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TERRITORIAL EFFICIENCY OF USE OF IRRIGATED LANDS IN BUKHARA REGION

Abstract. *This article is devoted to irrigated land, an important component of the natural resource potential of rural areas in the Bukhara region, and to an assessment of the efficiency of its use. General characteristics of the land fund and irrigated agricultural land in the region are examined, including their dynamics over time. Indicators of the availability of irrigated land in the districts are analyzed. The efficiency of irrigated land use by rural district is calculated using indices representing the ratio of the district's share in the gross agricultural output of the region to its share in the irrigated land fund of the region. The economic efficiency of irrigated agricultural land use in the districts of the Bukhara region is also calculated using the value of gross agricultural output at current prices per hectare of irrigated land. The article concludes with proposals and recommendations for improving the efficiency of irrigated agricultural land use in the region.*

Key words: *Bukhara region, rural districts, irrigated lands, territorial efficiency, index, intensive use, extensive use.*

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ТЕРРИТОРИАЛЬНАЯ ЭФФЕКТИВНОСТЬ ИСПОЛЬЗОВАНИЯ ОРОШАЕМЫХ ЗЕМЕЛЬ В БУХАРСКОЙ ОБЛАСТИ

Аннотация. *Статья посвящена важному компоненту природно-ресурсного потенциала сельских районов Бухарской области – орошаемым землям, а также оценке эффективности их использования. Рассмотрены общие характеристики земельного фонда и орошаемых сельскохозяйственных угодий области, в том числе, в динамике. Проанализированы показатели обеспеченности районов орошаемыми землями. Эффективность использования орошаемых земель в разрезе сельских районов рассчитана в виде индексов, представляющих собой отношение доли района в валовой сельскохозяйственной продукции области к его доле в фонде орошаемых земель области. Также экономическая эффективность использования орошаемых сельскохозяйственных угодий районов Бухарской области рассчитана через величину валовой сельскохозяйственной продукции в текущих ценах, приходящуюся на 1 гектар орошаемых земель. В заключении статьи приведены предложения и рекомендации по повышению эффективности использования орошаемых сельскохозяйственных земель региона.*

Ключевые слова: *Бухарская область, сельские районы, орошаемые земли, территориальная эффективность, индекс, интенсивное использование, экстенсивное использование.*

Introduction and problem statement. The quality of irrigated land is directly related to the global distribution of the world's population and is characterized by future trends in the use of these resources in agriculture. The sustainable use of land for food production is under threat due to inefficient use of irrigated land, loss of fertile land due to urbanization and industrialization, as well as future changes in population lifestyles, climate change, and the reduction of fresh water supplies worldwide. According to the Food and Agriculture

Organization of the United Nations (FAO)[1], irrigated farming systems consume 70 percent of the world's freshwater and account for 20 percent of the world's arable land. By 2050, agricultural production will need to increase by 60 percent worldwide, and by almost 100 percent in developing countries, just to meet the demand for food. This requires the rational use of irrigated lands in agriculture, the study of ways to restore and increase soil fertility.

In order to significantly improve the use of irrigated lands in agriculture, special attention is paid to meeting the projected needs for food and agricultural products, and to identifying the growing need for land resources and territorial variability in their use. Priority is given to developing the most effective options for an integrated approach to the study of all types of irrigated land use, linking socio-economic development with environmental protection and improvement, coordinating the distribution, planning and management of activities related to various aspects of land resource use, and improving the territorial organization of land resource use and its structure.

The issue of rational use of natural resources, including irrigated land resources, has been widely discussed in recent years. This process is especially important in countries specializing in the agricultural sector, in particular in Uzbekistan. The organization of rational use of land resources mainly pursues two goals, namely the effective use of land resources and their protection. In determining the efficiency of the use of irrigated land, as in other production processes, economic factors are of great importance. High productivity per unit of their yield, the usefulness of the amount per capita, etc. If efficiency is expressed in the example of a territory (region, province, district), it can be recognized as territorial efficiency.

Study of the problem. Irrigated lands are mainly an important object of research in agriculture, economics and geography. Much work has been done in this regard within the framework of the disciplines of geography, and these studies focus on the sectoral (agriculture, in particular, farming) and territorial (economic region, region and district) characteristics of irrigated lands. To this end, these lands are being studied by a number of researchers in many regions of our country within the framework of the above-mentioned goals. In particular, the irrigated lands of the Zarafshan economic region have been studied for agricultural and other purposes in different years (J.H. Thunen [22, 23], A.N. Rakitnikov [20], Z.M. Akramov [3], A.S. Saidov [21], F.M. Rahimboyev [18], D.Sh. Yavmutov [25], A.R.Rakhmatullayev [19], Sh.B.Kurbonov [8], V.N.Fedorko [5] J.A. Namozov [12, 13, 14]). However, the quantitative and qualitative indicators of these lands have not been considered separately, they have not been specifically studied within the territory. In this work, it is precisely these aspects that are given greater importance, and irrigated lands for agricultural purposes are analyzed separately by land type.

