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Editors

Ilia CHRISTOV

Eric STRAUSS

Abd-Alla GAD

Isa CUREBAL

Science, Ecology and Engineering Research in the Globalizing World

Managing Editor
Recep EFE



Ecological and Engineering Researches in the Globalizing World

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Comprehensive Analysis of Natural Agricultural Potential of North Kazakhstan Region

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INTRODUCTION

One of the most important factors in development and functioning of agriculture is natural agricultural potential. Natural agricultural potential means the combination of such natural conditions and resources required for development of agriculture and agricultural production as geological and geomorphological features, climatic and hydrological conditions, land resources, soil, biological and landscape features and their qualitative and quantitative performance. The combination of the features creates various preconditions and opportunities for agricultural production.

Natural agricultural potential has a significant impact on industrial structure, territorial arrangement and nature of agricultural production. For agricultural production to function, it is important not only to have and favorably combine natural potential components, but also to use them effectively and efficiently.

The **purpose** of the research is to conduct a comprehensive analysis of the main natural agricultural potential components of North Kazakhstan Region.

The **object** of the research is the territory of North Kazakhstan Region.

The **subject** of the research concerns natural conditions and resources of North Kazakhstan Region determining its natural agricultural potential.

MATERIALS AND APPROACHES OF THE RESEARCH

The information and analytical base of the research included maps (Anonymous 1-5). and archive and published materials (Anonymous 6; Zemtsov et al., 1988; Volkov, 1965; Fyodorovich, 1960; Bezsonov 1960, Abdulova et al, 2001, Anonymous 7, Gribskiy, 2004; Anonymous 8, Geldiveya, 1992; Nikolayaev, 1999).

In this research we applied the following methods: comparative-geographical and cartographic approaches, system analysis and a complex of landscape-

geographical and field methods.

RESULTS OF THE RESEARCH AND THEIR DISCUSSION

Basing on the analysis of different works concerning the study of agricultural natural potential of various territories (Romanova, 1994; Kadyshchinskaya 1989; Yatsukhno 1988; Nikolayev, 1985; Ishmuratov, 1985; Kaverin, 1995; Subbotina, 1993) we identified the following main components of natural agricultural potential: geological and geomorphological, agro-climatic, hydrological and soil components, vegetation potential of natural forage lands and landscape features and arrangement of the territory.

Geological and geomorphological potential

North Kazakhstan Region is located in the North of the republic. Most of its territory is located within the southern rim of the West Siberian Plain while the South-Western part of the region belongs to the North-Western outskirts of the Kazakh Hummocks.

The terrain of the plain part of the region is characterized by weak dissection, undulation and continuous overall surface slope to the North and the North-East. Average height of the plain lands in the region equals to 125-200 meters above sea level. The minimum elevations are in the basins of quite large salt lakes in the southeastern part of the region. The lowest point of the surface is in the basin of Lake Teke and equals to 29 meters above sea level (Anonymous 6).

The Yesil river in its meridian direction divides the region into the left-bank and the right-bank areas. The left-bank side can be characterized by a clearly hollow-hilly-ridged terrain and an abundance of lake basins and depressions. The right bank side is an even plain split in the East-North-Easterly direction by Kamyshlovsky ravine, a wide depression with flat bottom. The specific features of the right-bank side are numerous depressions and inland flat-bottomed degradations with no clear terrain design. The plain part mostly includes surface microrelief in the form of numerous and various indentations, small hollows and various flat, low-arched micro-ridges widespread (Zemtsov et al., 1988; Volkov 1965).

The southwest of the region has low-hill terrain with wavy ridged rock-defended denudation plains. These are mostly leveled plateaus with separate low mountain groups and hills. The terrain here is divided into several tiers with height range from 230-300 to 360-400 meters. The peaks of some mountain ranges are elevated to 600-700 m. Here can be found the highest point of the region – Zhaksy-Zhangyztai – of 730 meters (Anonymous 6).

The structure of the region terrain is subject to the peculiarities of tectonic and geological structure and lithological composition of the territory.

