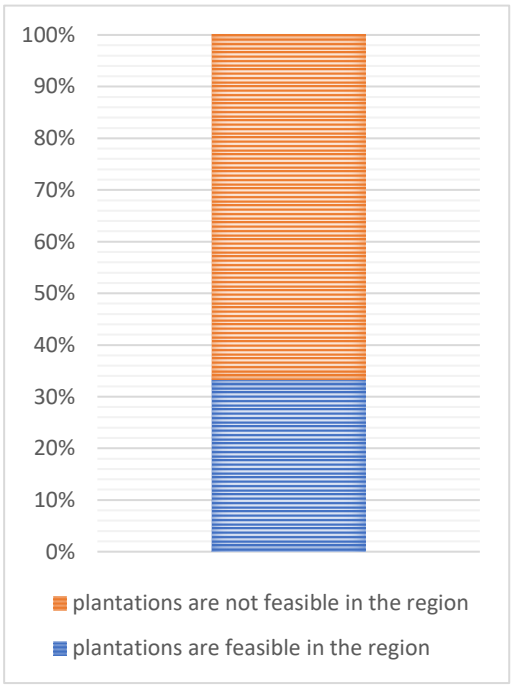

Figure 24: plantation feasability, according to herders of Gurvansaikhan soum

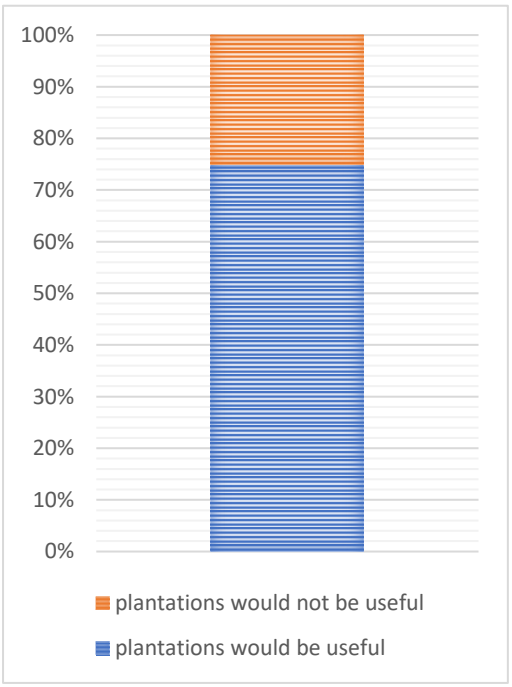

Figure 25: plantation interest, according to herders of Gurvansaikhan soum

According to « Figure 25: plantation interest, according to herders of Gurvansaikhan soum », the majority of herders consider that plantations as a fodder reserve would be useful. Amog them :

- 9 herders consider that it would save them from having to buy fodder in difficult years. The species they consider interesting to plant are: oat, corn, hay, wheat;
- 2 herders indicate that good quality fences would be needed, as it is difficult to protect the plantation from animals;
- 2 herders suggested that the plantations should be irrigated, as there is very little rain in the Gobi.
- 1 herder recommends that these plantations be carried out in the centre of the aimag.

Nevertheless, 67% think that plantations are not feasible in their region, according to « Figure 24: plantation feasability, according to herders of Gurvansaikhan soum »:

- 7 herders indicate that it is impossible to carry out plantations because of the soil and climate conditions in the Gobi region.
- 2 herders, 1 of whom has already tried to plant, felt that it would take too much time;
- 1 herder explains that being nomadic, it would be difficult to take care of plantations in a fixed location

e. Perception of plantation according to the perception of pasture condition

« Table 10: perception of plantation interest according to perception of pastures condition » describes the perception of interest in planting according to the perception of changes in the state of the pastures and according to the perception of the perception of the current state of the pastures.

Table 10: perception of plantation interest according to perception of pastures condition

	Plantations are useful	**Plantations are not useful**
Pastures are stable	3	0
Pastures are degrading	**6**	3
Pastures condition is bad	2	2
Pastures condition is medium	2	1
Pastures condition is good	4	1

According to « Table 10: perception of plantation interest according to perception of pastures condition », it is rather the herders who perceive a degradation of the pastures that are most interested in planting: two-thirds of them consider them interesting.

f. Other solutions in response to pasture degradation

During these interviews, other solutions in response to pasture degradation were discussed by some herders:

- 8 herders thought that fencing small areas of pasture to allow vegetation to regenerate would be useful, but some also mentioned the difficulties of fencing:
    - According to 4 herders, although it would be useful, it requires too much time and money. According to one of the four herders, an ideal location would be close to the winter camp. According to another of the four herders, another herder family

had already put up fencing on their pasture, about 2 hectares, and it had worked well.

