Economic-geographical characteristics of agricultural land use within the Selenga river basin

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Abstract. In the early 1990s, Russia and Mongolia started transformations of the land relations and the system of agricultural land use. This study seeks to identify the distinctive features in agricultural land use in the upper (Mongolian) and lower (Russian) parts of the basin. An analysis is made of the main indicators reflecting the economic-geographical characteristics of agricultural land use, the structure of agricultural lands, the level of agricultural development, the dynamics of the area and efficiency of use of croplands and crop yield of grains. It was found that in spite of the more severe natural and climatic conditions, the Mongolian part of the basin has higher efficiency of agricultural land use. A decrease in the area of the cropland at the beginning of the agrarian transformations was observed throughout the territory of the basin. In the Mongolian aimags within the Selenga basin, the area of the cropland decreased by 27.5%. In the subsequent period, the sown area remained stable, in spite of a significant amplitude of fluctuations during separate years. In the Russian part of the basin, the area of croplands at the beginning of the agrarian transformations decreased by 21.5%. The tendency for a decrease in croplands has persisted to date. The main of the transformation of the agricultural land use system are formulated.

1. Introduction

River basins provide the most objective and natural basis for solving many problems related to the organization and governance of rational environmental management [1]. The Selenga river basin is a unified transboundary geosystem which is intensively used in agriculture. The natural-territorial complexes of the Selenga basin are united not only by the arterial hydrological network, geochemical flows of matter, air flows, exogenous processes, etc. but also by agro-economic linkages existing for hundreds of years. The land relations and agriculture in the Russian and Mongolian parts of the basin in the 20th century were evolving under similar socio-economic conditions, and the state monopoly on agricultural lands was prevalent. The Russian and Mongolian parts of the basin are united by historical experience of nomadic livestock husbandry, the long-standing practice of hay production by the sums of Mongolia for settled livestock husbandry farms of Buryatia, the practice of moving livestock from

Mongolia to Buryatia, deliveries of queen bees and honeybee colonies as well as grain crops of elite reproduction, bread and bakery products from Mongolia to Buryatia. Drastic changes in the system of agricultural land use occurred in the mid-1990s. Private ownership over resources became widespread in Mongolia. Up to 48% of agricultural lands are concentrated in private arat farms [2].

The importance of the agricultural lands for agrarian production within the Selenga basin is attested by the following indicators: in the Republic of Buryatia, the districts located in the drainage area account for 73.7% of gross output of agriculture of the republic, and for 83.1% of agricultural lands, including 86.4% of croplands. The aimags located in the Mongolian part of the Selenga basin account for 37.3% of agricultural products of Mongolia. They include 32.2% of natural forage lands and 35.1% of croplands of Mongolia [3].

The goals of this investigation were to identify the distinctive features in agricultural land use and the main directions of transformation of agrarian nature management within the Selenga basin. The findings can be used in developing a unified system of environmental measures on the territory of the transboundary basin. This is particularly relevant in view of the globalization and regionalization of the world economic space. The findings can be used in carrying out the land reform, and in developing programs of development and information support of agriculture in the regions.

2. Methods

The information base for this study was provided by material made available by territorial subdivisions of Rosreestr, Rosstat and the State Statistics Committee of Mongolia as well as by material of field expeditions. The method of landscape analysis of the territory was combined with economic assessment methods and with the approaches of comprehensive physical-geographical research. These approaches are based on the theoretical and methodological principles of the Siberian geographical school related to the analysis of the substantial contrasts in the development patterns of agrolandscapes. This research has used the comparative-geographical and economic-mathematical methods as well as the grouping method.