From the point of view of tectonics and geology the main area of the region is the southern edge of the young epipaleozoic West Siberian plate consisting of two floors. The lower floor consists of the foundation made of metamorphosed rocks of Precambrian and early Paleozoic age, broken by cracks and threaded by intrusions. The upper floor forms a cover of soft sedimentary rocks accumulated at the bottom of ancient seas, rivers and lakes in the Mesozoic and Cenozoic age. The capacity of

the sedimentary cover varies from a few meters in the South to 2,000 meters in the North (Volkov 1965).

The southern and southwestern part of the region is located on the Northern edge of the Caledonian Kokshetau-North-Tien-Shan fold belt. Within the region it is formed by Sarysu-Kokshetau bending fold developed in the middle-late Paleozoic. One of its structural elements is the North Kazakhstan arch, expressed in the terrain by the Kokshetau highlands. The elevation is composed of rocks of granite composition that form a dissected folded terrain while being exposed to longtime denudation and weathering (Anonymous 7, 8)

Tertiary deposits of the region are mainly represented by continental Oligocene and Neogene rocks. Almost everywhere tertiary rocks are covered with Quaternary deposits, the upper part of which consists of a cover of loess-like sediments. The capacity of the top loess-like deposits is not uniform. They vary by complex structure and conditions of occurrence and are represented by ancient lake, meander and alluvial deposits (Volkov 1965, Anonymous 8).

Agro-climatic potential

The territory of North Kazakhstan region belongs to the continental steppe West Siberian climatic region. The climate of the region can be characterized as sharply continental due to the geographical position inside the mainland, remoteness from the oceans, predominance of plain terrain and domination of moderate air masses.

Sunshine duration per year is an average of 1,900-2,000 hours. Total solar radiation is around 95 kcal/cm² a year. The radiation balance in the region varies from 23-24 kcal/cm² in the North to 27-28 kcal/cm² in the South; it is negative from November to March.

The average monthly temperature of the coldest month (January) is -18.50°C, -19.50°C and of the warmest (July) is +18.80°C, +19.50°C. The average annual temperature is from +0.300°C to +1.200°C. The average annual range of air temperature reaches 37°C, the absolute temperature range is about 85°C (Abdulova 2001; Anonymous 9).

Winter is long, cold, with steady subzero air temperatures, strong winds and frequent snow storms; it lasts more than 5 months. Spring is short, dry and cool. Summer is warm, short and, despite the relatively large amount of precipitation, dry. The duration of the warm period ranges from 188 to 195 days. Autumn is cool, cloudy, and often rainy.

The average annual amount of precipitation in the region is in the range of 300-350 mm. Precipitation patterns vary as by months and by season. The territory of the region is characterized by a continental course of precipitation where the maximum falls in June-July and the minimum is observed in February-March.

The duration of stable snow cover is 150-170 days. In snowy winters its height can reach up to 50 cm while in dry winters it goes up to 10-15 cm.

The average annual wind speed is 4-5 m/s. The highest speed is observed in winter, especially in February-March (6.4-6.7 m/sec), the lowest – in August (3.6-4.3 m/sec). During the year, the prevailing winds are of western direction (Anonymous 6, 8).

Hydrological potential

Surface waters of the region are formed by the Yesil river, small rivers of internal drainage such as Koluton, Zhabay, Akkanburluk, Imanburluk with Saryozek, Terysakkan etc., numerous lakes and swamps. The Yessil with its side streams is transit and belongs to the Ob river system; the rest rivers belong to the basin of internal drainage.

The rivers are mainly snow-fed. More than 80% of annual runoff is formed by melt water. A small share falls on warm season precipitation and soil nutrition. The rivers behaviour is featured by significant spring floods.

The average annual layer of river runoff in the region ranges from less than 5 mm to 30 mm. the average annual runoff of the Yesil is about 2.5 m^3 , the flow rate is $76.0 \text{ m}^3/\text{sec}$ (Anonymous 2).

The number of lakes in the region varies between 2,500 and 3,500; their total area is 452430.5 ha. The lakes are uneven allocated. Average lake percentage for the region is 4.62%. The largest lakes are: Seletyteniz – 750.3 km^2 ; Ulken Karoy – 305.5 km^2 ; Shagalalyteniz – 267.4 km^2 ; Teke – 256.6 km^2 . Mainly lakes have a basin area not exceeding 1 km^2 . Most of them are 1.5-2.5 m deep (Anonymous 6).