  - One herder has already put up fences on 1 hectare close to his winter camp. According to his experience, the fencing has allowed for more vegetation growth and seed production. This herder was able to use the fenced vegetation as winter fodder. Unfortunately, when he returned from his summer camp, the fence had been destroyed by large cattle, and he now does not have enough money to put one up again.
  - According to 1 herder, this would be particularly beneficial for *Achnaterum splendens*.

- On the contrary, 2 of the herders interviewed are against the idea of fencing off pastures :
  - One knows another herder who has already put up fences. Unfortunately, the herder was victim of the yellow sands storms which covered everything up and further degraded the fenced pasture.
  - Another herder says that this is not compatible with the Gobi region, which experiences yellow sand storms almost every year. According to him, fences are a good solution for herders with small herds, or those who own a farm.

- One herder suggests reducing the herd while paying attention to the quality of the livestock. As an example, he explained that with 500 goats, you get a certain amount of cashmere that you could get with only 100 goats, if you improve the genetics.

4. FEARS AND EXPECTATIONS OF THE HERDERS WE MET

Among the herders we met, some told us some of their fears for the future, or their expectation and the help they would like to receive :

- Six herders would like the increase of animal products prices
- Two herders want a better pension for their retirement
- Two herders are afraid of the influence of mines on pastures and would like protection from mining activities and establishment
- Two herders want the construction of wells
- One herder would like to export his product, which is not currently easy
- One herder would like to get subsidies to buy fodder during difficult time
- One herder would be interested in a genetic improvement program

With regard to this last point, the concerned herder explained to us. Five or six years ago a genetic improvement program was initiated by the government. About 100 female sheep and goats with very good genetics were being given to young breeders to be bred. The offspring of those 100 females were kept by those young farmers. The 100 females were then sent to another family. The herder think it could be helping to start this program again, even with 40 females.

5. ESTIMATION OF THE DENSITY OF SAXAULS IN NATURAL CONDITIONS

« Figure 26: location of survey points and associated saxaul density (satellite background imagery: Bing) » locates the survey points for the application of the QCP method for estimating the density of saxauls under natural conditions, and their associated estimated density. « Table 11: result of measurements in natural forests of saxauls » describes the mean density and standard deviation calculated using the pollard formula, as well as the mean height, its standard deviation, its minimum and maximum for each of the 5 survey point.

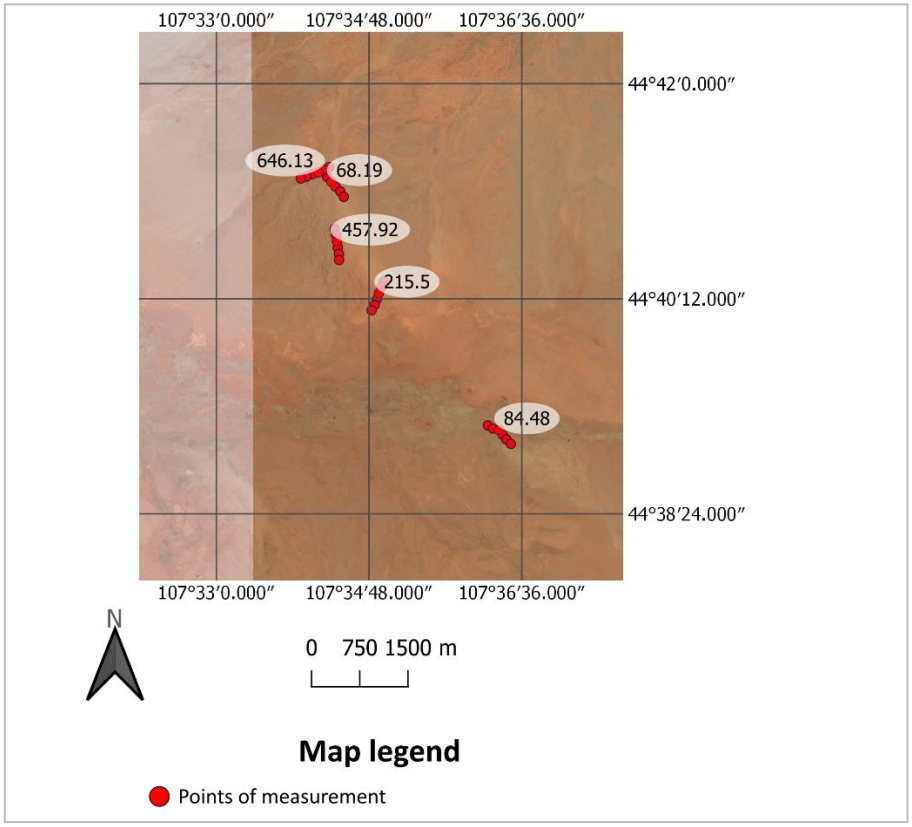

Figure 26: location of survey points and associated saxaul density (satellite background imagery: Bing)

