The grassland characteristics and productivity of East Asia

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1. The regionalization of East Asian grassland

The territory of Asian grassland is the second biggest one of the continents (Table 1). From latitude 11° 3′E to latitude 81° N., it covers nearly every climatic zones of the world. From east to west, it covers 8000 km. It means from the sea coast to the very inland. So the continentality sharply increases from the Atlantic Ocean in the west and Pacific Ocean in the east to the interior. The dry area accounts for 60% of the continent.

Table 1 Grasslands and arable lands of the world (10 thousand ha).

	Grasslands		Arable lands		Ratio of Grassl.
	Area	%	Area	%	and arable lands.
World	282840.4	100	127394.2	100	2.1:1
Africa	79810.4	28.2	21090.333	16.55	3.8:1
Asia	55246.6	19.5	47876.4	37.58	1.2:1
Oceania	46914.8	16.8	4792	3.76	9.8:1
South America	44682.2	15.8	10152.4	7.97	4.4:1
North America	47571.8	16.8	29214.8	22.93	1.6:1
Europe	8713.8	3.1	14269.6	11.21	0.6:1

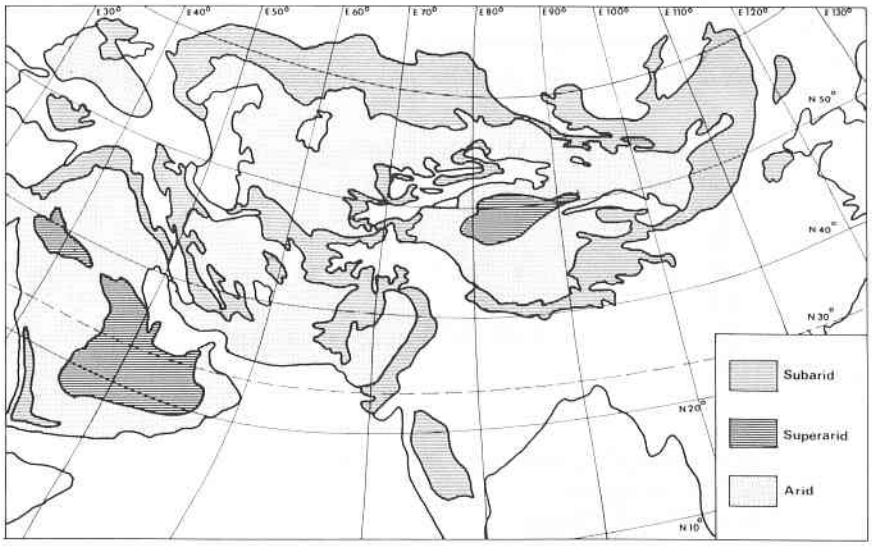

Fig. 1 Arid grasslands of Asia

There are a lot of criteria to asses the aridity of land resources. We use the criterion of Ren's system for Asian grasslands, e.g. K-values.
An arid region is identified by a K-value of less than 1.18 for any site in that area.
The arid grasslands in Asia could be classified as the map of Arid Grassland of Asia (Figure 1.).
Now I would concentrate our attention to the arid area of east Asia, although we have to get some relevant sites of central Asia.
This arid area includes four types of dry grasslands that are mainly used for extensive grazing.

1.1. The superarid Takla Makan region

The average annual temperature of this region is 7°–9° C; 14°–16° C in January and 24°–27° C in July. The rainfall is about 30 mm, and concentrated in the summer. The K-value is commonly not more than 0.1. The pattern of it's climate is shown in Figure 2. Sand dunes cover this area. Nearly no forage plants occur in the centre part of the area. But along the boundary of the region and on the river banks and around the

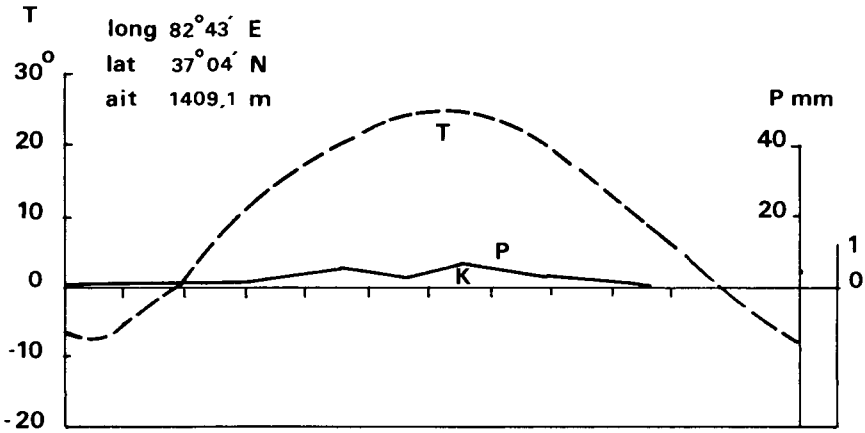

Fig. 2 Pattern of temperature, precipitation and K value of Minfeng, China

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	1	2	1	3	6	3	7	3	3	0	0	1	30
T	−7	−2	8	15	20	24	25	23	18	10	2	−5	11
K			0.04	0.06	0.10	0.05	0.08	0.04	0.06	0	0.04		0.07