3. Results and discussion

Agricultural development of the study territory is highly uneven. The highest degree of agricultural development is characteristic for the southern part of the Selenga middle mountains as well as for the area along the delta of the Selenga. The agricultural lands are continuous and account for 59% of the total area of land use. The croplands are located along broad river valleys and the steppe and forest-steppe intermontane depressions. The proportion of the croplands in the structure of agricultural lands varies from 57% in the lower reaches to 8% in the upper reaches of the basin. The highest degree of plowing is characteristic for the Bichura, Tugnui, Kudara and Borgoi steppes and for the slopes of the Tugnui ouval. The proportion of pastures in the structure of agricultural lands increases along the southward direction of the basin. In the dry-steppe aimags of Mongolia located in the foothill areas of Khentii, the pastures account for up to 92% of the agricultural area. At the beginning of the agrarian transformations, the entire territory saw a drastic reduction of the degree of agricultural development. The chief reason behind this is the disintegration of collective enterprises which are the main land “holders”. In the Mongolian aimags, the area of agricultural lands gradually recovered owing to an active participation of arat farms in the land reform which became owners of land parcels. A distinctive feature in land use in the Mongolian part of the basin is a high amplitude of fluctuations of the sown area for separate years. If, however, a long time interval, 10–15 years, is analyzed, the preservation of the sown area as a whole is noticed. In dry years, the area of croplands decreases dramatically but reverts to its former size thereafter. The area of croplands decreased by 21% during 1994–1999, remaining unchanged in subsequent years [2]. No reduction of croplands has been observed since 1999. Characteristic for the Russian part of the basin is a steady decline in the area of croplands. Between 1994 and 1999, the area of croplands decreased by 25% [3].

The aridity of the climate, the historical traditions and the work skills of the population coupled with a high proportion of natural rangelands on the territory were crucial to the livestock husbandry specialization of the region's agriculture.

Agricultural land use of the Mongolian part of the basin is characterized by integrated use of natural rangelands. Hay is harvested in the river valleys from July to September. In winters and springs, the river valleys are used as pastures. Agriculture has a secondary significance. Most of the croplands are concentrated in the steppe aimags (Selenge, Töv and Khentii) which are endowed with good atmospheric precipitation.

In the Republic of Buryatia, agriculture and livestock husbandry are pursued along the river valleys and in the intermontane depressions as well as gentle slopes of foothill areas. The agricultural lands of the Selenga middle mountains and the delta of the Selenga are represented by a continuous area at 540–720 m above the sea level and occupy the watershed spaces of the Selenga and its main tributaries: the Dzhida, Khilka, Chikoi and Tugnui. Over the course of several centuries this territory was the center of agrarian nature management. A relatively subdued topography of the Selenga middle mountains, the soil-climatic conditions and the historical features in settlement are responsible for the large size of croplands on the territory, including on the Tugnui ouval. Almost all slopes and flat watershed divides are plowed in the valleys of the Tugnui-Sulkhara rivers. A high degree of plowing of the Tugnui-Sulkhara depression is due to the fertile soils (chernozems, and chestnut and dark chestnut soils). Thus, in the farms of the Mukhorshibirskii district, the proportion of chernozems reaches 32.5% of the area of the croplands and 21.4% of the total area of the agricultural lands [4].

The agricultural lands of the Mongolian part of the basin are concentrated in narrow, deeply incised river valleys of the Mongolian Plateau at up to 1500 m above the sea level. The outruns are located throughout the territory, including in the foothill areas of Khentii and Khangai, at 2000 m above the sea level. The natural boundary of the agricultural area in the north-west are the Khan Khukhei, Ulan Taiga and Eastern Sayan mountain ranges which do not form a unified massif; in the middle part, the Khangai range, and in the northeastern part, the Khentii mountain massif.

The main producers of commodity grain are the southern steppe districts of the Selenga middle mountains (Bichurskii, Kyakhtinskii and Mukhorshibirskii). Wheat is the main crop in the structure of grain crops. Most of the grain-sown areas are concentrated in agricultural organizations. In the upper reaches of the Selenga, on the territory of Mongolia, the croplands are distributed evenly among land users of different forms of ownership. Grain crops are cultivated by collective farms as well as by arat farms. They account for 45 and 55% of the sown area, respectively. The structure of sown crops is dominated by grain crops for animal feeds.

In Mongolia, livestock husbandry accounts for up to 80% of gross agricultural produce. Its southern part is dominated by the nomadic system of livestock grazing; therefore, of critical importance are the centuries-long technologies of migrations and natural selection of animals. Different kinds of landscapes are used as seasonal pastures according to the natural and climatic conditions and to the wind regime in particular. In the summertime, "… the northern mountain slopes are a convenient habitat… for livestock", because the prevailing northerly wind in that season "blows round" livestock [4, p. 146]. In winters, the pastoralists move with their herds to higher areas and to lowlands to obtain shelter from the wind.

