

The place of natural resources in the model of transition to a green economy in Azerbaijan

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Abstract. The article explores the role of natural resources in the model of transition to a green economy in Azerbaijan, emphasizing the importance of rational resource use and the implementation of new technologies. A key component of the green economy index is the "natural resources group" sub-index, which includes 10 sub-indicators: volumes of fresh water, water consumption, oil and gas production, land fund structure, fishing, and forest areas. The author also highlights methodological issues that arise in comparative studies, including the dependence of some indicators' absolute values on the size of the country and geographical location. To provide a more accurate assessment of the state of natural resources, the article uses the volume of renewable freshwater per capita, which better reflects the potential for transitioning to a green economy. In conclusion, the article proposes refined indicators for assessing the "natural resources group" based on more reliable data, such as the share of hydrocarbon revenues in GDP, allowing for a deeper understanding of the impact of natural resources on sustainable development in Azerbaijan.

Keywords: natural resources, green economy, Azerbaijan, sustainable development, Sub-index, new technologies

1 Introduction

One of the important components of the composite index of the green economy model is related to the use of natural resources. The adoption of new technologies in resource utilization, along with promoting efficiency in their use, increasing forest cover, expanding water basin volumes, and implementing other measures, are crucial for the transition to a green economy model.

As we mentioned in the previous paragraphs, the "natural resources group" subindex (*NRT*) of the green economy index includes 10 sub-indicators: a) Fresh water taken from natural sources (million cubic meters); b) Water consumption (million cubic m); c) Oil production (thousand tons); d) Gas production (thousand tons); e), The structure of the land fund according to its purpose: Total land area of the country - total (thousand hectares); f)

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Land suitable for agriculture (thousand hectares); g) Non-agricultural lands (thousand hectares); h) Fishing (tons); i) Water resources utilization index (percentage); j) Area covered by forest (percentage).

2 Method

The research method employed in this study involves the calculation and analysis of the "natural resources group" sub-index. We will assume that the 10 sub-indicators of the "group of natural resources" sub-index (NRT) characterizing the green economy each have the same weight (10%). But in this case, we will use the formula $I_i = X_i - X_{min}X_{max}$ to bring all indicators to the same size. Hence, for each sub-index, the corresponding sub-index after the "normalization" operation is performed

Green Economy Composite Index (NRT) sub-index using these sub-indicators

$$NRT = \sum_{j=1}^{11} I_j \quad (1)$$

$$NRT = \sum_{j=1}^{11} I_j \quad (2)$$

will be calculated by the formula.

Also, taking into account the effects of quantitatively changing the 10 sub-indicators of the "natural resources group" sub-index (NRT) on the green economy, "+" or "-" signs will be assigned to them. For example, 1) The abundance of fresh water resources taken from natural sources is "+"; 2) Increase in water consumption "+"; 3) Increase in oil production "-"; 4) Increase in gas production "-"; 5) Increase of the total land area of the country "+"; 6) Increase of land suitable for agriculture "+"; 7) Area of non-agricultural land "+"; 8) Increase in fishing "-"; 9) Increase of the index of use of water resources "+"; 10) Increase in the area covered by forest "+"; 11) The share (percentage) of specially protected nature areas in the total territory of the country will be considered.

"Determining X_{min} and X_{max} during normalization is also important. We will assume that X_{min} and X_{max} are theoretically the smallest and largest possible values of any parameter. For example, $X_{min}=0$, $X_{max}=100$ can be taken for the "forested area" indicator.