Key:
K = (annual percipitation) / (accumulated temperature above 0 C x 0.1)
K < 0.28, superarid
K = 0.28 – 0.85, arid
K = 0.85 – 1.18, subarid
K = 1.18 – 1.45, semihumid

K = 1.45 – 1.82, humid
K > 1.82, damp

lake basins the following vegetation occurs: woodland (mainly *Populus euphratica*), bushland (mainly *Haloxylon*) and grassland (mainly *Artimisias* spp. and *Kochia* spp.). The area can be used as grazing land and/or fertile arable land. However superarid regions as Takla Makan are very scarce in China, and in east Asia as a whole.
No zonal domestic animals live in the superarid region. But in the oasis, such as along river banks and lake basins, sheep, cattle and goats can be held.

1.2. Arid Grassland

The Arid grasslands K-value varies from 0.29 to 0.85. The climatic pattern is given in Figure 3. Figure 3-1 shows mild winter, hot summer and two rainy seasons for this grassland area. It indicates a Mediterranean type of climate. Figure 3-2 indicates the transition regime between Mediterranean and Asian continental climatic types with mild winter and not so hot summer. Figure 3-3 indicates the typical Asian continental climatic type with cold winter, hot summer and one rainy season in summer.
It's equivalent natural landscape is semi desert. At Kasakhstan it is called Artimesia steppes. At some other places it is known as bush semi- desert. The vegetation consists mainly of *Artimesia*, *Calligonum*, and *Haloxylon*. The soils of this region are calcic brown soil, desert grey soil and azonal saline soil.
The arid grassland is very fragile. If the vegetation has been depleted desertification always happens.
Camel and goats are the zonal animals; sheep and cattle graze on the boundary of the arid and the semi arid regions.

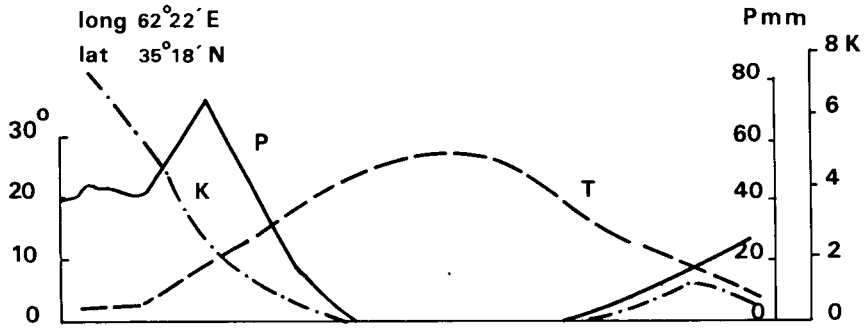

Fig. 3-1 Pattern of temperature, precipitation and K value of Kushka, U.R.S.S.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	5	8	9	19	12	19	16	17	17	12	9	7	150
T	−3	−3	2	10	18	23	26	25	20	13	6	0	11
K	7.25	4.55	2.65	0.95	0.06	0	0	0	0	0.18	0.56	1.61	0.47

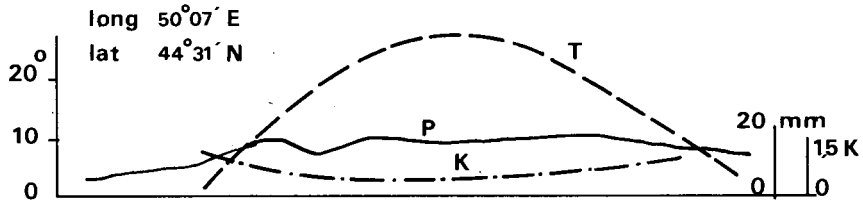

Fig. 3-2 Pattern of temperature, precipitation and K value of Ft. Shevchenko, U.R.S.S.

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	5	8	9	19	12	19	16	17	17	12	9	7	150
T	−3	−3	2	10	18	23	26	25	20	13	6	0	11
K	–	–	1.45	0.63	0.22	0.18	0.20	0.22	0.28	0.30	0.50	–	0.34