A characteristic feature of the lakes is their periodic drying and filling during the year, as well as by years, with filling periods less long.

Chemical composition and water salinity of lake water varies a lot. The lakes belonging to hydrocarbonate and chloride classes prevail. According to alkaline-acidic properties of water the lakes belong to the class of neutral and slightly alkaline lakes. Water salinity in the lakes ranges from 0.4 to 300 g/l. 54% of the lakes of the region belongs to brackish lakes, 38% of lakes are fresh lakes. Total fresh water reserves in the lakes of the region are more than 4 billion m^3 (Anonymous 6, 7).

Swamps are found throughout the region. The area of swamps is about 41.1 thousand hectares.

There are several aquifer systems confined to rocks of different age and composition within the region. The depth of aquifers varies from 1.5 to 25 m or more. Groundwater supply is mainly dependent on circulation of atmospheric precipitation. The main area of aquifers feeding is located within the Kazakh Hummocks. The average long-term pattern of underground runoff in the plain part of the region is 0.1-0.2 l/sec from 1 km^2 , and within the Kokshetau highlands it reaches 0.8 l/sec from 1 km^2 . The total groundwater salinity ranges significantly from 0.2 to 64.0 g/l [2, 6]. The southern part of the region is dominated by fresh waters and the North and North-East – by brackish and salty.

Soil potential

The territory of the region is characterized by heterogeneity of soil formation conditions; this causes diversity and complexity of the soil cover, their high complexity.

The zonal components of the soil cover of the region contain of grey forest soils combined with leached chernozem soils in typical forest subzone and chernozems in outlier forest-steppe and semi-dry steppe in the North; and southern chernozems in the conditions of dry steppes and chestnut (normal dark brown and

alkaline) soils within dry steppe at severe moisture deficit – in the South (Anonymous 8).

Chernozems are performed by all main types, subtypes and kinds of soils of the Chernozem zone of the West Siberian lowlands. The following kinds of black soil can be defined within the region: ordinary normal (non-alkaline), ordinary calcareous, ordinary alkaline, ordinary fused, weakly developed or underdeveloped soils.

Meadow, meadow-marsh and marsh soils spread within inundative degradations, depressions at watershed areas, low terraces of lakes and swamps, gullies and bottoms of ancient flow channels of the region.

Depressions under birch and aspen-birch groves have soloth soils.

Alkali soils are very wide spread and are the most common component of soil systems in the region.

Salt marshes are confined to low terraces and bottoms of drying and dried salt lakes, ancient shallows of runoff and inter-ridge depressions.

Alluvial soils have been developed in the valley of the Yesil river, and are also found in some part of meander area of the Iman-Burluk river (Anonymous 7, 8, Gribskiy 2004).

Vegetation potential of natural forage lands

The territory of the region is represented by about 700 species of higher plants that belong to more than 70 families. The most widely spread families are aster family – more than 100 species, gramineous family – more than 60 species, labiatae family – about 40 species, rose family – about 40 species, caryophyllaceous family – more than 30 species, cruciferous family – more than 30 species, umbelliferous family – 30 species, and bean family – about 30 species. Other families represented in the region include an average of 10-20 species of plants (Anonymous 6).

North Kazakhstan region is located at the junction of two natural zones – forest-steppe and steppe. This fact significantly affects features of the vegetation cover.

The main forest-forming species in forests of typical forest-steppe subzone are a warty birch and a downy birch. Treeless spaces are occupied with steppified meadows and meadow steppes. Indigenous vegetation is formed by needle grass, grain and mixed herb plant groups.

The subzone of outlier forest-steppe has an alternation of forest areas (outliers) with rich mixed herb and needle grass steppes. Forests cover depressions. Forest-forming species are a downy birch, sometimes a warty birch, and aspen. Grass cover consists of forest, meadow and meadow-steppe plants (Anonymous 7, 8).

Inter-outlier space is occupied by steppe plant communities: rich mixed herb and red feather grass at elevations with ordinary chernozems; rich mixed herb and needle grass at non-alkaline and calcareous chernozems; rich mixed herb and needle grass with field wormwood are limited to the tops of ridges and well-drained areas adjacent to the Yesil river; mixed herb, meadow saxifrage and needle grass in the South of outlier steppe, mostly on the right bank of the Yesil, at the ordinary and alkaline chernozems (Anonymous 8).