It should be noted that some of the sub-indicators of the "Natural resources group" sub-index, for example, 1) Volume of fresh water resources taken from natural sources; 2) Volume of water consumption; c) Volume of oil production; d) Volume of gas production; e) Total land area of the country; f) Land suitable for agriculture; g) Area of non-agricultural land; h) It is not clear to what extent indicators of the volume of fishing indicate the level of transition to a green economy. So, the absolute value of these indicators depends on the size of the country and some geographical location. For example, India, China, Indonesia, Pakistan and Iran are among the top five countries in terms of annual freshwater collection. It should be noted that fresh water resources taken from natural sources create the annual fresh water collection. World Bank reports report annual freshwater withdrawals as total water withdrawals excluding evaporation losses from storage basins. This collection includes water from desalination plants. The volume of this collection may exceed the volume of total renewable resources where there is significant reuse of water. However, the fact that the annual fresh water collection is high does not mean that these countries have the best opportunities to transition to a green economy in terms of this indicator. High volume of water harvesting does not mean using it for green economic growth. On the contrary, the use of these warehouses for the development of the agricultural sector and the expansion of the agricultural sector do not meet the principles of

the green economy. Therefore, we will take as a basis the other indicator - "volume of domestic renewable fresh water collection per capita". According to this volume, Iceland, Guyana, Suriname, Bhutan and Papua New Guinea are among the top five in the world. This indicator is much lower in Middle Eastern countries. For example, according to Bunya Bank data, per capita domestic fresh water reserves in Bahrain, UAE, and Qatar are 2, 15, and 20 cubic meters, respectively.

Similar methodological challenges for comparative studies also apply to agricultural land use. For example, in Great Britain, the total land area of the country is larger than the total land area of Singapore, and smaller than the total land area of China and Russia. However, whether the land area is large or small cannot characterize the transition to a green economy in the country. Therefore, the indicator "the ratio of the land used in the agricultural sector to the total land area" can better express the transition to a green economy. So, since it is not possible to increase the second indicator (total land area of the country), the increase of the first indicator increases the ratio. This does not meet the requirements of the green economy, which means "more=worse" for this indicator. Also, the "volume of oil production" and "volume of gas production" indicators show a weaker transition to a green economy in the country and do not allow for cross-country comparison. In this case, the indicator "share of oil and gas rent in GDP" is a more appropriate indicator. This indicator more clearly expresses the role of oil and gas revenues in the country's economy. Attempts to increase this rent by the country can be made either by increasing production or by weakening the non-oil and gas sector. For both cases, it means "more = worse".

Based on the above key indicators, the "natural resources group" (NR_t) sub-index of the Green Economy Composite Index

$$NR_t = I_1 - I_3,4 - I_6, \quad (3)$$

Here, I_1 - "volume of annual renewable domestic fresh water collection per capita"; I_3 - "share of oil and gas revenues in GDP"; I_4 - are the corresponding indices of the share of forested area in the total land area. During the calculations for this subindex, I_1 and I_4 were taken into account with a positive value, and $I_3,4$ with a negative value. Note that $I_3,4$ was calculated as the total share of two indicators, oil and gas revenues, in GDP.

3 Results and Discussions

For each $I_i = X_i - X_{min}$ indexed indicator, when determining X_{min} and X_{max} , possible maximum and possible minimum values for that indicator were taken into account. According to table 1 - according to the indicator "volume of annual renewable domestic fresh water collection per capita", according to table 2 according to the indicator "ratio of the land area used in the agricultural sector to the total land area" and according to table 3 according to the table, the ranking of the 10 countries with the highest index and the 10 countries with the lowest index according to the "share of oil and gas rent in GDP" indicator is given.

Based on the data in table 1, we can take 500,000 cubic meters and "0" cubic meters for X_{max} and X_{min} , respectively, for the indicator "Volume of annual renewable domestic freshwater collection per capita". It should be noted that in this ranking, Azerbaijan is much lower than the world average (5724.52 cubic meters) with 823.52 cubic meters of domestic fresh water per capita. Middle Eastern countries, as well as countries located near the equator, have much less fresh water resources compared to northern and southern countries.

Table 1. Ranking of some countries according to the indicator "Volume of domestic renewable fresh water collection per capita" (2017).