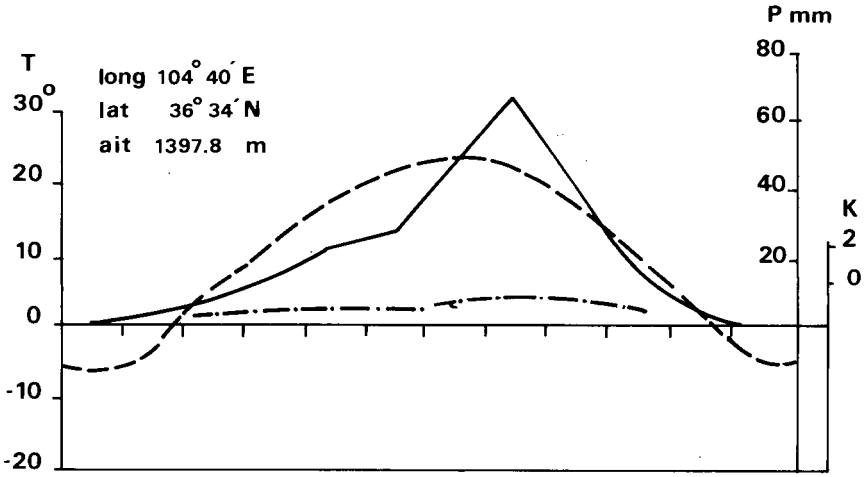

Fig. 3-3 Pattern of temperature, precipitation and K value of Jingyuan, China

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	2	3	6	14	23	26	47	64	38	17	5	1	246
T	−7	−3	5	12	17	22	24	22	17	10	2	−6	10
K			0.33	0.38	0.43	0.40	0.65	0.74	0.76	0.53	0.90		0.61

1.3. Semi-arid grassland

The semi-arid grassland's K-value varies from 0.86-1.18. The climatic patterns are shown in Figure 4. Figure 4-1 indicates the cold winter and the annual percipitation which does not vary much through the year. It is the transitional regime between the Mediterranean type and Asian continental type. Figure 4-2 indicates the warm summer and the summer rains.

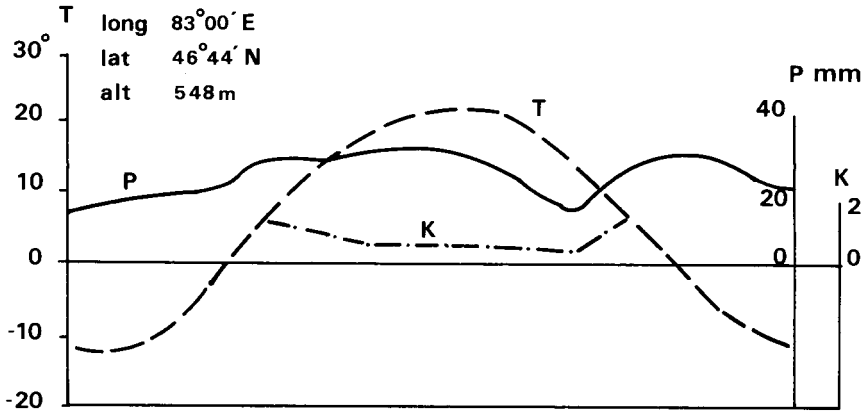

Fig. 4-1 Pattern of temperature, precipitation and K value of Tacheng, China

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	16	19	21	30	29	33	34	23	13	29	33	24	30,4
T	−13	−11	−2	8	15	20	22	21	15	7	−3	−10	6
K				1,19	0,63	0,56	0,51	0,36	0,27	1,45			0,92

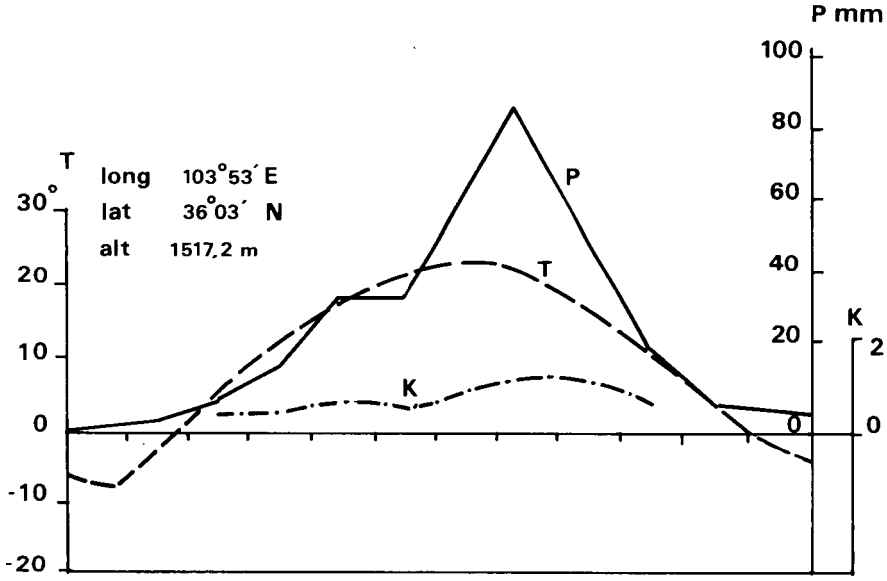

Fig. 4-2 Pattern of temperature, precipitation and K value of Lanzhou, China

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	1	2	8	17	36	36	62	88	54	22	4	1	331
T	−7	−2	5	12	17	21	23	21	16	10	2	−5	9
K			0,46	0,47	0,68	0,58	0,88	1,33	1,11	0,72	0,85		0,86

Their equivalent natural landscape is a dry steppe or a short grass steppe. Figure 4-1 represents the regions which have a Mediterranean vegetation composition, e.g. *Juniperus phoenicea, Quercus suber, Acacia* spp, *Artimisia herba-alba*. Figure 4-2 represents the regions which have got mongolian flora, for which *Sipa grandis, S. krylovii, S. bungeana* are the most characteristic plants. In the east part *Leymus chinensis* is the dominant plant.
Loess is the main soil, with very low organic matter content. Desertification has spread on misused lands.
The zonal animals are sheep, goat and cattle. Camel can also be held in the transition area between semi-arid and arid regions.