Table 11: result of measurements in natural forests of saxauls

Transect	Mean density (saxaul/ha)	Standard deviation (density)	Mean height (m)	Standard deviation (height)	Minimum (height)	Maximum (height)
1	**68.19**	14.54	0.87	0.47	0	1.6
2	**457.92**	97.63	0.83	0.31	0.4	1.4
3	**215.50**	45.94	0.81	0.21	0.4	1.25
4	**84.48**	18.01	2.13	3.24	0.25	1.7
5	**646.13**	137.76	0.77	0.26	0.4	1.3

According to the « Table 11: result of measurements in natural forests of saxauls », measured saxaul densities in studied saxauls forests range from 68 saxauls/ha to 646 saxauls/ha. The variability in density can be very high, even over a small distance: our measurement sites with our minimum and maximum estimated density are next to each other (see « Figure 26: location of survey points and associated saxaul density (satellite background imagery: Bing) »).

IV. CONCLUSIONS

In the region surveyed and with regard to the families encountered, the herds contain at least two different species among the five traditionnal reared species (camels, horses, cows, goats and sheep). The herds are large (820 heads on average), with a very variable number of heads according to families (140 minimum to 1661 maximum). The species most present within the herds is the sheep (414 on average), then the goat (338 on average), and thus the small livestock. The large livestock (camels, horses and cows) are less numerous within the herd (29, 28 and 11 heads on average respectively). The "small" herds, in our case those containing 140 to 573 head, are often complementary to a pension received by farmers over 60 years of age.

The herds graze freely around the camp, returning in the evening, for milking and drinking. They feed directly on the rangelands. Thus, very few feed inputs are used. Herders just buy hay, oat, bran, wheat, rye, and bag sar mal (a mixture enriched with protein and minerals), only for difficult times and/or for animals too weak to graze.

The labour force is family-based: men and women share the tasks, and sometimes receive help from their children and/or grandchildren. It is rare to hire a herder from outside the family to receive help.

Many food products derived from the milk of the different species are produced, however it is rather the non-food products that are sold: cashmere and wool. The food products seem to be mostly for family consumption.

About cashmere production, it seems that breeders could reach the production of 100 kg of cashmere per year from 250 goats. If production peaks for large herds, this must be due to lack of labour, but this should be checked in future work

The herders we met travel an average of 4 times a year, over an average distance of 17 km between camps. They move between winter, spring, summer and fall camps, knowing that the camps may be the same (a spring camp may serve as a summer camp). These movements are flexible and depend on the condition of the pasture, if it is good enough to support the herds.

The herders interviewed freely cited 32 different species (under their vernacular name(s)). 163 uses are associated with them. A search for correspondences between Mongolian vernacular names and Latin names revealed the Latin name of 68% of the species cited by the herders.

The most used species whose vernacular name - Latin name correspondence has been established are: "Budargana" (Salsola passerina), "Agi" (Artemisia frigida), "Khumuul" (Allium mongolicum), "Stipa"/"Goviin hyalgana" (Stipa gobica) and "Taana" (Allium polyrhizum). Saxaul has not been mentioned by breeders. The other species used for planting in the Gobi (elm, willow, seabuckthorn, silverberry) (Mühlenberg et al. 2006) were not mentioned either. Only poplar ('Ulias') was mentioned, but only by one herder. Only « Agi » is a woody plant : it could be interesting to study the technical and feasibility conditions of its planting.

The majority of the herders interviewed consider that the pastures are deteriorating, although 42% are still satisfied with the condition of the pastures. 33% consider the pastures to be unsatisfactory.

As an indication of the degradation of the pastures, the majority of the herders cited the decrease in specific diversity and the decrease in vegetation density.

Regarding the causes of pasture degradation, the majority of the herders interviewed consider that this is due to the lack of rain, and that it arrives later and later in the year. To a lesser extent, the herders consider that the increasing number of animals on pasture is a factor in the degradation of the pastures.

Planting as a solution to pasture degradation and as a fodder reserve for difficult years is of interest to 74% of herders. Nevertheless, 67% think that the conditions in the Gobi make planting impractical.

Other solutions in response to pasture degradation were mentioned: fencing off small areas of pasture to allow vegetation to regenerate, as well as giving priority to the quality rather than the quantity of animals bred (which could therefore be accompanied by a reduction in livestock numbers).

The density of Saxauls under natural conditions in the study area varies from 68 to 646 Saxauls/ha. Saxaul plantations with seedlings use a planting density of 300 saxauls/ha to 450 saxauls/ha according to Mühlenberg et al. (2006).