Countries			Countries		
1	Iceland	495049.50	1	Mauritania	93.40
2	Guyana	310880.29	2	Israel	86.08
3	Suriname	173531.69	3	Yemen, Rep.	75.45
4	Bhutan	104618.93	4	Saudi Arabia	72.50
5	Papua New Guinea	94927.28	5	Jordan	69.69
6	Gabon	79426.12	6	Maldives	60.44
7	Canada	77985.42	7	train	20.55
8	Norway	72390.05	8	United Arab Emirates	15.81
9	Solomon Islands	70279.70	9	Egypt, Arab Rep.	10.37
10	New Zealand	67932.52	10	Bahrain	2.68

Note: Compiled based on World Bank data.

Based on the data in table 2, we can take 100% and 0% for X_{ma} and X_{mi} , respectively, for the indicator "Ratio of the land area used in the agricultural sector to the total land area". Of course, it is practically impossible to use all the land for the agricultural sector in any country. At least because the construction of apartments and roads covers a certain part of the land. However, we have taken 100% for X_{ma} , considering that in some countries, for example, Uruguay and Mongolia, this figure is higher than 90% in some years.

Table 2. Ranking of some countries according to the indicator "The ratio of the land area used in the agricultural sector to the total land area" (2018).

Countries			Countries		
1	Iceland	495049.50	1	Mauritania	93.40
2	Guyana	310880.29	2	Israel	86.08
3	Suriname	173531.69	3	Yemen, Rep.	75.45
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Note: Compiled based on World Bank data.

Based on the data in table 3, we can take 90% and 0% for X_{ma} and X_{mi} , respectively, for the indicator "Share of oil and gas rent in GDP". Note that in some oil-rich countries, this indicator has approached 80% in some years. Therefore, we can take 90% as the maximum possible value. It should be noted that according to the official data of the World Bank for 2019, Azerbaijan is included in the top ten for this indicator. As a result of a certain decrease in oil production in the country, the decrease in oil revenues is compensated by the revenues from gas production. According to 2019 data, the share of oil and gas rent in Azerbaijan's GDP is higher than 25%.

Table 3. Ranking of some countries according to the "Share of oil and gas rent in GDP" indicator (2019)

Countries			Countries		
1	Timor-Leste	45.24	1	Czech Republic	0.0145
2	Congo, Rep.	44.69	2	Jordan	0.0144
3	Libya	44.57	3	Senegal	0.0121
4	Kuwait	42.66	4	Slovak Republic	0.0079
5	Iraq	39.80	5	France	0.0072
6	Equatorial Guinea	29.12	6	Japan	0.0060
7	Oman	26.68	7	Morocco	0.0035
8	Angola	25.81	8	Korea, Rep.	0.0020
9	Azerbaijan	25.43	9	Slovenia	0.0011
10	Saudi Arabia	24.78	10	Spain	0.0007

Note: Compiled based on World Bank data.

Table 4. 30 countries with the "highest" and "lowest" scores for the "natural resources group" sub-index of the Green Economy Index

N _o	Countries	I ₁	I ₂	I ₃	NR _t	N _o	Countries	I ₁	I ₂	I ₃	NR _t
1	Iceland	0.990	0.186	0.000	0.804	1	Mongolia	0.022	0.728	0.023	-0.729
2	Guyana	0.622	0.064	0.008	0.550	2	Rwanda	0.002	0.734	0.000	-0.733
3	Suriname	0.347	0.005	0.063	0.279	3	Djibouti	0.001	0.734	0.000	-0.734
4	Solomon a.	0.141	0.042	0.000	0.099	4	Angola	0.010	0.457	0.287	-0.734
5	Papua Y.Q.	0.190	0.026	0.081	0.083	5	Timor-Leste	0.013	0.256	0.503	-0.745
6	Bhutan	0.209	0.135	0.000	0.075	6	Uruguay	0.054	0.801	0.000	-0.747
7	Canada	0.156	0.065	0.018	0.073	7	Eritrea	0.002	0.752	0.000	-0.750
8	Norway	0.145	0.027	0.077	0.041	8	Syria	0.001	0.758	0.000	-0.757
9	Die Caribbean.	0.102	0.052	0.031	0.019	9	Burundi	0.002	0.792	0.000	-0.790
10	Belize	0.081	0.075	0.014	-0.008	10	C. Africa	0.002	0.794	0.000	-0.793
11	Singapore	0.000	0.009	0.000	-0.009	11	Lesotho	0.005	0.801	0.000	-0.796
12	Bahamas	0.004	0.014	0.000	-0.010	12	Nigeria	0.002	0.759	0.093	-0.850
13	M. Africa	0.061	0.082	0.000	-0.020	13	Azerbaijan	0.002	0.578	0.283	-0.859
14	Finland	0.039	0.075	0.000	-0.036	14	Kazakhstan	0.007	0.800	0.165	-0.959
15	Sweden	0.034	0.074	0.000	-0.040	15	S. Arabia	0.000	0.808	0.275	-1.083