1.4. Alpine arid grasslands

The Alpine arid grasslands represent a special type of the arid regions characterised by its high altitude, low temperature and an average annual temperature of not more than 3 C. It commonly occurs at about 3000 m in central and east Asia. The alpine arid grassland covers reasonable parts of Tibetan Plateau and some high mountains, such as the Tianshan, Qilian and Himalaya mountains. Climatic data are given in Figure 5.

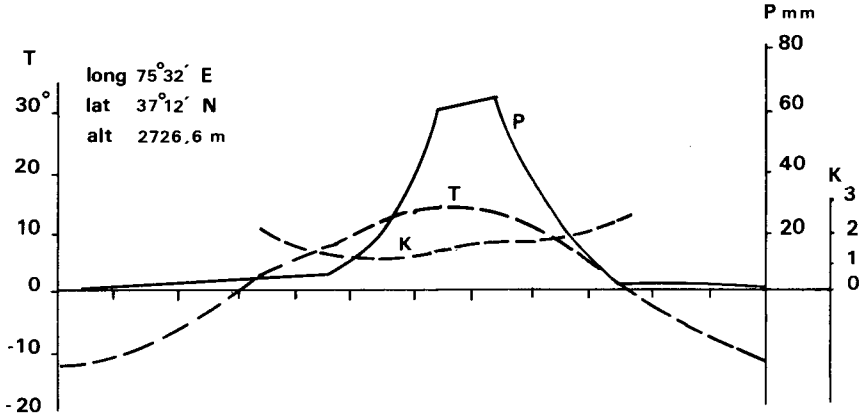

Fig. 5 Pattern of temperature, precipitation and K value of Gifeng, China

	J	F	M	A	M	J	J	A	S	O	N	D	Year
P	1	2	4	5	4	19	61	45	25	3	3	1	193
T	−12	−10	−4	2	7	11	14	12	7	2	−6	−10	
K				2,14	1,09	1,06	1,40	1,68	1,76	2,31			1,14

The vegetation is dominated by *Artimesia, Kobresia, Stipa, Artimesia frigida, Aster himalaicus, Leontopodium brevifolium, Kobresia humilis, Kobresia tibetica* and *Stipa gobica. Roegneria hirsuta, Festuca ovina* are also distributed broadly.

The soil is mainly an alpine calcic soil, the organic matter is considerable more than in non-alpine arid grasslands soils.
The zonal animals are yak, Tibetan sheep. Goats are also popular.

Table 2. The Grassland Potential Primary Production (GPPP) of Several Sites of Asian Grasslands.

Locality	No. of class in the key chart of grassland classification	GPPP* (t/ha)	Quantity enter grazing food chain (t/ha)
Mingfeng Long. 82°43′ E Lat. 37°04′ N Alt. 1409.1 m	5	4.8	0.01
Ft. Shevchenko Long. 50°07′ E Lat. 44°31′ N	13	7.0	0.07
Kushka Long. 62°22′ E Lat. 35°18′N	14	11.0	0.11
Jingyuan Long. 104°40′ E Lat. 36°34′ N Alt. 1397.8 m	13	7.35	0.07
Tacheng Long. 83°00′ E Lat. 46°44′ N Alt. 548 m	14	7.35	0.07
Lanzhou Long. 103°53′ E Lat. 36°03′ N Alt. 1517.2 m	21	11.3	0.11
Songchan Long. 103°32′ E Lat. 37°12′ N Alt. 2726.6 m	26 24	7.35	0.07

* Including beneath ground biomass.

2. The potential primary productivity of east Asia grassland

The realistic productivity depends on many factors, such as kinds of livestock, composition of herds, arts of management. Sometimes it is too complex to reveal the real productive characteristics of grasslands. But the grassland potential primary productivity (GPPP) can be estimated as a realistic criterion of grassland productivity. There are a lot of methods for this purpose. We suggest to use the key chart of grassland classification (Figure 6.) with the model to estimate Asian grassland primary productivity successfully; in which:

P = A (1 ± 0.35)
G – GPPP of any given class needs to be derived.
A – The biomass (include beneath ground) of any known grassland class in the chart.
S – The number of Class from A to P, along 'temperature' axis or 'rain' axis.
– – From class A to class P is right to left, bottom to top direction.
+ – From class A to class P is left to right, top to bottom direction.