In the middle and lower parts of the Selenga basin, the main system of livestock husbandry is represented by stall-feeding and grazing which is more particular about animal feeds and the conditions of livestock keeping. With stall-feeding and grazing, of significant importance are the ecological state and productivity of pastures and hayfields. Seasonal pastures in steppes and forest-steppes occupy non-forested interfluve areas, the upper parts of the slopes of depressions, steppizated terraces and high-mountain meadows in places, intermontane depressions and foothill areas. In the Kabanskii district, pastures occupy the area along the delta of the Selenga. The proportion of lands suitable for hay making is very low. The sole exception is the Kabanskii district. The abundance of moisture and subdued topography provide favorable conditions for the growth of vegetation thus providing the farms of the district with rich hayfields. Owing to a lack of natural hayfields, hay

making is done in abandoned areas of croplands, grassy glades and fallow lands. Large amounts of forage are produced in field crop rotations, which increases the product cost in livestock husbandry. The area of natural rangelands remains relatively stable. The state of livestock husbandry completely depends on their yield level. A major loss of livestock can occur in dry years. Livestock restocking is governed by an increase in yield level of the pastures.

The sown areas and grain crop yield in the aimags of Mongolia are larger than in the districts of the Republic of Buryatia. Depending on the particular aimag, the absolute size of the croplands varies from 0.599 to 105.8 thou ha. The significant differences in the size of croplands are due to the character of the hydrogeographical network, topographic features and the humidification pattern. In almost half of the aimags (45.6%), the mean long-term crop yield e1xceeds 14 centners/ha [4]. In the Republic of Buryatia, only three districts out of 14 (21%) reach such indicators. The highest yield level of wheat is recorded in the steppe and forest-steppe zones of the Selenga, Tuul and Kharaa valleys dominated by dark chestnut and chernozem soils. In the Orkhon, Bulgan, Selenge and Töv Aimags, the mean long-term indicators, respectively, are 22.9, 15.0, 14.6 and 15.1 centners/ha. Further eastward, atmospheric precipitation amounts are decreasing, and the yield level drops to 13.9 – 7.7 centners/ha. The western aimags in the foothill areas of Khangai are dominated by cryogenic taiga soils of the high mountains. The yield level varies from 0.2 to 22.8 centners/ha.

The distinctive features in the use of natural forage lands are revealed by data on the area of pastures and hayfields per conventional head of livestock (table 1). In most farms of the Selenga middle mountains, 0.8–0.9 ha corresponds to one conventional head. The delta of the Selenga shows a shortage of natural forage lands, and a mere 0.5 ha of hayfields and 0.2 ha of pastures are available for one conventional head. The numerous islands of the delta are used by the population as summer pastures. The number of livestock in Mongolia far exceeds the number on the territory of the Republic of Buryatia; therefore, the availability of natural forage in the Mongolian aimags is lower (table 2).

Table 1. Availability of grazing land and hayland in the districts of the Republic of Buryatia*.

Districts	Total area, ha		Number of conventional livestock (CLS)	Including per CLS, ha	
	hay-lands	grazing lands		Haylands	Grazing lands
Bichurskii	9983	28574	6313	1.581	4.526
Dzhidinskii	12231	124010	17216	0.710	7.203
Eravinskii	14639	111038	11154	1.312	9.954
Zaigraevskii	6635	16433	6104	1.087	2.692
Zakamenskii	8498	16600	5662	1.501	2,932
Ivolginskii	4097	12839	1673	2.445	7.674
Kabanskii	3658	2016	7992	0.458	0.252
Kizhinginskii	3810	6792	1965	1.939	3.456
Kyakhtinskii	8301	56395	8724	0.952	6.464
Mukhorshibirskii	10934	77197	13915	0.786	5.548
Pribikal'skii	6400	8100	3972	1.611	2.039
Selenginskii	16785	100031	7003	2.397	14.284
Tarbagataiskii	4277	24853	5271	0.811	4.715
Khorinskii	14222	66725	7954	1.788	8.389

*The table was compiled using data of the Federal State Statistics Service

With the existing traditional system of livestock husbandry, the ecosystems of the Selenga river are in a relatively stable state [5]. The degree of their disturbance corresponds to the number of livestock. With an optimal rate of grazing (up to 2 heads/ha), the pastures show a weak degree of disturbance of the soil cover, which manifests itself in a decrease in productivity of the subsurface vegetation mass

by a factor of up to 1.6 and soil compaction within normal parameters (up to 1.1 g/cm3 for the soils of steppe landscapes). The moderate degree of landscape disturbance (grazing pressure from 2 to 4 heads/ha) is characterized by soil compaction up to 1.21 g/cm3, and by a decrease in the mass of plant roots by a factor of up to 4.7. For an intense rate of grazing (more than 4 heads/ha) and, accordingly, a strong degree of landscape disturbance, the study revealed a decrease in root productivity by a factor of up to 22, soil compaction to 1.46 g/cm3 and destruction of the soil sod horizon [5, 6].