Aim and objectives of research. To calculate the efficiency of the use of irrigated land by districts using their agricultural production. Within the framework of this goal, the territorial efficiency of using irrigated land resources, the efficiency of using irrigated land resources, and the differences in the use of irrigated land in the studied districts were calculated.

Materials and methods. The territorial efficiency of agricultural production was first used by the German scientist Johann Heinrich von Thunen (1783-1850). On this basis, work on the location and development of this sector was carried out on economic geography [22, 23].

This work used statistical analysis, interregional comparisons, and mathematical methods. To clearly show absolute indicators, they were expressed in a certain ratio (percentage). Efficiency was calculated in indices relative to the average indicator of the region. Here, the indices were determined by the ratio of relative indicators (percentages). The efficiency of irrigated land use was shown in coefficients. They, in turn, were expressed in relative indicators.

[1] UNEP, 2011, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication (http://www.unep.org/greenekonomy).

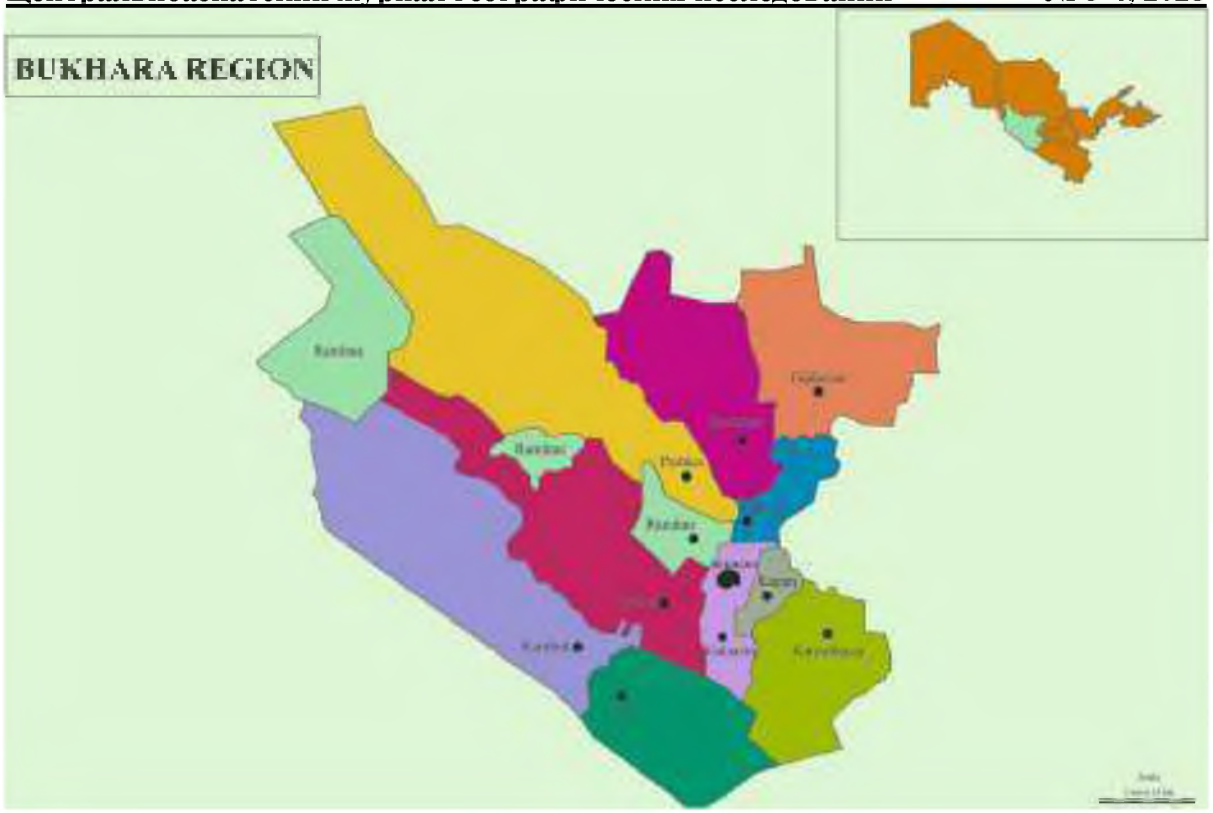

Figure 1. The map scheme of Bukhara region

Results and discussion. In terms of irrigated land provision, Bukhara region has an average indicator. It should be noted that almost all land types here are open-field, and there is no shifting cultivation. The total area of irrigated land (280.3 thousand hectares) is slightly more than a third of the Zarafshan economic region (35.7%), 6.5% of the republic. These land resources have increased by almost 7,000 hectares over the past quarter century (273.7 thousand hectares in 2000). There are a number of differences in the provision of irrigated land in the region, and the factors that cause this can be attributed to the geographical location of the districts, water supply, etc. In general, Jandar, Shafirkan and Bukhara have more of these lands, while Kagan and Karaulbazar have the opposite. Jandar district is also the leader in terms of irrigated arable land (24.8 thousand hectares), while Karaulbazar is in last place (7%). The difference in agricultural production is not so great [8, 9].

The production of agricultural products in the region also has its own characteristics, and as mentioned above, all of it belongs to arable land. According to data from 2025, agricultural products worth 41,039.4 billion soums were produced in the region. 47.9 percent of it belongs to agriculture, and the share of livestock farming is 21,384.4 billion soums. Over the past 15 years, the share of agriculture (1,364.9 billion soums in 2010) has decreased by 8.4 percent, while livestock farming has naturally increased by the same amount. The emergence of this situation can be directly attributed to issues related to water resources. At the district level, Jandar and Gijduvan districts dominate. Excluding urban areas, Karaulbazar has the lowest figure, providing 2.7 percent of the region's agricultural supply (Information from the Bukhara Region Statistics Department, 2024) [7].

