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**REASONS FOR CHANGES OF PLANT COMMUNITIES AND  
THEIR SUCCESSION TO VARIOUS LANDSCAPES OF KAZAKHSTAN**

**Abstract.** The article, based on expedition data from various years, divides the state of landscapes for a period of intensive use and depletion, for a period of a sharp load reduction and the beginning of recovery, for the period of quasi-root state of plant composition. Such a state of vegetation in various natural and climatic zones is of interest for modern soil, geobotanical, ecological and other studies.

**Keywords:** stages, vegetation, factors, load, pastures, arable land, restoration, climatic zones, landscape, duration.

**Introduction.** The development of society in the world is aimed at the development of natural resources. This process is directed towards a continuous increase in production for the use of natural resources. The natural resources of the territory of the Republic of Kazakhstan were also used in increasing order until 1991. Since this period, natural resources have been used less intensively. Reducing the production of enterprises has led to a decrease in the anthropogenic load on the environment. Significant term values and scale of the simultaneously reduced anthropogenic load led to the creation of temporary natural landscapes. The agricultural production of soil cultivation for crop and livestock (grazing) products has decreased dramatically.

Research goal is to show the factors influencing on a stage degree of restoration of vegetation, which further influence the soil and other components of landscapes in different natural and climatic zones of the republic.

To achieve this goal, we set the following tasks:

- to describe the initial state of vegetation in various areas with a maximum long-term load;
- to show the factors that increase the load on landscapes;
- to show factors that reduce anthropogenic loads on landscapes;
- to show the differences in the restoration successions stages in different parts and landscapes of the republic.

**Methods.** According to [1] in Kazakhstan for the period from 1954 to 1960 more than 18 million hectares of new lands in plains landscapes were plowed up. The rate of development of soils gradually increased. The culture of farming has grown: various kinds of mechanical treatments, crop rotations, application of fertilizers and pesticides. In the southern regions, irrigation systems began to develop, which made it possible to receive more diverse agricultural products; to increase the area of the developed lands and use them intensively. If 6.7 million hectares (9.2 million hectares of planted area for 1953) was used before 1954 by one technology and intensity (plowing depth of about 16-18 cm) [2], then in the future these areas have increased almost 6 times, and the technology of their use has changed.

Extensive development of large territories for 40-50 years in the northern and intensive development – 50-70 years in the southern regions, respectively, significantly affected many components of the landscape. The intersection of terrain and the interaction of zones of vertical zoning contribute to the conservation of the diversity of plant and other communities and contribute to greater environmental

sustainability of anthropogenic loads. The relationship between plant diversity and environmental sustainability is reflected both in the vertical direction of the plant-soil, between the components of landscapes (plants, soil, fauna, surface and groundwater), and horizontally between biocenoses, tracts and localities.

Thus, on the territory of the republic natural landscapes began to be replaced by agricultural landscapes. The share of the latter (plowed) increased. Out of 222.7 million hectares of soil, 182.06 million hectares were pastures, more than 5 million hayfields, and 35.6 million hectares of arable land [3]. Agro-landscapes from the ranks of those that have been used, have partly shifted to cultivated and cultured levels, and partly to degraded ones.

Large areas allocated for pasture, can contain a large number of livestock. By 1991, in agriculture, the number of cattle reached 9819 thousand, and small ruminants – 36 222 thousand heads [4] (according to [5] these figures are 6931 thousand and 41 752 thousand, respectively).

Over time, cultivated crop fields and pastures degraded to varying degrees began to be combined. The mountainous and flat territory allocated for pastures was degraded to varying degrees, and the territory closer to the villages was severely degraded.

Vegetation communities have changed greatly, as they are not eaten: adrazpan, horse sorrel, buckwheat and others. Soils underwent severe trampling and the slopes were covered with numerous paths. Many springs have disappeared; the rivers have become shallow. This situation could be observed throughout the republic.

