Geovisualization of agricultural economic indicators

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Abstract. Agriculture is an important part of the economy of Uzbekistan. The article analyzes using geographic information systems (GIS) of the agricultural economy throughout the country. The study presents the relationship between population density and the agricultural economy. The article analyzes the relationship among the population, irrigated land, and gross agricultural income by the regions. Electronic maps, created on the basis of a statistical database, contain some indicators that describe the agricultural data of the republic, which helps to study and characterize the spatial differentiation of the region's economy, the nature, and relationships of economic entities, as well as environmental management features. Analysis of statistical materials allows us to identify logically objective correlations and interconnections of events, to track economic processes and trends in their development. The cartographic method allows you to visually, and geographically visualize any economic and geographical phenomena, their regional ties, and interactions.

1 Introduction

In **our** country, large-scale reform is underway to create the necessary economic and legal framework for the development of agriculture. In a statement by the President of the Republic of Uzbekistan dated December 28, 2018, the parliament said, "We need to develop new crops and livestock farming" [1]. The rapid development of the agricultural sector, in turn, leads to an increase in the consumption of land and water resources, which could have a negative impact on the country's food security if timely measures are not taken to respond to emerging problems and threats. It is well known that more than 60% of the population of Uzbekistan lives in rural areas, which affects their well-being [2].

Agriculture is one of the most important sectors of the country's economy [3]. Therefore, it is extremely important to create a system of relationships that meets the requirements of a market economy during this transition. This is due to the fact that in a top-down economy, state-controlled agricultural autonomy does not allow the formation of market relations in this sector. Indeed, a market economy is fundamentally different from previous economies. In the transition to a market economy, the government should be guided by certain relations in agriculture within the framework of the law, but we believe

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that its intervention should be limited to creating a free environment for the efficient operation of agricultural enterprises [4]. In agriculture, the state appears to be the main reformer, and it is not recommended to advise the type of crop or the area for planting [5].

In the future, special attention should be paid to improving the quality of agricultural products. However, our people's demand for other products by medical standards was not fully satisfied. This requires more intensive development of agriculture in Uzbekistan. Some work has been done in the last decade. In particular, measures are being developed and successively implemented in agriculture, which allows the formation of economic relations that meet the requirements of a free market economy and ensure the gradual implementation of legal, organizational, economic, and social reforms [6].

2 Materials and methods

Economic geography as a regional division of labor differs from the geographical approach to the economic phenomena, the location of production; the conditions and peculiarities of product development in different countries and regions are studied. The peculiarity of economic geography is the wide range of economic phenomena under study. The main methods of economic and geographical research are statistical materials analysis, cartography, direct observation, and the study of economic and geographic phenomena [7].

The population density was calculated as the ratio of population to irrigated land in each province for the respective year. His visualization was presented on a map of the regions. Dark brown indicates a high population density and light brown is, on the contrary, relatively low [8].

According to the Statistical Committee, the gross agricultural income of the provinces was calculated as the ratio of the gross regional income to irrigated land. It is shown on the map to visualize this result. The size of a circle means that the profit per unit of land is greater and the smaller is less.

The population and the land area of Tashkent are not taken into account. This is due to the low agricultural income generated by the city of Tashkent and the disproportionate distribution of the urban population.

Analysis. We see population growth rates in all regions between 2009 and 2019, but statistics show a relatively high population density in Tashkent, Syrdarya, and Surkhandarya regions [9].