Note: calculated by the author.

Based on the above indicators, each I_1 , I_2 and I_3 , and based on them, by calculating NR_t for any year, it is possible to rank the countries on this component of the green economy. Table 4 shows the indicator I_1 for 2017, I_2 for 2018 and I_3 for 2019, as well as the highest and lowest NR_t for 2019 calculated on the basis of these indicators 30 countries are ranked.

It can be seen from table 4 that the indicators of the "natural resources group" sub-index of the Green Economy are not at all related to the level of economic development. The sub-indicators included in this sub-index, for example, the share of fresh water resources and rent of hydrocarbon resources in GDP, vary sharply from country to country and do not depend on the level of economic development, including the volume of GDP per capita. Among the 15 countries where this indicator is high, in addition to Canada and Norway, which have a high level of development, there are also poor countries such as Central Africa.

Among the 15 countries with the lowest rating on this sub-index, our country was ranked with -0.859 points. Of course, the fact that our country's indicator is so low is related to the price of all three sub-indicators. The lack of fresh water resources in Azerbaijan, the allocation of large areas for the agricultural sector, the lack of forest massifs and the richness of hydrocarbon resources have a negative impact on our results related to this sub-index. Although being rich in hydrocarbon resources creates important and favorable opportunities for economic development, it creates additional problems during the transition to the Green economy model. This is primarily related to environmental problems.

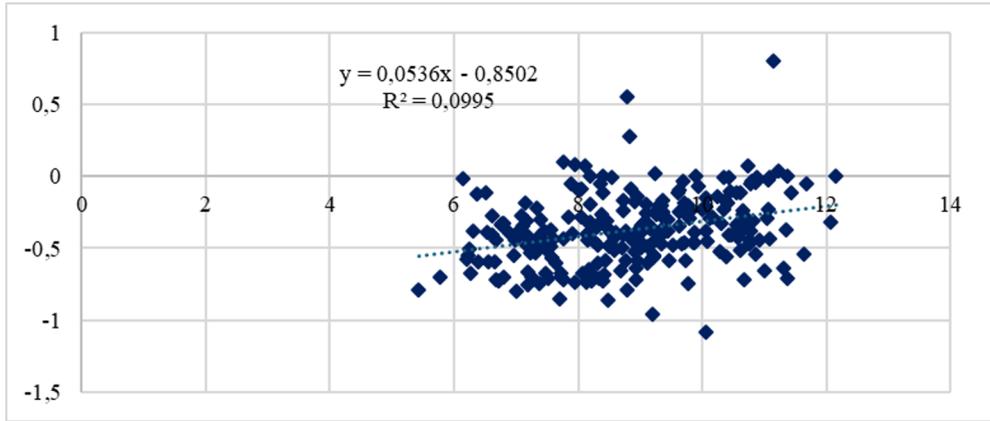


Fig. 1. The nature of the relationship between the "natural resources group" sub-index of the Green Economy.