These plantation densities do not seem too high compared to the natural densities of sites 2 and 5, but are still 2.1 to 6.6 times higher than the natural densities of sites 1, 3, and 4. The physical conditions of the study sites should be studied in more detail to find out under which conditions the highest and lowest densities are encountered, in order to adapt the planting densities proposed in the planting projects.

V. REFERENCES

eFloras. [s d]. Flora of China. Available on : < http://www.efloras.org/flora_page.aspx?flora_id=2 >

FloraGREIF. 2010. FloraGREIF - Virtual Flora of Mongolia. Available on : < https://floragreif.uni-greifswald.de/ >

Foray S. & Gac A. 2018. Elevage bovin et environnement, les chiffres-clés. Paris : Institut de l'élevage

Hardin, Garrett. 1968. "*The Tragedy of the Commons*." Science 162 (3859): 1243–48

Hiernaux P. 2016. *Note de synthèse sur les outils disponibles pour le suivi-évaluation des ressources fourragères et l'établissement de bilans fourragers*.

Mardesic I. 2018. *Perception et compréhension de la dégradation des pâturages par les éleveurs nomades mongols. La mise en place de groupes de gestion des communes comme solution d'adaptation ?* Environnement, Dynamiques, Territoires, Sociétés. Paris : AgroParisTech, 79 p.

Mitchell K. 2007. *Quantitative Analysis by the Point-Centered Quarter Method*.

Mühlenberg M., Batkhishig T., Dashzeveg T., Drössler L., Neusel B., & Tsogtbaatar J. 2006. *Lessons From Tree Planting Initatives in Mongolia*. Washington, DC : World Bank(Mongolia Discussion Papers, East Asia and Pacific Environment and Social Development Department).

Tungalag R. 2016. The Flowers of the Mongolian Gobi Desert. Admon. Ulaanbatar : B. Boldgiv

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VII. LIST OF FIGURES

VIII. APPENDICES

LIST OF APPENDICES

APPENDIX 1 : INTERVIEW GUIDE

Survey n° Date & time Location (GPS points)

---

1. The breeder and his breeding
    a. The breeder

Surname(s) : .....

First name(s) : .....

Age : .....

Sex : .....

Aimag : .....

Soum : .....

Bag : .....

Is livestock farming your main activity ? .....

.....

Other activity(ies) .....

.....

.....

How long have you been living in this region ?

Why ? *(If he has always stayed, why did he stay / if he comes from another region, why did he settle here ?)*

How long have you been breeding ?

Why ?

1

Survey n° Date & time Location (GPS points)

Additional notes :

.....

.....

.....

.....

b. The herd

Number of camels : .....

Number of cattle : .....

Number of goats : .....

Number of sheep : .....

Number of horses : .....

Number of poultry : .....

Other, specify : .....

Additional notes :

.....

.....

.....

.....

.....

.....

.....

c. Work organization

Do you work alone ? .....

If not *:*

With family number ? .....

Number of people : .....

With breeder outside the family ? .....

Number of people : .....

How are the tasks distributed ?

.....

.....

2

Survey n° Date & time Location (GPS points)

If breeders outside the family are involved in the tasks :

- How is it organized ? (Traditional association, cooperative, etc.)

Additional notes :

d. Organization of livestock activities

Is livestock managed together or separately (in term of species) ? .....

If managed separately :

- What is the composition of the herds ?

- For what reason(s) ?

Survey n° Date & time Location (GPS points)

e. The mobility

Are you mobile during the year ? .....

How many times per year ? .....

Which distance between camps ? .....

For what reason(s) do you stay that long on each camp ?

f. Livestock feeding

- What is the general diet of animals ?

What food is preferred during winter ?

4

Survey n° Date & time Location (GPS points)

Do you know toxic species ?

Do you use some of the species you cited ?

Additional notes :

g. Cultivation system

Do you plant crops ? .....

If yes : what do you plant mainly ?

If yes : wat are these crops for ?

Additional notes :

5

Survey n° Date & time Location (GPS points)

h. The production

- What do you produce ?

- Do you have anay idea of the quantities ?

- Is it for sale, personal consumption, or both ?

Additional notes :

2. Evolution of the pastoral environment

a. Perception of the condition of pastures

Is the quality of rangeland satisfactory during the travels ? .....

Is the quality of rangelands satisfactory around the camps ? .....

In you opinion, has the condition of rangelands changed in recent year ? .....

Has it evolved accordinf to what you may have heard from your parents, grand parents ? .....

Has it deteriorated or improved instead ? .....

6

Survey n° Date & time Location (GPS points)

How do you see that rangelands have improved/degraded ?

- ***If degraded*** : can you name extinct species (herbaceous and woody) ? :

- ***If degraded*** : can you name species in smaller quantities than before (herbaceous and woody) ?

In your opinion / your parents' opinion / your grandparents' opinion, what are the reasons for these changes ?

