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METHODOLOGY OF ESTABLISHING THE LIMIT SIZES OF LOT LANDS FOR THE AGRICULTURAL USE

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Abstract
This study aims to develop a methodology for determining and calculating the limit size of agricultural land plots that can be leased by individuals and legal entities of the Republic of Kazakhstan. The article substantiates agricultural production after the current long-term lease terms end. The basic condition is the formation of land use, in which there is a close dependence on conditions and factors of production, where land, material resources, and labor are in certain proportions and balanced.
The main criteria for determining the limiting sizes of land are: land area, leased to a single entity should not exceed 1/3 of the area of farmland rural district specific administrative area, and the physical person no more than 15% of the area of agricultural enterprises of the same specialization. Emerging land uses should be subject to zonal specialization by natural and agricultural zoning; take into account the minimum thresholds for the area of crop rotation in the crop production sectors and the size of livestock in herds of different types of livestock by the breed composition in the livestock industry.
Key words: limiting size, land plot, natural and agricultural zone, specialization, competitiveness, efficiency

Introduction

The agrarian transformation in Kazakhstan associated with the privatization of state property has led to certain changes in the legal and organizational structure of farms, land redistribution, fragmentation of large enterprises, and the expansion of small-scale production. In developing countries, land use is mainly determined by food needs as well as land suitability (Ying Zhang, Hongqi Zhang, 2012). Land-use patterns do not provide sufficient land for certain farming activities (Burian, 2015; Bizikin 2015). The experience of most countries demonstrates the practice of limiting the maximum allowable size of agricultural land and land holdings (Rumyantsev, 2015; Stupen, 2015; Aleknavicius et al., 2016). The regulation of lease relations abroad is also the legislative establishment of land rent limits (Habóczky, 2013). According to research by M. Ritter et al. (2020), the complex relationship between land price and plot size cannot be captured by a simple functional form.
Much of agricultural land in foreign countries is in private ownership; however, most of the agricultural land is leased (Bandlerova, Lazíkova, 2014). Hartvigsen (2014) and Jurgenson (2016) investigated that land fragmentation often hampers agricultural development when land ownership and land use are highly fragmented.
As a result of land reforms, there has been a reduction in the level of concentration of production in the leading branches of agriculture in agricultural enterprises and the efficiency and competitiveness of small-scale peasant and farmer farms. At the same time, in the country's northern region, excessively large land uses have developed, mainly in structures that are part of grain agroholdings, as well as in the western and central regions, where desert rangelands predominate (Scientific Report, 2016). The size of land use varies considerably within one administrative area. At the same time, due to the lack of statutory norms in the formation of land use, the natural and agricultural conditions, the capacity of economic entities to ensure the rational use of land, and the indicators of diversification of agricultural production by the specialization of the region are not taken into account.
Land inventory materials for 2012-2014 show the irrational use of agricultural land and withdrawal of part of valuable types of land from agricultural turnover (Inventory materials, 2012-2014). In this regard, an urgent problem is the development of methodological approaches to determining the norms for setting the limit size of land use within the administrative district, which can be granted to individuals and legal entities of Kazakhstan, which will allow for a fair public policy in the public interest, taking into account local conditions and ensuring compliance with the rules of rational and efficient use of agricultural land.
The purpose of the study is to develop a methodology for determining and calculating the limit size of agricultural land plots that can be leased by individuals and legal entities of the Republic of Kazakhstan.

Methodology of research and materials

The object of the study – is administrative districts by natural-economic zones, large and extra-large agricultural formations of different specializations of the Republic of Kazakhstan.

Research methods: computational-constructive method, economic-mathematical method.

The methodology for calculating the limit size of land plots to be leased to a non-state legal entity is reduced to determining the area of crops under cereals, fruit, and fodder crops in the field cereal, fruit and fodder crop rotations according to 1 formula (Kaliyev et al., 2017):

$$S = [(S1 * N1) * K1 + (S2 * N2) * K2 + (S3* N3) * K3] *Kr \quad (1)$$

where are: S – the area of arable land in a cereal crop rotation, taking into account the plowing ratio,

S1 – an area of 1 field in a cereal fallow rotation,

N1– number of fields in a cereal fallow rotation,

K1– number of crop rotations in a grain and fallow crop rotation,

S2 – an area of 1 field in a crop rotation,

N2 – number of fields in a crop rotation,

K2 – number of crop arrays in a crop rotation,

S3 – the area of 1 field in the forage rotation,

N3 – number of fields in the forage rotation,

K3 – number of crop rotations in the forage rotation,

Kr – the rate of ploughing of the land area.