Complexes of wormwood-fescue and goldilocks-fescue associations are also

widespread due to small drainage and salinization of soils in the subzone of outlier steppe.

The subzone of semi-dry steppe is dominated by rich mixed herb and red feather grass, and needle grass, mixed herb and red feather grass groups at the ordinary and calcareous chernozems interspersed with sedge-willow thickets on water-logged depressions.

Dry steppe with southern chernozems the grasses are represented by xerophilic sod grasses; a significant part belongs to wormwood. Vegetation of dark chestnut soils includes grain-wormwood groups with some wormwood-saltwort associations (Anonymous 5).

Rock outcrops of mountain-hilly terrain in the southwest of the region consist of pine forests with an admixture of birch and aspen. The grass layer is poor and dominated by lichens. Hills and low hill degradations are overgrown with needle grasses and mixed herbs (Anonymous 7).

Alkali soils are confined to salt-resistant halophytic fescue-wormwood groups while salt marshes are spread by a saltwort.

Internal-drainage depressions are occupied by meadow steppe plant associations. Lakeside depressions are confined to grain and mixed herb groups. Water-logged depressions are overgrown with bulrush, cattail, reeds and sedge. The floodplain of the Yesil has various meadow communities and a lot of moisture-loving plants and sedge marshes.

Landscape features and arrangement of the territory

The territory of North Kazakhstan region, despite the overall plain type of the terrain, has rather a complex and heterogeneous landscape structure with a large set of geosystems. Various natural complexes can be found within it including plain uplands, valley and lake-basin landscapes and hummock-hilled landscapes in the South-West of the region (Anonymous 6).

The landscape structure of the region as a whole is characterized by clear zonal differentiation of geosystems, associated with an increase of incoming solar heat and simultaneous reduction of atmospheric moisture from North to South.

Along with zonal landscapes, the natural complexes that were formed due to the influence of different azonal (intra-azonal) factors, such as development and widespread of meso- and micro-landforms, nature of groundwater occurrence, or complexity of soil cover, have become widespread. Landscape arrangement of the territory is greatly influenced by the valley of the Yesil and its side streams, as well as small temporary streams, ancient flow channels, and numerous lakes.

Dominant zonal landscapes of forest-steppe natural zone are flat and undulating, as well as ridged and hollow upland plains with rich mixed herb and grain steppified meadows at leached chernozems, ordinary chernozems and meadow-chernozem soils, and birch and aspen-birch forests and groves on gray forest and soloth soil (Anonymous 6, 7, 10; Geldiyeva 1992).

The North-Western edge of the Kokshetau highlands is spread by forest-steppe natural complexes of hilly plains with individual hummocks and ridges with steppified pine and birch forests and groves at the ordinary chernozem, sod-cryptopodzol gravelly and soloth soils (Anonymous 7, 8).

Dominant zonal landscapes of uplands of the steppe zone are flat and undulating, as well as hollow-hilly-ridged plains with mixed herb and red feather grass vegetation at ordinary chernozems and meadow-chernozem soils and hollow-hilly plains with needle grass, fescue and wormwood vegetation at calcareous chernozems (Anonymous 7, Geldiyeva, 1992, Nikolayaev, 1992).

Intrazonal (azonal) natural complexes are represented by intrazonal forests along the valley of the Yesil river, and meadow, meadow-steppe, alkali-meadow-steppe, alkali and alkali-salt marsh natural complexes (Anonymous 6).

CONCLUSIONS

The comprehensive analysis of natural conditions and resources of the North Kazakhstan region showed that its territory is characterized by sufficiently high natural agricultural potential for development and functioning of agricultural production. In general, the main components of the natural agricultural potential and their combination create quite favorable conditions and various opportunities for agricultural production in the region.

The study of natural agricultural potential allows explaining of the laws of territorial arrangement of agriculture, determining the ways of further development and improvement of agricultural production. One of the important issues in this direction is rational and effective involvement and use of natural agricultural potential. An important tool to address this issue may be the assessment of agro-resource potential and agro-resource zoning.

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