Additional notes :

7

b. Planting as a fodder reserve

Do you think plantations could be useful, as fodder, in difficult year ?

Do you think plantation is feasible in the Gobi ?

Additional notes :

c. Other solutions in response to pasture degradation

Do you fencing a small area of pasture could be a solution ?

Are there any other solutions you could think of ?

Survey n° Date & time Location (GPS points)

End of the interview…

What would be your fears and/or expectations regarding the pasture conditions, your flock, etc. ?

Do you have any questions ?

9

APPENDIX 2 : DATA FROM MEASUREMENTS AMONG PLANTATIONS

Date	26/08/19
Location	Gurvasaikhan
Inventory method	Circle with 7 meters radius
Surface (m²)	153,9

Longitude : 107°2'47.526''E
Latitude : 45°31'32.284''N

Individual	Informations	Circumference (cm)	Diameter (cm)	Height (m)
1	Populus	19 17 17	6,0 5,4 5,4	3
2	Populus	13 36 19 23	4,1 11,5 6,0 7,3	3
3	Dead			
4	Dead			
5	Dead			
6	Dead			
7	Ulmus	15 16 21	4,8 5,1 6,7	3
8	Ulmus	23 15 14	7,3 4,8 4,5	3
9	Dead			
10	Populus	15 26 17 19	4,8 8,3 5,4 6,0	3

Date	26/08/19
Location	Gurvasaikhan
Inventory method	Circle with 7 meters radius
Surface (m²)	153,9

Longitude : 107°2’49.026’’E
Latitude : 45°31’31.706’’N

Individual	Informations	Circumference (cm)	Diameter (cm)	Height (m)
1	Umus	9	2,9	2
2	Ulmus	20 13 17 13	6,4 4,1 5,4 4,1	3
3	Dead (Hippophae rhamnoides)			
4	Hippophae rhamnoides (almost dead)	10 9	3,2 2,9	2
5	Hippophae rhamnoides (almost dead)	10	3,2	2
6	Ulmus	16 17 24 17	5,1 5,4 7,6 5,4	4
7	Dead (populus)			
8	Hippophae rhamnoides	16	5,1	2
9	Hippophae rhamnoides	10 7	3,2 2,2	2
10	Dead (populus)			
11	Ulmus	21 24 16	6,7 7,6 5,1	2
12	Ulmus (almost dead)	12	3,8	1,5
13	Ulmus	16 20	5,1 6,4	2,5

Date	26/08/19
Location	Gurvansaikhan
Inventory method	Circle with 7 meters radius
Surface (m²)	153,9

Longitude : 107°2’49.91’’E
Latitude : 45°31’30.653’’N

Individual	Specie	Circumference (cm)	Diameter (cm)	Height (m)
1	Ulmus	14 13	4,5 4,1	2
2	Ulmus	15 13	4,8 4,1	2
3	Ulmus	13	4,1	2
4	Ulmus	10 10	3,2 3,2	1,5
5	Ulmus	11	3,5	1,5
6	Ulmus	12 13	3,8 4,1	2
7	Ulmus	11 11	3,5 3,5	1,5
8	Ulmus	11 8 7	3,5 2,5 2,2	2
9	Ulmus	12	3,8	1,5
10	Ulmus	12 10 7	3,8 3,2 2,2	2
11	Ulmus	11 14	3,5 4,5	2
12	Dead (Ulmus)			
13	Ulmus	19	6,0	2
14	Ulmus	15 7 7	4,8 2,2 2,2	1,5
15	Ulmus	11 13 11	3,5 4,1 3,5	1,5
16	Ulmus	13 9 9	4,1 2,9 2,9	2
17	Ulmus	10 10	3,2 3,2	1,5

Date	01/09/19
Location	At a herder's
Inventory method	Inventory of all planted trees

Longitude : 106°55'6.667''E
Latitude : 45°32'49.741''N

Individual	Informations	Circumference (cm)	Diameter (cm)	Height (m)
1	Ulmus	49	15,6	4
2	Ulmus	41	13,1	4
3	Ulmus	24	7,6	4
4	Ulmus	22	7,0	3
5	Ulmus	26	8,3	3
6	Ulmus	13	4,1	2,5
7	Ulmus	27	8,6	3
8	Ulmus	34	10,8	4
9	Ulmus	20	6,4	3
10	Ulmus	18	5,7	2,5
11	Ulmus	20	6,4	2,5
12	Ulmus	18	5,7	2
13	Ulmus	17	5,4	2,3
14	Ulmus	17	5,4	1,8
15	Ulmus	17	5,4	2,5

Date	01/09/19
Location	At a herder's
Inventory method	Inventory of all planted trees