The nature of the relationship between the volume of GDP per capita for almost all countries of the world, even for groups of countries classified according to income level and geographical location, and the "natural resources group" sub-index of the Green Economy (Fig. 1) suggests that these indicators there is no significant correlation between. However, since the increase in the volume of GDP per capita stimulates the possibilities of transition to the green economy at a certain level, a certain trend is felt in such dependence.

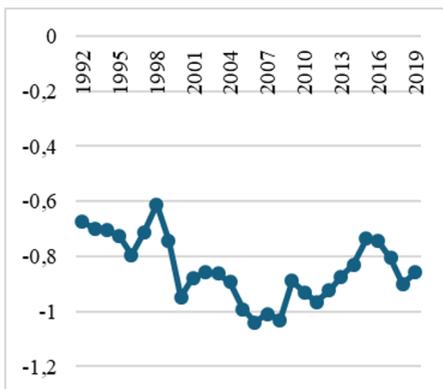


Fig. 2. Dynamics of "Natural resources group" sub-index for Azerbaijan.

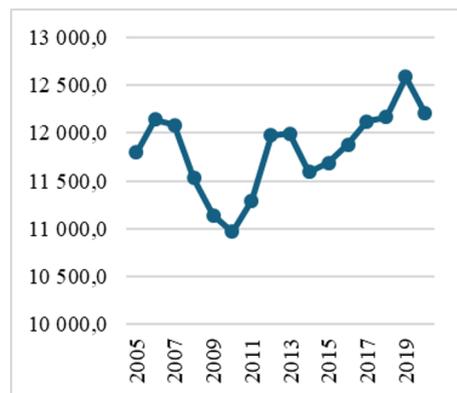


Fig. 3. Fresh water withdrawn from natural sources (million cubic m).

The dynamics of Azerbaijan's "natural resources group" sub-index (1992-2019) suggests that Azerbaijan's performance on this sub-index is not so good. In the country, the share of land allocated to the agricultural sector in the total land area is high (Fig. 2). There is little fresh water supply from internal sources. Population growth leads to a continuous decrease in the per capita supply of fresh water from domestic sources. This may lead to an aggravation of the fresh water problem in the near future. It is necessary to reduce the possibilities of using fresh water in the agricultural sector, to increase attention to the cultivation of agricultural products that require less irrigation. In particular, it is necessary to increase the volume of imported "virtual water" and decrease the volume of exports. For example, it is more appropriate to reduce the production volume of products that require a large amount of water, especially watermelon, cotton and rice products grown in Azerbaijan, and to import these products. It is possible to give priority to the cultivation of olives and grapes. However, the Green economy model supports limiting the amount of land allocated to the agricultural sector as much as possible, but increasing productivity through technological and innovative methods.

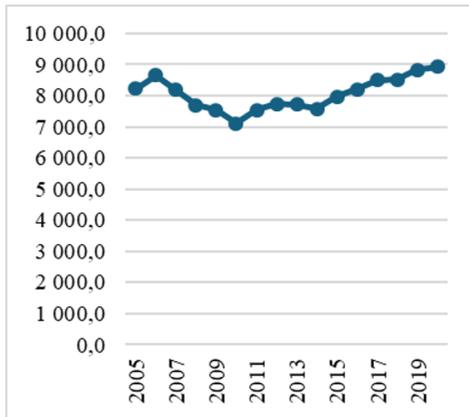


Fig. 4. Water production (million cubic m).

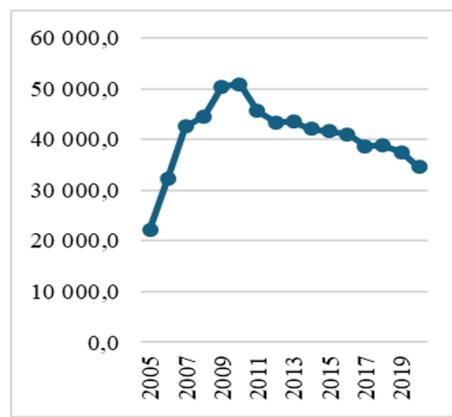


Fig. 5. Oil production (thousand tons).