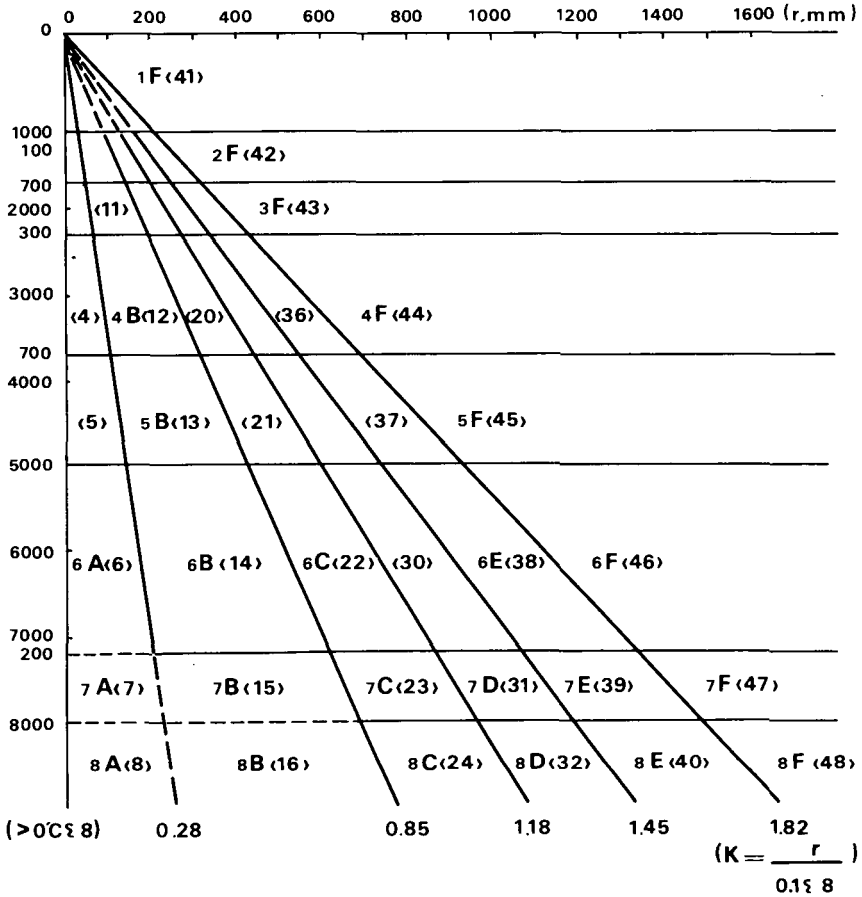

Fig. 6 Key chart of grassland classification

Following this method we can obtain the GPPP of various types of Asian grassland. We are lacking experience with the warm desert. Table 2 indicates the GPPP of several sites in Asia which we have mentioned above.

The arid grasslands have no more than 0.01% of photo energy fixed in plant tissues. Even such a small amount of biomass seems a surprising low proportion which enters the extensive grazing food chain.
It is estimated that only about 0.1% (super-arid region) to 1% (semi-arid region) can be used.
Asian grassland production is very low (Table 3). Generally it is no more than 10 Animal Products Unit (APU). Whereas the APU in New Zealand is 338.5, in Canada 73 APU and 46 APU in the United States.

Table 3. The grassland productivity ha of several Asian countries.

P.R. Mongolia	3.2	Animal Products Unit.
Saudi Arabia	0.6	Animal Products Unit.
P.R. Yemen	1.7	Animal Products Unit.
China	14.5	Animal Products Unit.

There are two main reasons which cause the rangeland to get such a low grassland ecological efficiency.*
First, seasonal loss of animal production. In the extensive grazing system a period of malnutrition occurs every year in which the forage plants die. In central Asia the plants wither by lack of moisture or low temperature. In east Asia the plants wither mainly because of low temperature in winter. The mortality of adult animals is no less than 6% of the total. The loss of body weight is even five times more than that. If body weights decreases 25%, it means moderate exhaustion. Usually body weight loss of 30% had been reported. Putting the loss of dead animals (6%) and body weight decreasing (30%) together, the annual loss of animal production is nearly 40%.

Secondly, miss-management of grassland animal production. In Asian grassland regions the livestock is not always managed properly. The animals are kept to very old age and are not sold on the right time. The reproductive females constitute no more than 40% of the total. In addition, too large a number of animals are kept on a given pasture which causes very heavy grazing pressure which leads to grassland deterioration over the years.

3. Some Proposals

3.1.

By trying to use the Chart of Grassland Classification to estimate the grassland primary productivity on a global scale and to identify the correct factors. We have estimated the primary productivity on some sites of

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* grassland ecological efficiency – the efficiency of animal production.

temperate Asian grassland, and plan to do this also for tropical grasslands and warm temperate arid grasslands. It needs a worldwide network of sites to do this on a global scale. We should try to use the model in a much larger area than we have done in east Asia. This way we can find the short comings of the models and find ways to improve them or develop other new models for this purpose. For example the temperature and moisture characteristics of potential grasslands may be used to determine the primary productivity.