Longitude : 106°55'6.667''E
Latitude : 45°32'49.741''N

Individual	Informations	Circumference (cm)	Diameter (cm)	Height (m)
1	Ulmus	13	4,1	2,5
2	Populus	14	4,5	2
3	Populus	10	3,2	1,6
4	Populus	9	2,9	1,6
5	Populus	10	3,2	1,6
6	Populus	12	3,8	1,6
7	Ulmus	8	2,5	2
8	Ulmus	6	1,9	1,7

APPENDIX 3 : DATA FROM THE INTERVIEWS

N	Soum	Bag	Sex	Age	Main activity	Other activities	Installation date	From birth
1	Gurvansaikhan	Gurvansaikhan	F	61	Yes	No	1979	No
2	Gurvansaikhan	Dersen-us	M	51	Yes	No	1968	Yes
3	Gurvansaikhan	Gurvansaikhan	F	39	Yes	No	1980	Yes
4	Gurvansaikhan	Chuluut	M	30	Yes	No	1989	Yes
5	Gurvansaikhan	Elgen	M	40	Yes	No	1979	Yes
6	Gurvansaikhan	Gurvansaikhan	M	61	Yes	No	1991	No
7	Gurvansaikhan	Dersen-us	F	66	Yes	No	1953	Yes
8	Gurvansaikhan	Dersen-us	F	46	Yes	No	1973	Yes
9	Gurvansaikhan	Elgen	M	37	Yes	No	1982	Yes
10	Gurvansaikhan	Elgen	F	82	Yes	No	1937	Yes
11	Gurvansaikhan	Chuluut	F	69	Yes	No	1950	Yes
12	Gurvansaikhan	Dersen-us	F	63	Yes	No	1956	Yes

Breeding start date	Livestock	Camels	Horses	Cows	Sheeps	Goats	Permanent workforce	Occasional workforce
2012	573	220	0	13	0	340	2	0
1999	1200	0	0	0	700	500	2	2
2000	1087	2	150	35	600	300	5	1
2014	870	0	50	10	460	350	2	0
1999	1661	80	109	32	1100	340	2	3
1991	270	0	0	0	150	120	2	0
1993	360	0	0	10	200	150	3	0
1992	685	0	10	5	300	370	2	0
1999	1204	0	0	4	600	600	2	3
1949	1280	50	10	20	500	700	6	0
1970	140	0	0	0	60	80	3	2
1979	507	0	7	0	300	200	2	0

Family workforce	Outside family workforce	Total workforce	Mobile	Minimum of minimum move / year	Mean distance (km)	Crop	Milk	Milk products
2	0	2	No	0	0	Yes	Yes	No
3	1	4	Yes	4	12	No	No	No
5	1	6	Yes	6	30	No	Yes	Yes
2	1	3	Yes	7	50	No	No	No
4	1	5	Yes	3	40	No	No	No
2	0	2	Yes	2	15	No	No	No
3	0	3	Yes	2	20	No	No	No
2	0	2	Yes	4	10	No	No	Yes
5	0	5	Yes	1	6	No	No	No
6	0	6	Yes	5	8	No	No	No
5	0	5	Yes	4	5	No	No	No
2	0	2	Yes	4	4	No	No	No

Live animals	Meat	Skin	Cashmere	Sheep wool	Camel wool	Camel wool rope	Horsehair	Incomes
Yes	No	No	Yes	Yes	No	No	No	12100000
No	No	No	Yes	Yes	No	No	No	10300000
Yes	Yes	No	Yes	Yes	No	No	Yes	65000000
No	No	No	Yes	Yes	No	No	No	15200000
No	No	No	Yes	Yes	No	No	Yes	30775000
No	No	No	Yes	Yes	No	No	No	2900000
Yes	No	No	Yes	Yes	No	No	No	9050000
Yes	Yes	No	Yes	Yes	No	No	No	17825000
No	Yes	Yes	Yes	Yes	No	No	No	10750000
Yes	No	No	Yes	Yes	Yes	No	No	5300000
No	No	No	Yes	Yes	No	No	No	3027500
No	Yes	No	Yes	Yes	No	No	No	7240000

Pastures are good	Pasture condition	Late vegetation	Less numerous species	Less dense vegetation	Smaller vegetation	Less good for animals	Weeds more numerous	Problem from number of animals
Yes	S	No	No	No	No	No	No	No
Moy	S	No	No	No	No	No	No	Yes
Yes	D	No	Yes	Yes	Yes	No	No	No
Moy	D	No	Yes	No	No	No	No	No
Yes	D	No	Yes	No	No	No	Yes	Yes
Yes	S	No	No	No	Yes	No	No	No
No	D	No	No	Yes	Yes	No	No	No
No	D	Yes	Yes	Yes	Yes	No	No	No
No	D	No	Yes	Yes	Yes	No	Yes	Yes
Yes	D	No	Yes	Yes	Yes	No	No	Yes
No	D	No	Yes	Yes	Yes	No	Yes	No
Moy	D	No	Yes	Yes	Yes	No	No	No