In the database of the State Statistics Committee of the Republic of Azerbaijan, the "natural resources" group of the Green Economy includes 10 indicators. In fact, it would be more correct to use these sub-indicators when calculating the "natural resources group" sub-index of the Green Economy Index. As we mentioned above, when conducting comparative research on the countries of the world, it is quite difficult to obtain the figures related to these indicators, so we had to be satisfied with only three indicators. Fresh water resources taken from natural sources in Azerbaijan are less than the world average (Fig. 3). In other words, Azerbaijan is one of the countries with low fresh water reserves. Another difficulty in supplying our country with fresh water is that the Kura and Araz rivers, which are the main sources of fresh water resources, are significantly polluted because they pass through the territory of other countries. On the other hand, the volume of fresh water collected from these basins decreases every year. The possibilities of the Samur-Devachi canal, which is one of the fresh water sources, are also very limited. Despite the implementation of important measures aimed at increasing the fresh water supply in the country, due to the low total supply, there are still problems in supplying not only agricultural fields, but also households with continuous fresh water. Our country lags behind developed countries and even most developing countries in terms of fresh water consumption. In recent years, the volume of water consumption in our country has

increased slightly and reached 9 billion cubic meters. This means 857 cubic meters of fresh water per person (Fig.4). This is much less than most countries in the world.

Oil production in Azerbaijan has increased rapidly since the second half of the 19th century. At the beginning of the 20th century, the oil produced in Baku accounted for almost half of the oil produced in the world. During the time when Azerbaijan was part of the Soviet Union, Baku oil occupied the main place in the country's oil production. During the Second World War, the volume of Baku oil production was even more than 40 million tons per year. However, this volume decreased in the following years. After the collapse of the Soviet Union and Azerbaijan's independence, oil production decreased sharply. In September 1994, after the signing of the Agreement of the Century and the construction of the BTC oil pipeline, the export volume of Azerbaijani oil also increased. Undoubtedly, during the years of independence, oil production and export played an exceptional role in the economic development of the country and the improvement of the welfare of the population. Thanks to the income from oil, other sectors of the economy also began to develop rapidly. Directing the oil revenues to the development of education and health care also boosted the development of human capital in the country. Since 2005, oil production has been continuously increasing, reaching a peak level of -51 million tons in 2010 (Fig. 5). Despite the decrease in oil production in the following years, due to high oil prices in the world market, the oil sector remains the leading sector in the country's GDP. But despite this, the investments directed to the non-oil sector at the expense of oil revenues are bearing fruit. Year by year, the amount of added value produced in the non-oil sector is increasing.

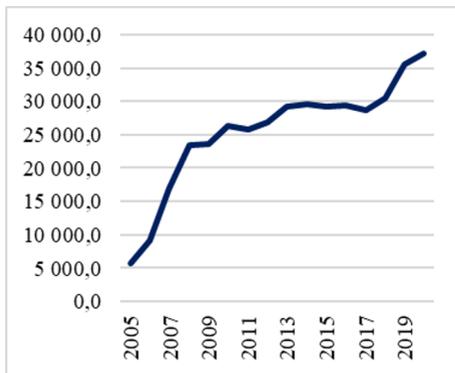


Fig. 6. Gas production (thousand tons).

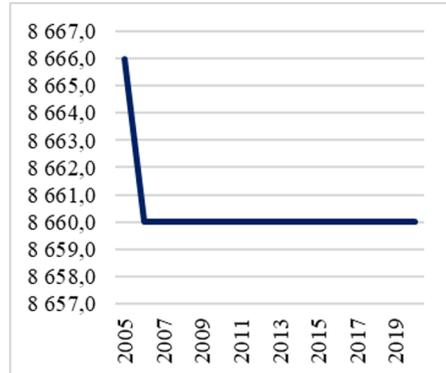


Fig. 7. Total land area of the country - total (thousand ha).