Research materials. The method of etymologization of the existing land structure, qualitative composition of arable land and cultural and technical condition of hay and pasture lands, their water availability, availability of labour resources, state of material and technical base, and investments were used to assess production indicators of administrative districts; potential opportunities of using available resources to form competitive agricultural formations were determined (Interim scientific report, 2017). The study used data from the state land cadastre, data, and statistical materials of the Land Resources Management Committee of the Republic of Kazakhstan.

Discussions and results

The main emphasis in the establishment of maximum land use limits for economic entities and leasing land was placed on the degree of land availability in the regions, qualitative state of arable land and soil fertility, degree of watering of pastures, application of innovative technologies in crop and livestock production sectors, etc. (Table 1).

Table 1

Assessment of the level of land availability, soil fertility, qualitative condition of the main types of land

Natural-agricultural zone	Land availability per 1 gricultural worker, ha*	Land occupancy per 1 rural inhabitant, ha/person **	Average bonitet score	The share of uncondition ally arable land, %	The specific weight of watered waterlogged pastures, %	The specific gravity of pastures (Radical improvemen t), %
Forest-steppe	40.5	23.0	55	78.5	45.6	19.4
Steppe	39.1	21.2	45.6	45.4	37.2	29.6
Dry-steppe	49.3	28.5	26.6	51.7	32.2	9.2
Semi-desert	102.6	47.9	21.3	56.5	37.6	4.1
Desert	45.6	22.5	16	33.4	51.7	0.01
Foothill-desert-steppe	4.47	2.31	23	39.5	92.9	6.2
Foothill-desert	4.6	1.9	17.2	52.1	88.3	5.6
Mountain-steppe	26.5	12.7	37	75	35.5	4.1
Mountainous	8.1	4.0	38	53,8	42.6	1.1
*,** Note - Calculations based on data from the Statistics Agency of Kazakhstan, 2018						

These indicators are a limiting factor in the formation of extra-large farms to which farmland can be assigned. Thus, the indicator of high soil fertility and production structure with a predominance of arable land in forest-steppe, steppe, mountain-steppe, and mountain zones reflects the development of highly efficient production and determines the size of limiting large farms with smaller areas compared to dry steppe, semi-desert, desert, piedmont-steppe, and piedmont-desert zones, where farms can be formed with area 2 and more times larger.

Let us consider the methodology for establishing the limit size of land plots that can be leased for agricultural production to legal entities in the forest-steppe, steppe, and dry-steppe natural agricultural zones of Kazakhstan.

Accepted criteria:

1) choice of specialization by a long-term study of the development of crop and livestock branches in farms of these zones shows that their specialization is almost identical and forms grain, grain and livestock (dairy), grain and livestock (meat), grain and ovine, grain and livestock types of farms;

2) production structure: Rational combination of branches in the structure of commodity output value corresponds to a share of the crop sector – 70-65%, a share of the livestock sector – 30-35% while keeping diversification of grain-production based on the application of resource-saving technologies (minimum and zero), where the share of grain is not over 70%, including wheat – 65%, technical and oily crops - not less than 13%, forage - 17% (agricultural management systems, 1979-1982);

3) ploughability of land use, taking into account the share of arable lands in a total agricultural area, is taken: in forest-steppe and steppe natural-agricultural zones it will be within - 60-75%; in dry steppe - 25-50%;

4) The system of crop rotations in three natural-agricultural zones is accepted as four- and five-field fallow cereals, five-field alternating crops, six-field forage (grass-field);

5) the minimum threshold for rational use of arable lands, taking into account the effective use of highly productive machinery, is set at 400-500 hectares per field;

6) technological pattern in plant growing is established by the application of traditional, minimal, and zero tillage with the use of agricultural machines and towed implements with optimal terms of sowing and harvesting – 7-10 days with mechanics working ten hours;

7) several cattle in the forest-steppe zone are taken from 1200 to 1400 conditional heads of cattle (hereinafter – Cattle), in the steppe from 1600 to 2000 conditional heads of cattle, in the dry steppe from 2000 to 3000 conditional heads of cattle.