As can be seen from Figure 3, we see the highest income per unit of irrigated land in areas with a high population density. Of course, provincial data may not be so comprehensive, but we can see a correlation between population density and gross agricultural income. In the Namangan and Syrdarya regions, growth rates were lower than those in other regions, and in the Khorezm region, on the contrary, it decreased [12].
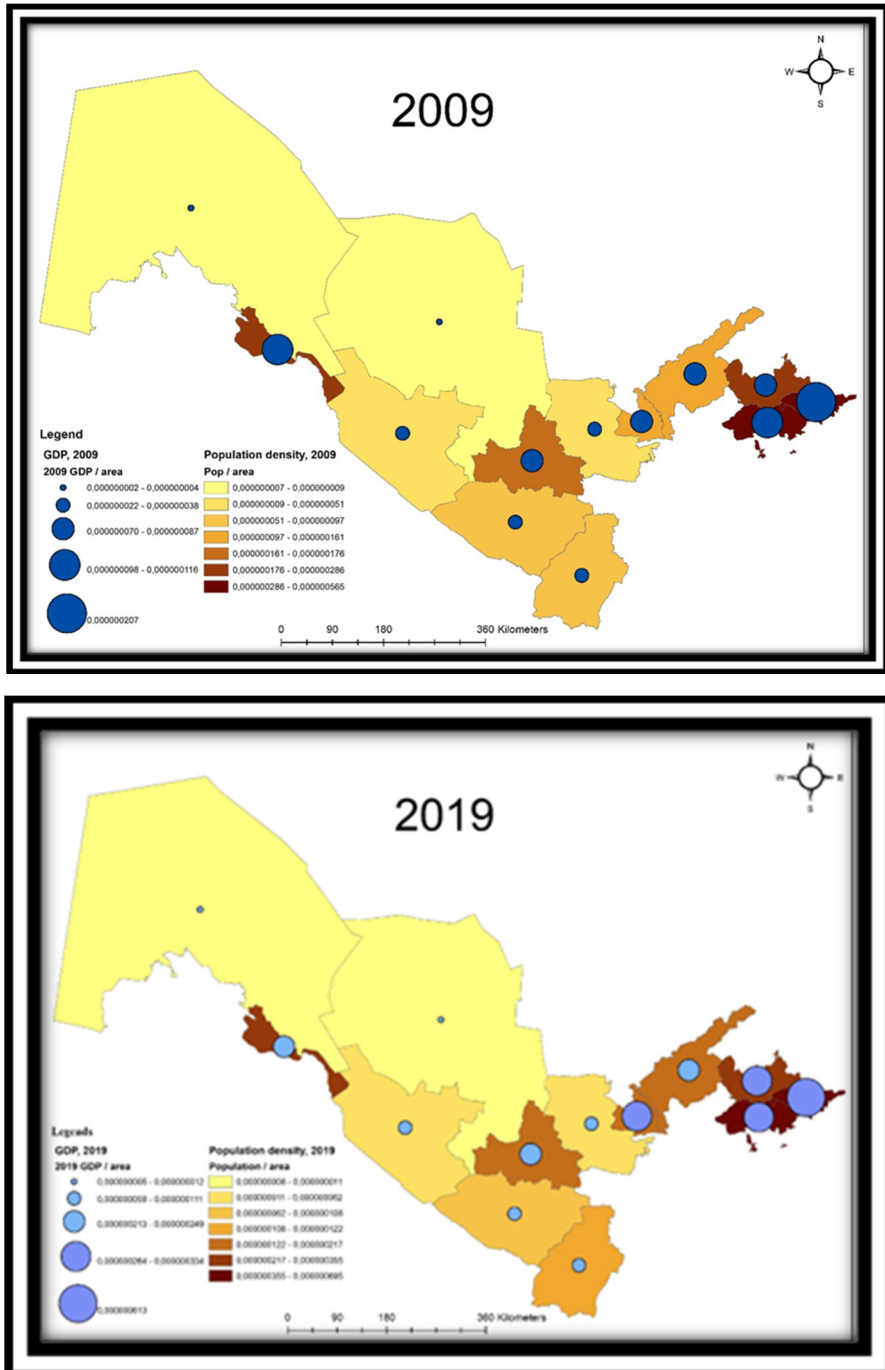
Fig. 1. Comparative maps of population density and gross income of agriculture for the period of 2009-2019.