3.2.

Try to use the Animal Products Unit (APU) system as a criterion of grassland productivity. This criterion can reveal the economical and ecological value in both.

Many criteria have been used for this purpose. They are the weight of forage, the nutrient contents of forage, such as total digestable nutrients (TDN), digestable energy (DE), metabolisium energy (ME), productive net energy (PNE) etc, the animal biomass method such as animal number, body weight, carcass weight etc. But the realistic criterion should be the resulting animal products such as milk, wool, meat, skin etc. But how to measure the various animal products with one criterion? We try to use the APU system.

Table 4. Conversion table from different animal products to Animal Product Unit (APU).

Items	APU
1 kg body weight gain	1.0
One sheep carcass of 50 kg	22.5 (45 dressing %)
One beef cattle carcass of 260 kg	140.0 (50 dressing %)
1 kg of offals available	1.0
1 kg of standard milk (corrected to 4% of milk fat)	0.1
1 kg of clean wool for every kind	13.0
One working horse of 3 years old	500.0
One draft cattle of 3 years old	400.0
One draft camel of 4 years old	750.0
One working donkey of 3 years old	200.0
Moderate work horse of one year	200.0
Moderate work of cattle one year	100.0
Moderate work of camel one year	300.0
Moderate work of donkey one year	80.0
One piece of lamb-hide (for lamb hide breed)	13.0
One piece of sheep fur (for fur breed)	15.0.
One piece of cattle hide	20.0 (7% of live wt.)
One piece of horse hide	15.0 (9% of live wt.)
One piece of sheep hide	4.5 (9% of live wt.)
One mutton sheep	34.5 (6% of live wt.)
One beef cattle	196.0 (7% of live wt.)

One APU is equivalent to 1 kg body weight gain of grazing beef cattle in moderate condition. That is about 26.5 times the digestible energy, or 22.5 times the metabolism energy, or 13.9 times the growth net energy. Thus any kind of animal product may be compared with the energy consumed by beef cattle which prodeces 1 kg body weight gain, to obtain their APU respectively. We can calculate every kind of animal products with the conversion table from different animal products to APU (Table 4).

3.3.

Organizing the network on a global scale to classify and to make an inventory of the grasslands of the world. For vegetation, soil and climate, these classification systems of the world already exist. Undoubtedly, they contributed tremendously to practical and theoretical purposes for many relevant scientific fields. But we have not yet got such a world wide grassland classification system. IBP has established its network in the world and have done a lot of research about biomass productivity of grasslands. It really accumulated very much precious data. However their inventory is not perfect, due to the lack of a grassland classification system on global scale. Hence I would like to offer a suggestion to organize ourselves trying to develop a worldwide grassland classification system. That would be a good instrument for the inventorization of grasslands of the world and would enable us to bring order in the numerous scientific papers and data.

Desert ranges of Central Asia, methods of their taxation, utilization and improvement

by Shamsutdinov Z.Sh.,
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Introduction

Natural ranges of the Soviet Central Asian republics make up 85-95% of all agricultural grazing lands. From time immemorial they have been used as the forage reserve base of Karakul sheepbreeding. The current state of desert ranges is characterized by low productivity (150-300 kg/ha of dry feed mass), its sharp annual and seasonal variations, and also by the diversity of range lands. Subsequent successful development of Karakul sheep breeding must be founded on a more effective use of the pasture-forage resources. In this respect the methodological basis and methods of inventory, taxation, rational utilization and improvement of desert ranges are being developed in the USSR.

Natural conditions

The distinctive features of Central Asia's deserts are the high temperatures, extremely arid climate,and small amount of precipitation (80-250 mm). The summer is very hot (40°-45° C air temp.), long and dry. During the year the air temperatures reaches the maximum values of 80°-90° C. The coldest month is January: average monthly air temperature is +1.9° – 1.1° C, absolute minimum is –27°- –29° C.

During the year wet and dry periods clearly stand out. The wet period is from November to April, the dry period begins in May and continues to November-December. During this period, particularly in summer, there is almost no precipitation.

Sierozems, grey-brown and sandy-desert soils predominate in the desert zone of Central Asia.

Types of desert ranges: their characteristics

Many years of investigations by the National Research Institute of Karakul Sheep Breeding (Amelin, 1944; Morozova, 1946; Gaevskaya, 1971, et al.) revealed four groups of range types in the desert zone of Central Asia.

1. Shrub-Ephemeral Ranges

This range type is mainly attributed to sands. Almost all life forms of plants take part in the grass/herbs layer of the shrub-ephemeral ranges. Trees and shrubs are represented by *Haloxylon persicum Bge., Salsola richteri Kar., S.paletzkiana Litv., Ephedra strobilaceae Bge.*, different species of *Calligonum*, dwarf shrubs – by *Astragalus, Convolvulus, Artemisia and* others. The lower stratum consists of ephemeroids-*Carex* physodes Bieb. and ephemerae-Bromus, Eremopyrum, Malcolmia, Astrogalus and others. Depending on range differences the yield of dry fodder mass is 150-300 kg/ha. It is possible to use this type of fodder for animal grazing in any season of

the year, but preferably in winter.