Table 2. Availability of natural forage lands in the aimags of Mongolia*.

Aimags	Area of natural forage lands, thou ha	Number of CLS	Natural forage lands, ha, per CLS
Arkhangai	3793.4	2912519	1.323
Bulgan	2633.0	2008110	0.137
Bayankhorgor	6100.2	2976003	2.05
Darkhan-Uul	194.2	230406	0.871
Zavkhan	6994.2	2999903	2.311
Sekenge	1771.5	1030201	1.725
Orkhon	41.1	210090	0.195
Töv	5434.5	2626660	2.069
Övörkhangai	5746.2	2623304	2.190
Khövsgöl	4435.7	3425211	1.295
Khentii	5404.1	2183223	2.475

*The table was compiled using data of the State Statistics Committee of Mongolia

This work was done under grant 18-45-030039 p_a of the Russian Foundation for Basic Research and within the state assignment of Baikal Institute of Nature Management SB RASH (project no. 0339-2016-0001)

A large portion of the soil cover in Mongolia needs irrigation. However, shallow soils of light particle-size distribution undergo erosion with the removal of mineral and organic compounds and fine earth. In this case, soil optimization requires a package of agrochemical and agrotechnical measures and the protection against deflation. Excessive watering of loamy soils leads to the deterioration of their temperature regime, and enhancement in cryogenic phenomena and the development of salinization processes.

Agricultural land use on the territory of the Selenga basin is concentrated on the Baikalian-type depressions. The existing soil-ecological situation is favorable for traditional livestock husbandry [7].

4. Conclusions

In spite of the pre severe natural and climatic conditions, a secondary role of plant-growing, the intensity of development of the grain economy and efficiency of use of croplands in the agrarian economy is higher than in the Russian part of the basin. This implies a faster rehabilitation of the sown areas after dry periods, the absence of abandoned croplands, and a high yield level of grains. The efficiency of plant-growing in Mongolia was positively influence by the privatization of land parcels. The private arat farms engaged in agriculture are distinguished by a higher labor productivity when compared with the collective farms of the Republic of Buryatia.

The Russian and Mongolian parts of the Selenga basin are characterized by an asynchronous development of agrarian nature management. Mongolia has preserved traditional nomadic technologies of grazing. On the other hand, the herd structure forms according to the market conditions. In the Republic of Buryatia, nomadic livestock husbandry had prevailed in almost all regions prior to the collectivization of private farms in the 20th century. Nowadays there is a widespread system of livestock stall-feeding and grazing, with agricultural organizations dominant in land use. A significance importance in the development of the agricultural sectors are the federal and republican programs.

The structure of sown lands existing in the Republic of Buryatia, with a high proportion of feed crops (including grains for feeding purposes), meets the requirements of livestock husbandry and yields a small but stable profit for agricultural enterprises.

The current conditions of economic management demand revival of plant nurseries and seed sorting units in order to develop new high-yield drought-tolerant and early maturing varieties followed by their introduction in both the Buryat and Mongolian parts of the Selenga basin. In general, however, emphasis should be placed on the development of the livestock husbandry component.

To increase productivity of stall-feeding and grazing livestock husbandry requires an enhancement in field and meadow-pasture forage production. Specifically, it is necessary to revive the melioration and fertilization system for hayfields and construct new permanent cultural pastures. In view of the small areas of natural hayfields, it is best to partly use the croplands for the production of hay from annual and perennial grasses.

The districts of the Republic of Buryatia are characterized by a decline in the agrarian production potential in the suburban zone. This implies a decrease in intensity of agricultural land use by collective farms, their total decay in some of the suburban areas, and a reduction of sown areas.

Acknowledgments

We are grateful to V.G. Mikhalkovsky for his assistance in translating the manuscript.

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