3 Results and discussion

Today, more than 85 percent of consumer goods are produced in agriculture in Uzbekistan. They consist of crop and livestock products. In 2019, agriculture accounted for 28.8% of the gross domestic product of the Republic of Uzbekistan. 23.3% of GDP was in the industry and 5.1% of GDP was created building sector. The numbers indicate the role of the agricultural sector in the economy. This year, entrepreneurs of all types of agriculture produced gross output of 117315.9 billion UZS. This is mainly 818.4 thousand tons of cotton fiber, 6 375.4 thousand tons of grain, 9.635.1 thousand tons of vegeTables, 2 589.7 thousand tons of fruits and berries, 2 417.4 thousand tons of meat, 10 480.7 thousand tons of milk, 1,082.6 thousand pieces of snow skin, 7,360.5 million eggs and other agricultural products.

Table 1. Agricultural gross income of the Republic of Karakalpakstan and regions for 2009-2019, in billion UZS.

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Republic of Karakalpakstan	309,9	363,4	443,1	548,8	618	816,7	993,3	1116,5	1267,2	1366,5	1877,1
Andijan	881,7	1074,6	1369,8	1627,5	2115,5	2615,3	3162,2	3884	4708,6	5370,6	7292,3
Bukhara	884,2	1069,6	1224,1	1516,8	1946,6	2383,2	3023,9	3438,9	3917,4	4484,6	5669,6
Jizzakh	515,1	631,5	729,2	904,4	1162,7	1400,2	1726,2	1999,1	2252	2509	3277,5
Kashkadarya	806,6	1015,4	1194,1	1491,8	1826,3	2439,5	3047	3505,6	3996,6	4345,4	5584,6
Navoi	417,8	521,3	616,9	764,7	1009,6	1332,4	1780,4	2094,2	2491	2863	3781,1
Namangan	649,4	838,2	983,2	1193,8	1549,6	1984,9	2517,5	2915,6	3141,8	3478,9	4786,6
Samarkand	1245,3	1492,9	1775,8	2251,3	2832,6	3580	4381,7	5129,3	5821,3	6796,1	8936,2
Surkhandarya	761,5	925,2	1100,8	1347,3	1710,9	2227	3042,6	3429,3	3851,8	4220,2	6201,6
Syrdarya	345,5	419,5	522,3	668,3	857,1	1122,1	1507,6	1748,1	1960,6	2168,1	2818,4
Tashkent	1083,2	1284,8	1684,7	2113,8	2795,4	3411,9	4100,7	4712,3	5218,2	5786,7	8173,6
Fergana	780,2	953,3	1135,5	1315	1756	2254,9	2965,4	3480,8	3973,1	4498,2	5894,2
Khorezm	624,5	721	849,1	1031,2	1242	1596,1	1952,9	2283,6	2576,8	2947,1	3674,2