2. Dwarf shrub-ephemeral ranges

This type of range is widely spread in the Central Asian deserts on sierozems and grey-brown soils, sometimes on compact sands. The main plants forming this dward shrub-ephemeral range type are different species of *Artemissia* (wormwoods)-*Artemissia diffusa Krasch., A. turanica Krasch., A. terraealba Krasch., A. badhysi Krasch.*

The wormwood ranges are highly regarded by cattle-breeders. It is possible to use this range type in any season of the year, as a rule twice a year: in spring (or in summer) when animals graze on ephemeroids and ephemerae and again in autumn (or in winter) when they browse on dwarf shrubs, saltwarts and dry ephemerae. Forage reserve on the ranges fluctuates within 150-300 kg/ha of dry matter.

3. Ephemeral ranges

They are spread mainly in foothill areas of Central Asian deserts. The main plants of ephemeral ranges are *Carex pachystylis L. Gay., Poa Bulbosa L.* Sometimes they are complemented by such ephemeroids and ephemerae as *Gagea, Bromus, Eremopyrum, Leptaleum, Thigonella,* and *Malcolmia.* These ranges are mainly of spring-summer utilization.

In the first period of spring 100 kg of dry forage of ephemeral pastures holds 81 fodder units, in winter the nutritive value of fodder is reduced to 32 feed units. In an average year the yield of ephemeral pastures is 400-500 kg/ha of dry matter.

4. Saltwort ranges

This range type does not spread over large areas, it usually is included into other zonal range types by the plots of different size on saline sierozems, takyrs and solonchaks. This range type consists of perennial saltworts-*Salsola gemmascens Pall., S. orientalis S.G. Gmell.* and of annual saltworts-*Climacoptera lanata (Pall.) Btosch., Gamanthus gamocarpus (Moq.) Bge., Halimocnemis villosa kar. et Kir.* The yield of saltwort ranges largely depends on meteorological conditions of the year. The forage mass yield of saltwort ranges does not exceed 10-20 kg/ha and only in favourable years it reaches 100-200 kg/ha of dry matter. Annual saltworts are consumed by sheep in autumn and winter. According to sheep owners the sheep breeding on saltwort ranges stimulates its multi-fetus pregnancy.

Taxation as a means of economic evaluation of ranges

From the brief descriptions of the characteristics of different types of desert ranges, it is evident that quantity and quality of range forage differs considerably by year, season and type. In the desert zone it is common that the range grass stand is similar in weight but different in floristic composition and contains diverse quantity of nutrients and differs in economic value. The determination of additional fodder reserves is possible by means of qualitative evaluation (taxation) of range lands.

The work on taxation of ranges must begin with a geo-botanic study of territory. Geo-botanic classification of ranges and compound configuration

of their contours given on the ordinary rangeland maps give a clear view of the diversity of the vegetation cover, soils and relief, as well as of the forage mass supply in dynamics of seasons for average yield for every range area. It is often difficult to use these data in practice due to their complicated and insufficient nature. In this respect geo-botanic data can provide the firm base for the assessment of the scientific and economic evaluation of range lands according to conditions or quality classes, thus enabling performance of simple and prompt evaluation of range quality and puts them to use with profit.

All previous work on range inventory sets the stage for the transition to such quantitative economic evaluation of desert lands. The task is to determine what main indices (natural and economic) must be taken as the basis for the evaluation of quantity of (palatable) forage, floristic composition of grass stand, real composition of fodder units and digestable protein in forage. By means of taxation it is possible to determine what range is better, what kinds of ranges are necessary concerning the pressure of livestock and consequently the quantity and quality of animal produce and what priority measures for the most effective land utilization must be taken to maintain its maximum productivity. Taxation also gives an idea of hectare commensurability of range lands. Quantitative and qualitative comparison of range lands is important for many economic calculations for planning purposes and rational utilization of lands.

The resulting work on range evaluation will include a map showing the qualitative appraisal of land in the desert zone, on which the characteristics of range lands will be presented in clear graphic form. Therefore, Karakul breeders can see what opportunities they have. It will also give an opportunity to develop a coordinated system of measures aimed at improvement of ranges and their most efficient utilization.

Methodical basis for range taxation

Many years experience of research work by the Karakul Institute in range taxation makes possible an elaboration of the main methodical principles of this work for Karakul sheep breeding ranges. This work begins with range and geo-botanical survey of territory and mapping of all types of range lands on a precise topographic base (1: 100.000). The survey is carried out on large areas typical of the given natural zone for a period of several years (up to 10 or a minimum of 5 years) in order to involve the whole weather cycle.