Table 1

The share of districts in the production of agricultural products by the provision of irrigated land

№	Districts	Availability of irrigated land (in hectares) R_{il}	Share in agricultural production (in soums) R_a	Agricultural products per hectare of irrigated land (in billion soums) and index
1	Bukhara	28048	4416,6	157,5
		10,0	10,8	1,080
2	Jandar	33453	5238,4	156,6
		11,9	12,8	1,076
3	Kagan	19152	2837,0	148,1
		6,8	6,9	1,015
4	Alat	21967	2704,6	123,1
		7,8	6,6	0,846
5	Peshku	22890	3907,0	170,7
		8,2	9,5	1,159
6	Karakul	27059	3778,3	139,6
		9,7	9,2	0,948
7	Karaulbazar	16423	1111,5	67,7
		5,9	2,7	0,458
8	Ramitan	27657	4351,4	157,3
		9,9	10,6	1,071
9	Vabkent	25182	3651,6	145,0
		9,0	8,9	0,989
10	Gijduvan	27437	4741,7	172,8
		9,8	11,6	1,184
11	Shafirkan	28376	3636,7	128,2
		10,1	8,9	0,881
By region		280247	41039,4	146,4
		100	100	1,000

The table was compiled by the authors based on data from the Cadastral Agency under the Ministry of Economy and Finance of the Republic of Uzbekistan and the Bukhara Regional Statistics Department for 2024.

Note: *The table is presented in fractional form, with absolute values in the numerator and relative values in the denominator. In particular, the share of irrigated land in the region and their ratio index are presented.*

The latest (2024) data was taken as the index of the share of regions in agriculture. The index of effective use of irrigated land is calculated relative to the total indicator of the region for districts (see Table 1).

$$\mathbf{I_{euil} = R_a / R_{il}}; \text{ in this:}$$

I_{eul} (effective use of irrigated lands) – Index of irrigated land efficiency,

R_a (ratio of agricultural production) – Ratio in agricultural production

R_{il} (ratio of irrigated lands) – The ratio (share) of districts with irrigated land [15].

When calculated using this formula, the state of use of irrigated land resources of the regions is obtained. Gijduvan district, which is well-endowed with agro-climatic natural resources, stands out in terms of the level of use of land resources, that is, it records a level almost 1.2 times higher than the regional average. Along with Gijduvan, Peshku district also stands out in the use of arable land. The area that is very lagging behind in the production of agricultural products from irrigated land is Karaulbazar district. It is this district that is considered the most passive in the agricultural sector of the region. This is directly related to the unfavorable natural conditions.