Many scientific works cited examples of desertification of territories. The depletion of the meadow biodiversity in the steppe zone occurred by 70%, and in the desert – 60%. According to the data of [6], 48 million hectares were degraded to a strong extent (according to data [4] – 30-32 million hectares) pastures of which 24 million hectares are medium and severely downed, and 24.8 cause soil deflation due to an unregulated grazing.

We have recalculated the annual ration of cattle and small ruminants (livestock for 1990), which equals 612 million tons of fodder units (f.u). The productivity of the entire pasture area is 291.3 million f.u., about 45 million f.u. is the productivity of meadows. The difference between natural productivity and rational consumption of feed for domestic animals is 275.7 million f.u. The difference between natural productivity and rational consumption of feed for domestic animals is 275.7 million f.u. What is the harvest of pastures from 172.3 million hectares. That is, the negative balance equals -94.38% (almost 2 times). These calculations also show that the cattle should be less by 4452,5 or small ruminants – by 26921,9 heads, so that the pastures are not (further) degraded.

This situation makes it necessary to keep plant growing in a state of tension, demanding the preservation and increase in the productivity of not only pastures, but also arable land. The produce of arable land partially goes to livestock feed: perennial grasses (legumes, cereals) in grain rotations, fodder crop rotations (corn and sunflower for silage, fodder beet, feed grain, beet pulp and others).

In an ecologically tense situation, there were many landscapes with natural pastures and hayfields. Eating plants, from year to year, were deprived of the possibility of normal growth and development during the growing season. Plants did not have time to blossom, or seed the growing territory, because of which some species gradually disappeared. The grassiness and productivity of the plant mass changed, this entailed further transformation of the animal world, soil properties, surface and underground runoff.

However, the social and economic situation in the RK has developed in such a way that the number of livestock began to decline from 1991 to 1995 by 1,746.5 thousand cattle and 11090.6 thousand small ruminants, by 1996 1213 thousand of cattle, 5548.2 thousand heads of small ruminants [4]. These data shows that the reduction in the number of livestock for 1996 already exceeds the level of (intensive) number of livestock (2959.5 thousand cattle + 16638.8 thousand small ruminants), which caused damage to landscapes (or 4452.5 thousand cattle or 26921.9 thousand small ruminants).

Expedition surveys of 2015-2017 showed that our forecasts were confirmed in term of the restoration of landscapes with a decrease in the number of livestock by 2 or more times led to the conservation and restoration of vegetation. We use new statistical data on the decrease and increase in the number of livestock for the period from 1990 as a maximum and until 2016. There are confirming facts (table). For 8 years, the number of cattle decreased by 5799,3 thousand heads, and the small ruminants by 26134,0 thousand. For the period 1997-2002 a minimum of these animals were kept (from

Dynamics of livestock cattle and small ruminants (thous.) as a factor in reducing successions  
(load reduction and early recovery)

Years	Cattle	Changes relative to the maximum	Small ruminants	Changes relative to the maximum
1990	9757,2		35660,5	
1998	3957,9	5799,3	9526,5	26134,0
2016	6413,2	3344,0	18184,2	17476,3

3957.9 thousand heads to 4559.5 thousand cattle and from 9526.5 thousand to 11273.0 thousand heads). Furthermore, the growth in the number of livestock was quite smooth (table).

Such dynamics of the number of cattle from 1996 to this year has created the conditions for achieving the quasi-climax state of the plant association in a large part of the country.

**Results.** About this topic, you can separately identify the period as a factor of restorative succession with the stage of "reducing the load and the beginning of restoration of vegetation in various parts of landscapes and the entire landscape." In this period, the stage can also be divided into fractional: transitional from anthropogenic to natural; the beginning of the natural.

The tendency of reducing the number of livestock since 1991 was maintained until 2000. For 10 years, cattle decreased by 5,821,200, and small ruminants - by 26,665,900 heads (data interpreted [4]). Although the number of livestock since 2000 began to increase from 4106.6 thousand cattle and 9656.8 thousand small ruminants to 5303.0 thousand and 13786,1 thousand in 2003, respectively. By 2004, it was increased to 363.2 thousand and 1329.3 thousand heads [5], the environmental situation has become much more favorable (improved).