1

Problem from lack of rain	Plantation feasible	Plantation interesting
No	Yes	Yes
Yes	Yes	Yes
Yes	No	Yes
No	No	No
Yes	Yes	Yes
Yes	No	Yes
Yes	No	No
Yes	No	No
Yes	No	Yes
Yes	No	Yes
Yes	No	Yes
Yes	Yes	Yes

[1] Moy = medium

APPENDIX 4 : ETHNOBOTANICAL DATA

Genus	Specie	Mongolian vernacular name	Number of families	Grazing livestock feed	Grazing livestock feed - Winter	Human uses	Unwanted specie	Harmful to livestock	Purchase for livestock feed	Planting / Planting trial	Total uses	% of family citing the species
Salsola	*passerina*	Budargana	8	8	6						14	67%
Zea	*mays*	(corn)	1							1	1	8%
Secale	*cereale*	(rye)	1	1	1				1		3	8%
Artemisia	*frigida*	Agi	8	8	7						15	67%
Amygdalus	*mongolica*	Buils	2	2	2						4	17%
		Burjnuur	1	1							1	8%
		But	7	6	5						11	58%
Glycyrrhiza	*uralensis*	Chikher uvs	1			1					1	8%
Saussurea	*amara*	Gashuun	5	5	4						9	42%
Avena	*sativa*	Hoshuu budaa	5	4					4	1	9	42%
Ulmus	*pumila*	Khailas	1							1	1	8%
Caragana		Khargana	2	2	2						4	17%
Nitraria	*sibirica*	Kharmag	1			1					1	8%
Scorzonera	*parviflora*	Havisgana	2	1		1					2	17%
Artemisia	*anethifolia*	Sharilj khonin	1	1	1						2	8%
Allium	*mongolicum*	Khumuul	12	11	3	9					23	100%
Chenopodium	*prostratum*	Luuli	2	1			1				2	17%
		Mukhii uvs	1			1					1	8%
		Nokhoi-sivee	1				1				1	8%
Stipa	*glaerosa*	Saiirin hyalgana, Mongol	3	3	2						5	25%
		Sharilj	1			1					1	8%
Artemisia	*pectinata*	Shulkhii	1		1						1	8%
Stipa	*gobica*	Stipa, Goviin hyalgana	9	9	7						16	75%
Euphorbia	*humifosa*	Suutei nogoo	1					1			1	8%
Allium	*polyrhizum*	Taana	12	12	2	1					15	100%
		Teemen but	1			1					1	8%
Achnaterum	*splendens*	Gyalbar Ders, Ders	3	3	2						5	25%
Allium	*odorum*	Tuutsai	1			1					1	8%
		Ukher-shulkii	2				2				2	17%
Populus		Ulias	1							1	1	8%
Artemisia	*adamsii*	Umkhii sharilj	3				3	1			4	25%
Tricitum		(wheat)	2	2					2	1	5	17%

Genus	Specie	Mongolian vernacular name	Grazing livestock feed	Grazing livestock feed - Winter	Human uses (food, medicine)	Unwanted specie	Harmful to livestock	Purchase for livestock feed	Planting / Planting trial
Salsola	*passerina*	Budargana	57%	43%	0%	0%	0%	0%	0%
Zea	*mays*	(corn)	0%	0%	0%	0%	0%	0%	100%
Secale	*cereale*	(rye)	33%	33%	0%	0%	0%	33%	0%
Artemisia	*frigida*	Agi	53%	47%	0%	0%	0%	0%	0%
Amygdalus	*mongolica*	Buils	50%	50%	0%	0%	0%	0%	0%
		Burjnuur	100%	0%	0%	0%	0%	0%	0%
		But	55%	45%	0%	0%	0%	0%	0%
Glycyrrhiza	*uralensis*	Chikher uvs	0%	0%	100%	0%	0%	0%	0%
Saussurea	*amara*	Gashuun	56%	44%	0%	0%	0%	0%	0%
Avena	*sativa*	Hoshuu budaa	44%	0%	0%	0%	0%	44%	11%
Ulmus	*pumila*	Khailas	0%	0%	0%	0%	0%	0%	100%
Caragana		Khargana	50%	50%	0%	0%	0%	0%	0%
Nitraria	*sibirica*	Kharmag	0%	0%	100%	0%	0%	0%	0%
Scorzonera	*parviflora*	Havisgana	50%	0%	50%	0%	0%	0%	0%
Artemisia	*anethifolia*	Sharilj khonin	50%	50%	0%	0%	0%	0%	0%
Allium	*mongolicum*	Khumuul	48%	13%	39%	0%	0%	0%	0%
Chenopodium	*prostratum*	Luuli	50%	0%	0%	50%	0%	0%	0%
		Mukhii uvs	0%	0%	100%	0%	0%	0%	0%
		Nokhoi-sivee	0%	0%	0%	100%	0%	0%	0%
Stipa	*glaerosa*	Saiirin hyalgana, Mongol	60%	40%	0%	0%	0%	0%	0%
		Sharilj	0%	0%	100%	0%	0%	0%	0%
Artemisia	*pectinata*	Shulkhii	0%	100%	0%	0%	0%	0%	0%
Stipa	*gobica*	Stipa, Goviin hyalgana	56%	44%	0%	0%	0%	0%	0%
Euphorbia	*humifosa*	Suutei nogoo	0%	0%	0%	0%	100%	0%	0%
Allium	*polyrhizum*	Taana	80%	13%	7%	0%	0%	0%	0%
		Teemen but	0%	0%	100%	0%	0%	0%	0%
Achnaterum	*splendens*	Gyalbar Ders, Ders	60%	40%	0%	0%	0%	0%	0%
Allium	*odorum*	Tuutsai	0%	0%	100%	0%	0%	0%	0%
		Ukher-shulkii	0%	0%	0%	100%	0%	0%	0%
Populus		Ulias	0%	0%	0%	0%	0%	0%	100%
Artemisia	*adamsii*	Umkhii sharilj	0%	0%	0%	75%	25%	0%	0%
Tricitum		(wheat)	40%	0%	0%	0%	0%	40%	20%