Determination of the maximum area of the land plot leased to the non-state legal entity with the optimal structure of production, where 70% is the cash crop production, 30% – is livestock, and contains from 1200 to 3000 conventional heads of cattle is connected with taking into account natural landscape and plough ability of the rural district. The plough ability of rural districts and natural-agricultural zones in the three zones under consideration ranges between 25% and 75% (Table 2).

The justification for the size of the crop rotations is based on the research and development work of technology institutes and centers. At present, in these natural-agricultural zones, four-field and five-field grain and pair crop rotations with a short rotation and a pure fallow field of 20% to 25% are used in grain production.

Table 2

Level and coefficient of the ploughed area of land use by natural-agricultural zone

The natural and economic zone	**Number of areas**	**Number of districts, units**	**Area of agricultural land, thousand ha***	**Number of rural districts**	**Arable land, thousand ha****	**Ploughed area, %**	**Coefficient of plowing**
Forest-steppe	1	2	624	29	414.4	66.4	1.34
Steppe	4	6	3464	75	2184.3	63.1	1.37
Dry-steppe	6	9	7656.2	153	2067.5	27.0	1.73
*,** Note - Calculations based on data from the Statistics Agency of Kazakhstan, 2018							

In recent years the grain-growing regions have switched to resource-saving technologies with minimum and zero tillage of soil in six-field crop rotations, which ensure the conservation of soil fertility. Fodder crop rotations with three fields of perennial (annual) grasses for the production of green and roughage are used for animal husbandry.

Based on the level of land availability of the administrative district of the grain-growing regions in the agricultural enterprises of grain and cattle breeding specialization the size of one field in the crop rotations is taken 450 hectares. The number of crop rotation arrays is taken depending on the area of the rural district and the maintenance of a rational ratio of crop and livestock sectors.

To calculate the land area of specialized grain and cattle breeding farms with dairy cattle, the coefficient of ploughed area for the forest-steppe and steppe zones was taken as 1.25 to 1.4; for the dry-steppe zone as 1.5 to 1.75.

The calculation of the maximum area to be leased to non-state legal entities is determined by the formula.

For the forest-steppe zone for agricultural enterprises of grain and cattle breeding type with livestock of 1200 conditional heads of cattle, the area of the land plot will be (2):

$$S = [(450*4) *5+ (450*5) *2+(450*6) * 1)]*1,34 = [(9000) + (4500) + (2700)]* 1,34 = 21700(ha) \quad (2)$$

For the steppe zone, for a grain and cattle breeding farm with 2,000 conditional cattle, the land area would be (3):

$$S = [(450*4) *6+ (450*5) *2+(450*6) * 2)]*1,37 = [(10800) + (4500) + (5400)]*1,37= 28400(ha) \quad (3)$$

For the dry-steppe zone, the maximum size of the farmland with 3,000 conditional cattle is (4):

$$S = [(450*4) *6+ (450*5) *2+(450*6) *2)]*1,73 = [(10800) + (4500) + (5400)] * 1,73=35800(ha) \quad (4)$$

By varying the number of cereal, fodder, and crop rotations, depending on the area of agricultural use in the rural district and the level of ploughing of the territory, the specialization of farms and the maintenance of livestock species, limit land use limits for legal entities in each specific administrative district are established.

Conclusions and proposals

The first option was to maintain the necessary diversification of production and introduction of resource-saving technologies by limiting grain crops and increasing the share of oilseeds and fodder crops.

The results of the optimization model identified multiple increases in the number of cattle in these natural-agricultural zones and a twofold increase in the output of cattle breeding per 100 hectares of agricultural land.

The second option optimizes the land of future grain and livestock farming entities in the same natural-agricultural zones under consideration.

As a result of the decision optimum parameters of the limiting sizes of the ground areas which can be given out in rent for legal bodies have been defined: for the agricultural enterprises of a grain and cattle breeding specialization the optimum size will be the ground area of 25.2 thousand hectares of arable land, 10 thousand hectares under natural forage lands, in total 35.2 thousand hectares of agricultural lands.

In the meat direction, the optimal size of land plots to be leased to legal entities is 21.8 thousand hectares of arable land, and 10 thousand hectares of natural grassland, in total 31.8 thousand hectares of agricultural land.

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