PAPER • **OPEN ACCESS**

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To cite this article: S T Toksanbaeva *et al* 2022 *IOP Conf. Ser.: Earth Environ. Sci.* **954** 012087

Current state and prospects for the development of agricultural land in the Nura River basin

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Abstract. The Nura River basin is located on the territory of Central Kazakhstan and is a single territorial-production structure with a developed industry that plays an important role in the economy of the entire Kazakhstan. Effective industrial development should be based on the well-tailored farming industry. However, significant continentality of the target basin, along with orographic conditions, predetermines high heat and power and scarce water resources, which negatively affect the crop productivity. The paper analyzes the current status of land reserves nearby the Nura River basin, with due account for climatic conditions and water availability, considers the modern composition and structure of cultivated areas, indicating the leading sectors constituting the farming industry, and also outlines the main directions and prospects for the development of agriculture for the coming period. It provides the rationale for sustainable agriculture along with industrial development of the basin. Due to the location of the basin in the zone of dry steppes and semi-desert zones, the paper shows the need to use irrigation reclamation as the main way to increase the crop yield.

1. Introduction

The Nura River basin is located within the Kazakh Uplands between 51° and 48° north latitude and 68° and 77° east longitude, has an elongated shape from the southeast to the northwest. The average length of the basin in the northwest direction is about 550 km, and in the northeast direction – about 200 km. The upper part of the basin occupies the most elevated part of the Kazakh Uplands, which is a peculiar, highly heterogeneous geomorphologically, highly elevated territory. At an altitude of about 1,100 m, on the northern slopes of the Kyzyltas low mountains, is the source of the Nura River that runs into Lake Tengiz located at an elevation of about 304 m. The total catchment area is 60.8 thousand km^2, the length of the river is 978 km, the total drop is about 800 m. The river belongs to an internal drainless basin and is a large river of the Nura-Sarysu basin.

From an administrative and territorial perspective, most of the Nura River basin (upper and middle) is located within the Karaganda region, with its lower reaches to cover the southern outskirts of the Akmola region, mainly within the Tengiz-Kurgaldzhinsky depression. The river basin is represented by 13 districts of the Akmola and Karaganda regions and 1 administrative center of the Karaganda region (Figure 1 and Table 1).