APPENDIX 5 : DATA FROM QCP METHODS IN NATURAL SAXAULS FOREST

Section	Position	Distance (m)	Height (m)
0-100	Left rear	4,6	0,9
	Front left	9,5	0,8
	Front right	7,5	1,45
	Right rear	2,3	1
100-200		5,4	0,8
		3,5	1,1
		4,1	1,1
		2,9	1,5
200-300		3,8	1
		15	0,6
		6,9	1
		4,5	0,7
300-400		0	0
		0	0
		0	0
		0	0
400-500		5,9	0,7
		6,7	1,25
		13,8	1,35
		7,1	0,95
500-600		8,9	1,1
		55	1,1
		8	1,6
		16,1	0,9
0-100	Left rear	4,5	1,25
	Front left	3,35	0,65
	Front right	3	0,95
	Right rear	3,5	0,55
100-200		2,5	0,75
		4,6	1,35
		3,3	0,65
		8,5	0,9
200-300		5,8	0,85
		3,5	0,6
		7,5	0,45
		4,3	1,4
300-400		7,9	0,8
		9,4	0,6
		4	0,45
		9,2	1,4
400-500		2,3	0,85
		2,9	0,55
		3,4	1
		3,7	1,2
500-600		5,7	0,4
		2,3	0,9
		2,6	0,8
		4,55	0,5

0-100	Left rear	5	1,1
	Front left	5,1	1,2
	Front right	2,5	1,25
	Right rear	7,8	0,65
100-200		7,9	0,7
		6,2	0,8
		7,3	0,7
		4	1
200-300		13,3	0,75
		6,4	0,9
		6,8	0,9
		2,1	0,45
300-400		6,6	0,8
		3,9	0,55
		4,1	0,6
		8,8	0,4
400-500		6,45	1,05
		11,6	0,85
		5,8	0,95
		18,1	0,9
500-600		7	0,75
		2,3	0,7
		6,1	0,8
		4,5	0,8
0-100	Left rear	3,3	0,9
	Front left	1,6	0,8
	Front right	5,4	1,1
	Right rear	4,8	2
100-200		21,5	0,55
		4,8	3
		5,9	2,3
		7,5	2,4
200-300		27,3	1,2
		8,6	2
		11,1	1,9
		8,7	2,3
300-400		2,5	1,2
		3,8	0,8
		1,8	1,8
		4,9	2,1
400-500		12,1	1,2
		5	17
		8	1,2
		15,3	1,4
500-600		4,8	1,05
		8,6	0,25
		7,5	1,35
		33,7	1,3

0-100	Left rear	2	0,5
	Front left	2,1	0,5
	Front right	1,6	0,5
	Right rear	6,2	0,7
100-200		5,9	0,75
		2,9	0,7
		3,3	0,9
		11,7	0,45
200-300		5,1	1,3
		3,6	0,7
		2,3	1,2
		6	0,8
300-400		3	0,45
		2,5	1,1
		5,9	0,9
		2,6	1,05
400-500		1,5	0,7
		4,3	0,95
		2,4	1,1
		1	0,5
500-600		5	1
		1,2	0,4
		3,4	0,65
		3,2	0,6