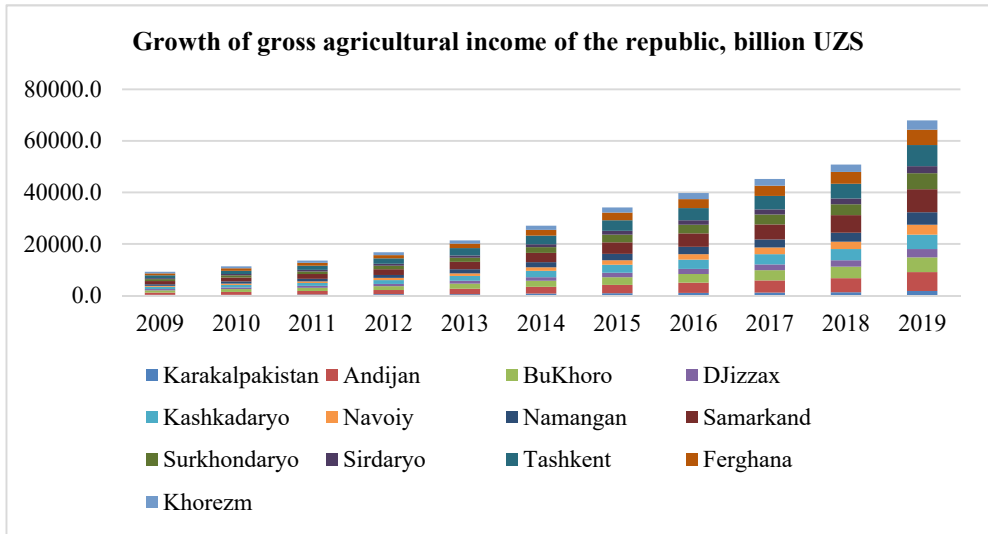**Fig. 2** Growth of gross agricultural income of the republic, billion UZS.
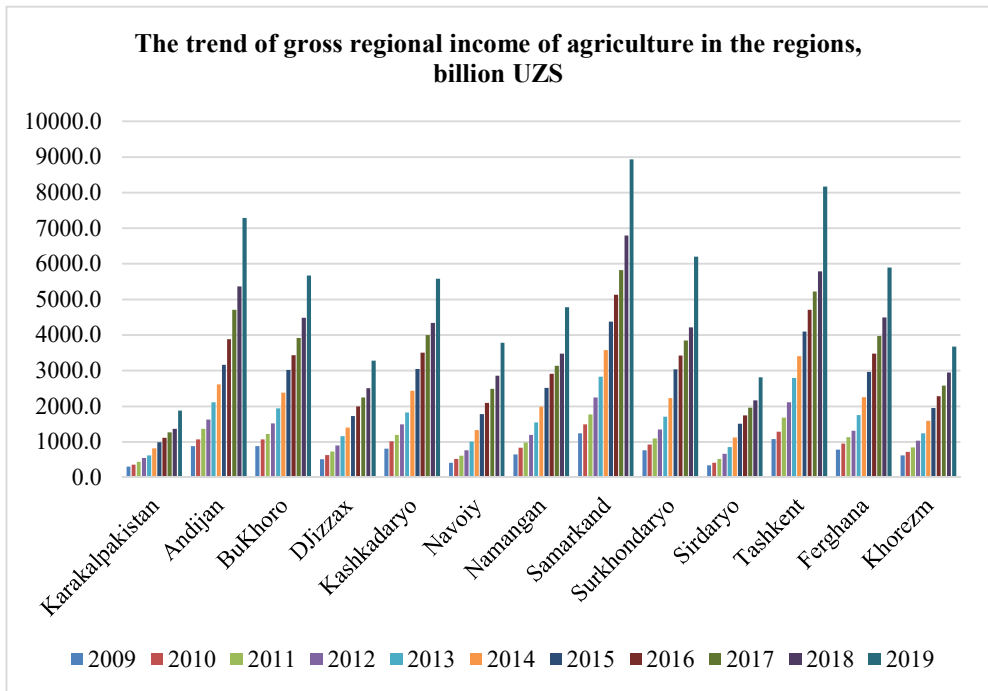

Fig. 3. Growth of gross income of agriculture of the Republic of Karakalpakstan and regions, bln UZS.

Figure 2 shows the growth trend of gross agricultural income in the republic. We see that the share of Andijan, Samarkand, and Tashkent regions in GDP is higher than that in other regions.

Gross income of agriculture. Growth rates of agriculture in 2009-2019 were the highest in the Navoi region (9 times) and the lowest in the Republic of Karakalpakstan (6 times). At the same time, an analysis for 2018–2019 shows that the highest growth was recorded in the Surkhandarya region (47%), and the lowest - in the Bukhara (26.4%) and Khorezm (24.1%) regions.

4 Conclusions

Based on the results of studies, it can be concluded that there is a high probability of maximizing the benefits of land in areas with a high population density. This can be explained as follows. In densely populated areas, on every meter of land one tries to maximize profits from land or vice-versa. That is, the user of irrigated land can fertilize more land in addition to planting the main crop and planting additional crops along the canal, which can be used as a source of income.

It is important to note that instead of the proposal, it is necessary to introduce freedom to farmers in one province as an experience in growing crops [10]. It is necessary to create favorable conditions for the placement of non-agricultural facilities for processing agricultural products, taking into account the needs of the economy. That is, the fact that the tax on non-agricultural enterprises is the same or low for the category of agricultural land has a positive effect on the growth of diversified agriculture [11]. Farms choose the most cost-effective option to earn more.

Acknowledgments

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