In the time of range taxation it is necessary to take into account only the part of fodder resource (in feed units) which is consumed by sheep during grazing. For every survey year the degree of range productivity is estimated in percentages of the year regarded as average for its fodder supply (100%). Taking into consideration the length of range seasons (for the given locality) average weight of annual supply of range forage is estimated differentially for every range area (map unit) distinguished on the geo-botanic map.

Evaluation criterion

The total nutrition value of forage supply in feed units per one hectare is

taken as a qualitative evaluation criterion of range lands. In relation to forage supply and its total nutrition value it is worthwhile to evaluate desert ranges according to a closed 100 points on a 5 classes scale. Maximum productivity observed during a number of years is taken as the standard – 100 points (first class). All other ranges of the given type in any year can be evaluated by comparison with this standard in points and classes of taxation.
Due to the sharply expressed dynamics of forage supply in the Central Asia desert ranges owing to weather fluctuations of certain years, the economic value of the same plots changes drastically year by year. These differences in the quality of range lands are clearly seen while evaluating them in conditional points of the estimation scale. According to this scale ranges of the best quality are attributed to the first class and get the highest points and the ranges of lower productivity are accordingly attributed to other classes and less points. The following estimation scale was worked out and used for the dominating type of Central Asian range lands.

The estimation scale of 100 points is the most suitable for conditions of desert zone range lands. The range with grass stand consisting mostly of the main species of fodder plants and having the greatest nutrition value in the best yielding year should be given by the highest points e.g. 100. Then comparison is to be made of other ranges with this one. A range reliable in yield, reclaimed by phytomelioration measures, consisting of natural wormwood-ephemerae with an area of 2200 ha was given 100 points and used for further comparison. In all years investigated the qualitative indices of this range were the highest, and in a very productive year this range was of perfect condition, which clearly demonstrated what production can be obtained from this land at a given stage.
By means of model range land for the given conditions the real 'price' of one point can be determined and expressed, e.g. in feed units, and accordingly other range differences can be evaluated and then grouped into classes.

The following five classes are proposed:
first class – excellent ranges; 71-100 points;
second class – good ranges; 40-70 points;
third class – satisfactory ranges; 21-40 points;
fourth class – poor ranges 0-21 points;
fifth class – unsuitable range; 0 points;

All range differences of the sample farm were evaluated according to this scale. On the range-geo-botanical map they were coloured accordingly and they were given corresponding identification in the field. It seems expedient to include the degree of management, e.g. watering, into the evaluation procedure. It is evident that a range for the sample farm, even with abundant forage, can not be considered satisfactory without watering points. Other corrections might be necessary also. Consequently in this methodical example the range-standard (1 class, 100 points) was characterized by the following productivity indices: on average 1360 kg/ha of dry feed matter consumed by sheep, containing 580 kg/ha of feed units and providing year round grazing of 134 sheep on 100 ha. Thus the 'price' of one point was equal to 13 kg of dry feed matter, 5,8 kg of feed units and 1,34 sheep.

According to the scale adopted the standard and absolute meaning of the 'price' of one point, the taxation of range varieties (map units) of the given type is carried out for any productivity. All range varieties are evaluated in points and quality classes. Proceeding from taxation data and one point 'price', the carrying capacity of 100 ha ranges of different quality for any year as well as for the average productivity year is determined differentially for every variety. On the basis of an ordinary average-scale geo-botanical map the taxation map for the sample farms ranges or for vaster areas is drawn up for differences in productivity in an average year, thus the geo-botanical map units are economically estimated. The taxation map clearly shows what range types are present, and what ranges demand priority in phytoreclamation measures.

Rational utilization and improvement of Ranges as a means of enhancing their quality status

The evaluation of ranges according to quality classes forms the basis for organizing the work on their rational utilization and improvement. This work is in its turn, may lead to increase their productivity and quality classes. The National Research Institute of Karakul Sheep Breeding (Gaevskaya, 1971), Desert Research Institute of AS TSSR (Nechaeva, 1954, 1981) developed a system and technology for the rational utilization of ranges on the basis of application of range rotations and transhumance grazing of sheep. It is established that this rational way of range utilization provides favourable conditions for vegetative and seed regeneration of main fodder plants and improves their botanic composition and the structure of associations cenopopulations, resulting in an increase of the productivity by 25-30%.

By now economical agrotechnical and ecological sound methods for enhancement of the range productivity are developed. They include: creation of multi-year polystratum and polycomponent range agrophytocenoses of different terms of utilization, creation of range protecting belts as well as the introduction, selection and seed-breeding of desert fodder plants (Shamsutdinov 1975, 1980). The application of a worked-out system of range phytomelioration provides the development of 1200-1600 kg/ha of dry forage matter (or 600-800 feed units) in desert areas of Central Asia. It shows the possibility of the sharp increase in the quality of Central Asian desert ranges. Up till now the work on enriching the ranges within an area of 2 mln. ha has been carried out in the Central Asian desert zone. Further expansion of the magnitude and rates of implementing the measures for enhancing the productivity of Central Asian desert ranges is envisaged by means of a long-term program.

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