This has had a positive effect on landscapes and first of all, on the vegetation cover. If in 1991 the demand for cattle and small ruminants in feed units was 612 million centners, in 1999 the demand was 212.3 million centners. The calculated critical mass of pasture productivity, taken in f.u. is 336.3 million centners. It can be assumed that the increase in plant biomass in pastures and meadows (for 1999) was 124 million centners or 248 million centners of hay. This amount of hay can be obtained, approximately, from 13 million hectares of meadows or 50-60 million hectares of pasture. The number of cattle and small ruminants receiving the optimal diet, will use 316.0 million centners fodder unit in 2004. This volume will be lower than the total productivity of pastures and meadows (336.3 million centner f.u.). This means that in nature there will still be preserved plants that will be able to give seeds, organic mass, preserve soil, release oxygen and so on.

Thus, landscapes that were in agricultural use as meadows and pastures for 50-70 years, found themselves in natural conditions for 20-27 years. Creation methods for assessing the factors that influence the formation of temporary natural landscape were needed. This formation proceeds in stages. These stages follow the natural path with "soft" influences and the stage of development of plant communities can again reach a state close to the initial, that is, before production use.

During this period, plant communities entered not only in the full-fledged phase of development (full-fledged ripening, seeding, etc.), but also in the biological and biogeochemical cycles.

Many landscape areas were in natural conditions, the vegetation of which lost proportionality in associations, the projective coverage, productivity, quality. However, different landscapes are restored in different ways. The vegetation cover of the rugged terrain is more diverse than that of the aligned ones and its recovery occurs more quickly.

When restoring the vegetation cover of various landscapes, the important role is played by the boundaries of contacts with alluvial landscapes or their remoteness. The greatest variety of plants preserved in the valley landscapes. Temporarily natural pastures occupy a vast territory that has been in natural conditions for several years after long-term use. The stability of these landscapes is different, so the succession stages of the vegetation cover will be different, respectively.

Figure 1 shows the state of plants in the roadside part, a few meters and in space. Plants are distinguished by a considerable height. Plants on gray-brown soils of the foothill zone is due to the climatic conditions of 2016 and to the absence of pasture load.

The density of plant standing on this field raises a natural question that a certain distribution of ripened seeds occurs here. In the future, this density will change due to intraspecific and interspecific competition for light, moisture, nutrition. These changes are associated with pollination of plants.





Figure 1 – Temporarily natural landscapes formed on gray-brown soils with undisturbed vegetation

During the stages of evaluation methods for the development of vegetation on former pastures, it should be borne in mind that the role of domestic animals in the spread of plant seeds decreases or is absent at all. The proportion of the physical factor in the spread of seeds is increasing. However, it is methodically correct to allocate a terrain where winds dominate and terrain, where there is a relatively high water flow, which also contributes to the spread of different seeds and fruits of plants.

In Figure 1, in the temporarily natural landscapes formed on gray-brown soils, undisturbed vegetation to the horizon is seen. The use of temporarily natural pastures for grazing will begin already on more or less restored landscapes that are close to natural fertility.

The transition of the Republic of Kazakhstan development to market conditions caused a reduction in the acreage of agricultural production by 19308,3 hectares. Temporarily natural landscapes are characterized by a previously cultivated by 20-22 or 25-27 cm homogeneous arable layer, the economic removal of biophilic elements for 50-70 years, a peculiar herbage, mechanical compaction of the upper layers of landscapes with machinery wheels. A significant part of the developed territories is now also in natural conditions for more than 20-27 years.

For example, the field located on the western outskirts of Karamendy village has a certain vegetation, which was formed on dark chestnut solonchous soil (figure 2). The vegetation of this site differs from the natural one.



Figure 2 – Plot with vegetation on the soil surface

The field is temporarily natural due to the decrease in the anthropogenic load (TNL), which has not been cultivated for more than 20 years by cereals and perennial grasses. Currently, it is used as a pasture for local livestock. However, there is no noticeable etching or trampling of the terrain.