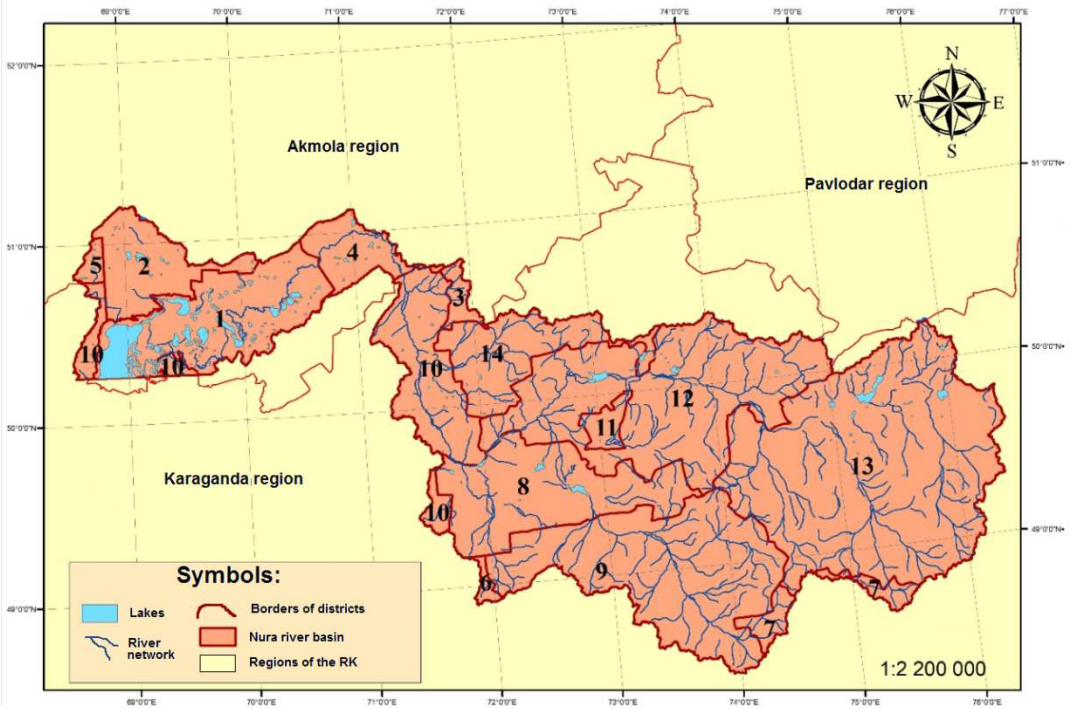

Figure 1. Map of districts by administrative division of the Nura River basin

Table 1. Data for the Nura River Areas

No.	Districts	Regions	Center	Square, km^2
1	Korgalzhynsky	Akmola	Korgalzhyn	6,349
2	Egindykolsky	Akmola	Egindykol	3,071
3	Arshalynsky	Akmola	Arshaly	520
4	Tselinogradsky	Akmola	Koktal	1,874
5	Atbasarsky	Akmola	Atbasar	328
6	Zhanaarkinsky	Karaganda	Atasu	219
7	Aktogaysky	Karaganda	Aktogay	1,106
8	Abaysky	Karaganda	Abay	6,500
9	Shetsky	Karaganda	Aksu-Ayuly	10,496
10	Nurinsky	Karaganda	Kievka	5,373
11	Karaganda	Karaganda	administrative center	498
12	Bukhar-Zhyrausky	Karaganda	Botakara	12,033
13	Karkaralinsky	Karaganda	Karkaraly	18,915
14	Osakarovsky	Karaganda	Osakarovka	3,759

The climate in the central part of the Upland is characterized by large annual and daily air temperature amplitudes, hot and dry summers, severe winters with little snow. A highly dissected small hillocky area forms local climate features and is characterized by even more arid conditions with much continentality and a small amount of atmospheric precipitation (300-350 mm).

The continentality is due to the protection of the territory from the west by the Ural ridge and from the east by the Central Siberian plateau and Altai. Being open from the south and north contributes to the invasion of dry and hot air masses from the South Kazakhstan and Central Asian deserts in the summer and the flow of cold air from the Arctic seas in the winter.

The main part of the territory falls within the arid steppe zone, except for the upper reaches of the river, located in the semi-desert zone.

Surface runoff from the target territory is generated mainly by meltwater. A significant part of the runoff is accumulated in lakes and microdepressions and is spent on evaporation and filtration. Due to high temperatures in summer, a deficit of air humidity and dryness of the soil are so great that rainfall is almost completely spent on wetting the upper soil layer and evaporation and has no practical significance in the formation of runoff.

Ground water inflow to most rivers in the target area is not sufficient, or is completely absent in temporary watercourses. The Nura River alone, as well as its large tributaries, get sustainable groundwater inflow.

Despite different physical and geographical conditions in the catchment area, the rivers of the basin have some hydrological features in common: the annual runoff occurs almost exclusively due to spring meltwater, a large variability of annual runoff volumes, low summer, autumn and winter low-water periods, and for most small tributaries, complete cessation of runoff after spring flood [1].

A significant fragmentation of the basin, along with climatic, geological and hydrological impacts, imposes a number of typical features on the soil cover of the target territory of the region. The tops of ridges and hills are covered with brown rubble, while gentle slopes are covered with loamy soils. In the central part of the hillock, dark chestnut soils prevail. The southern regions of the Kazakh Upland are represented by light chestnut soils. The soil cover of the semi-desert zone consists of light chestnut, brown and gray-brown soils. In this zone, in low areas with clay soil, salt licks and salt marshes occupy a significant area. The soils are mostly thin and low-humus, which determines the relatively low productivity of the vegetation cover.

2. Problem statement

The difference between agricultural production and other industries and its specific features lie in the fact that agriculture is not only a sphere of production, but also a sphere of life for a vast majority of the nation. The rural economy and rural settlements are inextricably linked: rural settlements were historically founded around agricultural activity and ceased to exist as soon as the latter ceased to exist.

Modern history only proves this pattern: the crisis in agricultural production entailed an outflow of the population and collapsed life support systems in rural settlements. Reforms in agricultural production, transferring it to market rails, the use of marketing strategies to assess the growth of agricultural potential have exposed the problem facing the rural population.

The wider objective of agricultural production is to obtain high and stable yields by attracting labor resources. What is more, sustainable growth of the industry requires development of industrial enterprises and the service sector. In other words, with the development of the national economy and its industry, agriculture should also develop.

The largest in the Republic of Kazakhstan Karaganda-Temirtau industrial company is located nearby the Nura River with the key industries including mining (coal), mining and processing of mineral raw materials, ferrous and nonferrous metallurgy, machine-building and metalworking enterprises, production of building materials, light and food, fuel and energy, woodworking and petrochemical industries.

Sustainable development of industrial enterprises is unthinkable without appropriate support to agricultural producers [2]. In this regard, development of the farming industry is an urgent task towards the Nura River basin. The main task, though, is the efficient use of land reserves, with due account of the heat and power and water resources of the basin in order to increase the yield and volumes of agricultural products.

3. Materials and methods

The current status of land reserves. The land reserves nearby the Nura River basin make up 142.27 thousand km^2 and stretch within the territories of the Akmola and Karaganda regions, which is 24.78% of the total area of the two regions – 574.2 thousand km^2.