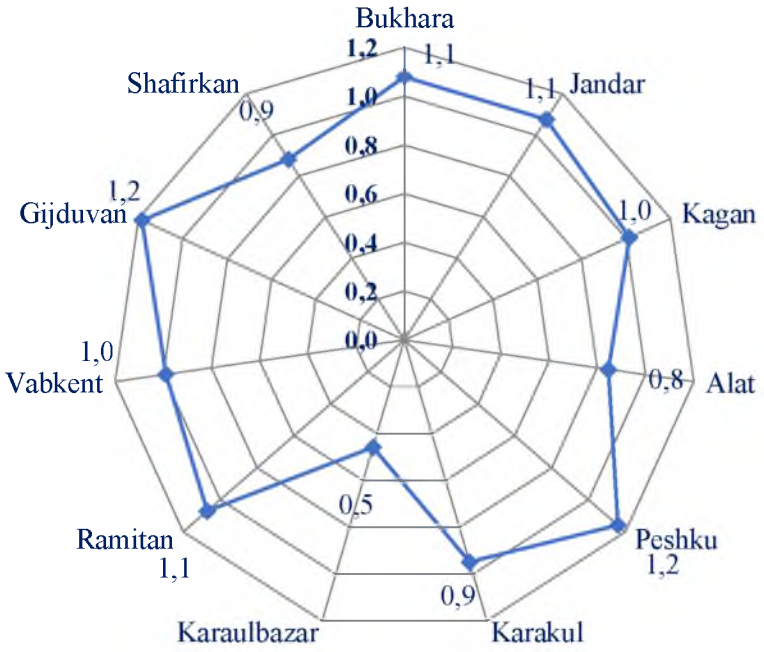

Fig 2. Territorial efficiency of irrigated land use

The figure was compiled by the authors.

The territorial efficiency of agricultural production from irrigated land does not differ significantly across the regions. In particular, Gijduvan and Peshku districts are 15 billion soums higher than the regional average (146.4 billion soums) (see Table 2). The efficiency of irrigated land use in these districts is due, firstly, to favorable natural conditions, and secondly, to the previously traditional development of fertile agriculture (intensive farming and animal husbandry). In addition, these regions are considered to be the main growth areas in terms of population density and the regional economy. Their main problem is that the rational use of land and water resources is not as expected. These include the transfer of land useful for agriculture to other sectors, problems with water distribution, and some shortcomings in the free conduct of activities.

Table 2

Indicators of effective use of irrigated land in regional districts (billion soums per hectare)

№	Compared to the regional average	Range of values	Districts	Average
1	Very high	Above 165	Gijduvan, Peshku	171,7
2	High	150 - 165	Bukhara, Ramitan, Jandar	157,1
3	Average	135 - 150	Kagan, Vabkent, Karakul	144,2
4	Low	120 - 135	Shafirkan, Alat	125,6
5	Very low	Less than 120	Karaulbazar	67,7

Source: Data from Table 1.

The second group includes districts with different conditions and levels of development, the average efficiency of using irrigated land is more than 10 billion compared to the regional indicator. Both intensive and extensive agricultural sectors are well organized in these regions.

The third group can show the real state of land and water use efficiency in the region. Because these are the main support areas of the agricultural sector of the region and are better provided with irrigated land resources than others. However, the efficiency of using these resources is far behind their potential, although these districts have sufficient opportunities for developing the regional economy.

The current situation of the districts of the fourth group is lower than the regional indicator, and there is a high possibility of its further decline in the future. In general, the negative process applies to almost all districts of the region.

In terms of regional agro-economic production and the efficiency of using arable land, the Karaulbazar district lags far behind the regional average. This is due, firstly, to the unfavorable conditions of the region, and, secondly, to the inadequate conditions and opportunities for the development of intensive agriculture.

Conclusion. There is a decrease in irrigated land resources per capita. If this process continues further, in 2030 each person will have 8 hectares of irrigated land, and by 2050 - 5 hectares. However, in our (agrarian-industrial) conditions, a person needs at least 6 hectares of irrigated land per year to live a normal life. From the above figures, it can be seen that by 2050 the region will begin to experience a shortage of irrigated land resources. However, given that these resources are not evenly distributed throughout its territory, it is not difficult to notice that some regions with unfavorable conditions will experience a shortage of irrigated land resources. To prevent this problem, it is necessary to do the following:

When planning the regional agro-economy, it is important to take into account the availability of land resources, in particular, irrigated land, soil fertility (the difference between the Gijduvan and Karaulbazar districts is 20 points), the share of irrigated land in the total area (Vobkent 63.8 percent, Karaulbazar 2.2 percent) and other agricultural indicators. Planning agricultural production without taking these aspects into account will not lead to good results.

Work on the use and protection of irrigated land resources (scientific research, regional decision-making, implementation and results) should be carried out in a comprehensive manner. Monitoring (seasonal and annual) and control within the government play an important role in this.

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