Vegetation on the field is represented by 95% fescue; the maximum height of plants reaches 60 cm, the panicles of fescue reaches a height of 23-30 cm. Very often there are plants of white wormwood. These are young plants in height of 5-20 cm. Geranium with 5-finger leaves in height from 5 to 15 cm are found somewhat less often than wormwood. Sometimes *Tanacetum millefolium* in height from 20 to 35 cm occurs quite often.

Feather grass rarely occurs. There is an *Astragalus* (Cinquefoil) in height from 13 to 43 cm, a plant with leaves of lanceolate form, reaching 8-16 cm in height. An umbellate plant with a height of up to 4 cm is even less common.

The surface of the soil is covered with vegetable litter by 20-30%. There is horse and cow dung on the field. Projective soil is covered by plants 50-60%.

This state of the field was reflected in another component of the landscape - the soil. In this case, the soil is both more inert, and as a "landscape mirror". Changes in the direction of restoration are associated with vegetation, but are barely noticeable, while at the same time there is a homogenized arable layer free from the treatments. This arable layer begins to differentiate slightly, as can be seen in figure 3.



Figure 3 – The beginning of the arable layer differentiation on a temporary natural field due to the reduction of anthropogenic load

On the territory of the "Naurzum State Nature Reserve" on June 21, 2016, an incision was laid. Coordinates: Latitude N 51 ° 39'119 ", longitude E 64 ° 12'245", Naurzum region, Karamendy village. The incision is laid in the east of the village Karamendy, 300 m from the meteorological site and 200-220 m from the columns; west of the high-voltage line, which passes at a distance of 100 m.

Here is how the 0-6 cm layer of soil looks like: gray, weak turf, rootlets, slightly moistened, loose, small lumpy, powdery, greasy, no effervescence.

We use new statistical data on the reduction of arable land for the period since 1990 as a maximum of 35182.1 thousand hectares and until 1999, as a minimum of 15285.3 thousand hectares. For 9 years



for the period of 1998-2006 arable land was at its minimum from 15285.3 thousand hectares to 18610.4 thousand. In the future, the growth of arable land was quite smooth and reached an area of 21,473.6 thousand hectares.

In figure 4 temporary natural landscapes formed on chernozems of southern carbonate soils with unbroken grass stands are shown. At the same time, this site could previously be subject to grazing, parking equipment and so on. At this time, we have seen the state of the field with the replacement of plant succession of the quasi-root state. According to available data on the vegetative composition of these soils, there are errors due to the lack of a comparative version of the virgin state.