Most of the land available, being located on the territory of the Karaganda region, is expected to shape the priorities set by the farming industry that provides agricultural products to the industrially developed part of central Kazakhstan [3, 4]. With this in view, a huge role in providing the population with agricultural products, within the territory under consideration, is assigned to the production of meat, milk, vegetables, fruit and berry crops and grain.

With the natural and climatic conditions that have come together over many years to be presented as significant heat and power and scarce water resources, the promotion of irrigated agriculture is of great importance for obtaining sustainable crop yields.

Composition and structure of the cultivated areas. The wider objective pursued by the farming industry is to meet the needs of the population for food, industry for raw materials, ensuring the production of forage in quantities required by animal husbandry. Based on the specific challenges facing the agriculture of a particular region, a certain line of activity is shaped in a way that governs the composition, structure and use of the land available.

The target territory is located within two natural and economic zones that specify priority projects of agricultural production in this area.

As compared with other areas, the leading branch of agricultural production in the target basin is animal husbandry engaged in breeding cattle for meat and dairy products. An important component of the regional food base is crop production that accounts for 21% of the agricultural industry.

A huge portion of areas sown is occupied by grain crops – 79.09%, including wheat – 72.23%, forage crops – 19.94%, industrial crops – 0.04%, potatoes, vegetables, melons – 0.92%. Thus, agriculture in the region is subordinated to the production of grain, especially spring wheat and fodder.

Irrigated agriculture is primarily represented by the cultivation of potatoes, vegetables, melons and fodder crops – 78.55%. However, the share of sown areas on irrigated land is only 0.41% of the total. This is mainly due to poor water availability in the territory and currently remains a priority area of agricultural production in the basin.

4. Results and discussion

Prospects for the development of agriculture. Large heat resources in the target basin [5] coupled with poor water resources lead to a significant drying out of soil in summer. The soil moisture resources are not able to provide favorable conditions for sustainable growth and development of crops. Everywhere, during the growing season, there is a lack of moisture in the soil, which negatively affects the productivity of cultivated plants [6]. In such cases, water balance alteration in the root layer, to a level sufficient for optimal growth and development, can be achieved by artificial soil moistening.

Irrigation is one of agrotechnical land reclamation techniques aimed at improving the water-physical properties of the root layer by artificial moistening of soil. Due to additional supply of irrigation moisture, the volumes of biomass of agricultural crops and their yield increase significantly.

However, the widespread use of irrigated agriculture is hampered by the scarce water resources of the Nura basin. In this regard, the further growth of agricultural products is primarily achieved through the most careful management of water resources. Moisture deficits and irrigation rates should be estimated based on the methods that most fully reflect zonal and local conditions of heat and moisture supply in the basin, taking into account long-term temperature fluctuations. A widespread integration of modern systems and methods of irrigation, as well as improvement of a reclamation state of irrigated agriculture, is of great importance for the efficient use of water resources. An increase in the yield of each hectare can also be achieved by optimizing the structure of sown areas, promoting scientifically grounded crop rotations, exploiting gentle methods of tillage through modern technology, as well as integrated types of reclamation of the root layer of soil [7].

A cluster approach applied in vegetable growing and potato growing through vegetable microclusters should be considered as the most effective method for promoting sustainable development of rural areas and solving the socio-economic problems of the regions located within the basin [8].

An important area of effective use of land reserves is the expansion of cultivated areas by using fallow lands. Along with this, the volume of crop production increases up to 1.2 times. Another important principle in increasing the cultivated area is reclamation development of salt marshes that are most common in lowland areas. Moreover, it should be borne in mind that improving the condition of saline soils will require certain labor and time resources.

The most promising direction for agricultural development in the grain industry can also be attributed to the determination of priority areas for increasing the economic efficiency of durum wheat production [9].

5. Conclusion

Having evaluated the current state of agricultural production, soil and climatic conditions in the Nura River basin it is clear that to ensure further growth of crop production, livestock products, industrial crops, vegetables, melons and potatoes, sustainable use of land and water resources should be provided. The combination of natural and economic factors characterizing the region suggests that there are all opportunities for an effective increase in agricultural production.

A crucial factor in improving crop production is increased crop yields and the most efficient use of irrigated land. Currently, the irrigated areas used occupy 0.88% of arable land and perennial plantations and provide 3.39% of all agricultural production. With the existing significant fluctuations in yields on rainfed cropland, production increases on ameliorated lands. However, the current state of agricultural production on irrigated lands indicates that agricultural production on irrigated lands is still low.

Here, along with organizational and economic reasons, a certain share of low yields from an irrigated hectare accounts for irrational use of water resources, low water supply, under-watering, a low level of operation and organization of irrigation, as well as imperfection of irrigation systems and structures.

A cluster approach applied in vegetable growing and potato growing through vegetable microclusters should be considered as the most effective method for promoting sustainable development of rural areas and solving the socio-economic problems of the regions located within the basin.

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