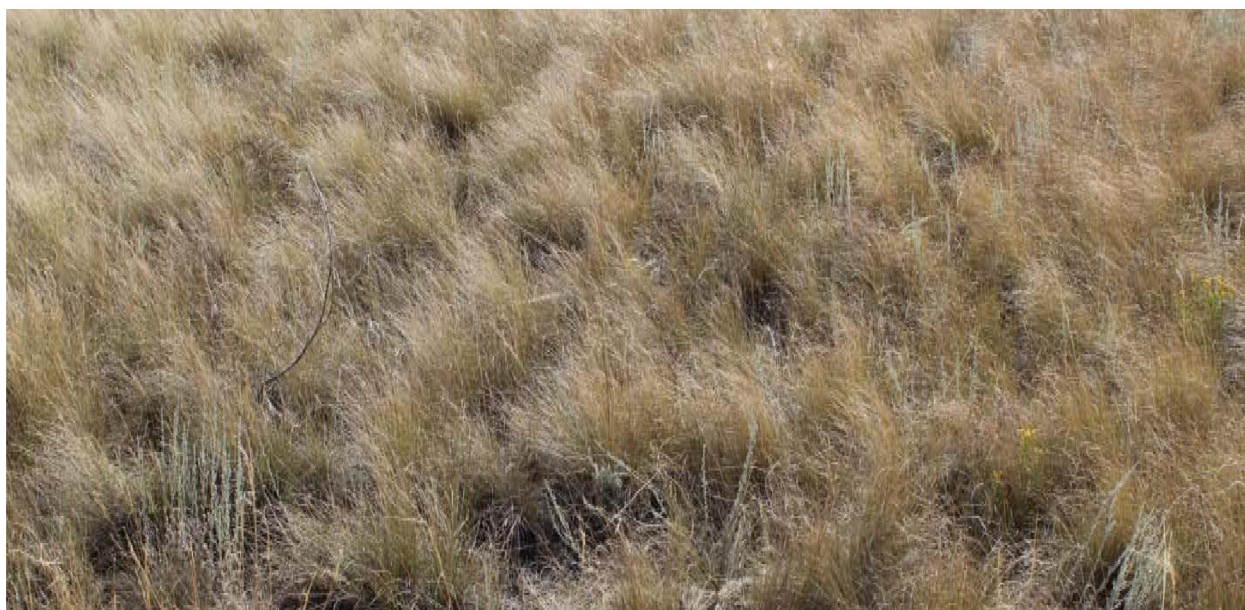


Figure 4 – Temporarily natural landscapes formed on the chernozems of southern carbonate with vegetation

Temporarily natural landscape formed on the southern carbonate chernozems with unbroken herbage, vegetation begins to accumulate vegetative litter on the soil surface. This is the beginning of the steppe felts formation.

According to the restored vegetation on the gray-brown soils of the foothill zone (taking into account the height and density of the grass stand), we expect the same successful development of plants on soils with more favorable conditions. Chernozems are a favorable condition for the development of plants.

**Conclusions.** Landscapes on the territory of the Republic of Kazakhstan have been used to varying degrees for decades, and then remained in natural conditions for a relatively long period. These landscapes should be classified as temporarily natural, since their functions have changed somewhat (neither agro landscapes nor natural landscapes) and they are able to influence the natural environment. At a certain succession stage, they have a restoration association, or a large phytomass, that has not yet been studied by vegetation, than they were in natural conditions. This phenomenon is associated with the influence of different natural and anthropogenic factors. This is of cognitive and scientific interest for establishing the role of the influence of various factors in each specific case.

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### **ҚАЗАҚСТАН РЕСПУБЛИКАСЫНДА ӨСІМДІК ҚАУЫМДАСТЫҒЫНЫҢ ӨЗГЕРУ СЕБЕПТЕРІ ЖӘНЕ ОЛАРДЫҢ ӘРТҮРЛІ ЛАНДШАФТАРДАҒЫ СУКЦЕССИЯСЫ**

**Аннотация.** Мақалада, әртүрлі жылдардағы экспедициясының деректеріне негізделе, ландшафтардың жай-күйін қарқынды пайдалану және сарқылу кезеңіне, жүктеменің күрт төмендету және қалпына келтіру кезеңіне, өсімдік құрамының квази-тамырлы кезеңі бойынша бөледі. Осындай әртүрлі табиғи-климаттық аймақтардағы өсімдіктердің жағдайы қазіргі замандағы топырақтық, геоботаникалық, экологиялық және басқа да зерттеулерге қызығушылық тудырады.

**Түйін сөздер:** кезеңдер, өсімдіктер, факторлар, жүктеме, жайылымдар, егістік жерлер, қалпына келтіру, климаттық аймақтар, ландшафт, ұзақтығы.

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### **ПРИЧИНЫ ИЗМЕНЕНИЯ РАСТИТЕЛЬНЫХ СООБЩЕСТВ И ИХ СУКЦЕССИИ НА РАЗЛИЧНЫХ ЛАНДШАФТАХ РЕСПУБЛИКИ КАЗАХСТАН**

**Аннотация.** В статье на основе экспедиционных данных различных лет делят состояние ландшафтов на период интенсивного использования и истощения, на период резкого сокращения нагрузки и начала восстановления, на период квазикоренного состояния растительного состава. Подобное состояние растительности в различных природно-климатических зонах представляет интерес для современных почвенных, геоботанических, экологических и других исследований.

**Ключевые слова:** стадии, растительность, факторы, нагрузка, пастбища, пашни, восстановление, климатические зоны, ландшафт, длительность.

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