The technology used in oil production in the 21st century is significantly different from the technology used in oil production in the 19th or even the 20th century. Nevertheless, oil production remains the main source of waste that is directly or indirectly released into the environment. In addition to the waste generated during oil production, the toxic waste generated during its processing and even use is one of the main pollutants of the atmosphere, soil and water in the world. The volume of waste generated during the use of petroleum products, especially gasoline, kerosene and diesel fuel is already at such a level that there is a serious need to unite global efforts to reduce it. As a result of the increase in the welfare of the population in our country, the number of cars has increased significantly both in the regions and in the city of Baku.

Although the decrease in oil production reduced the income to some extent, due to the increase in gas production, it was possible to maintain resource income at a certain level. From 2005 to 2019, gas production increased from 5 million tons to 37 million tons (Fig.

6). The increase in gas production, as in the case of oil production, causes serious damage to the environment. However, gas production is also expanding its role in the country's energy supply and additional income.

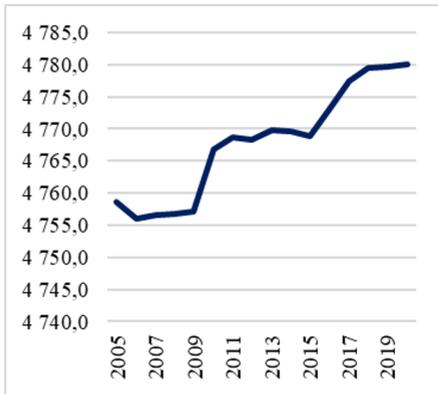


Fig. 8. Agricultural land area (thousand hectares).

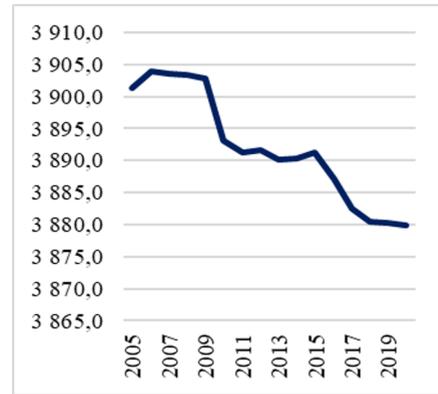


Fig. 9. Non-agricultural land (thousand hectares).

It should be noted that despite the indispensable role of the agricultural sector in global food security, each country prioritizes the service sector, especially the digital and knowledge economy, rather than the agricultural sector as a strategic priority. But despite this, in order to ensure the economic development of land areas suitable for agriculture and regions, support is given to the annual increase and more efficient use of land areas suitable for the agricultural sector in our country. The state's financial assistance to the agricultural sector, subsidies and tax concessions have made it possible to expand the land areas allocated for agricultural purposes in the country. However, the use of the latest technologies in the agricultural sector does not allow to completely eliminate its negative effects on the environment. The use of various pesticides and chemical preparations has a negative effect on the ecological balance. The amount of land used for agricultural purposes in Azerbaijan increased by 20 thousand hectares from 2005 to 2020 (Fig. 8). In fact, this is not a large area to attract attention. On the other hand, about 50% land use for the agricultural sector means that this sector does not have a large volume of harmful wastes thrown into the environment. In this sense, we can consider that Azerbaijan is in an average position on this indicator. Also, the land area used for non-agricultural purposes is 3.8 million ha. is around.

Azerbaijan is located on the west coast of the Caspian Sea. Access to the Caspian Sea in a wide radius has a positive effect on the country's fisheries. In the Caspian Sea, species of fish that are considered rare in nature grow. Large-scale oil and gas production in the Caspian Sea has threatened the life of fish species. The serious pollution of the Kura and Araz rivers has threatened the life of fish growing in such freshwater basins. These threats are also affected by the increasing fishing. According to ARDSK data, fishing in the country increased from 21,000 tons to 61,000 tons between 2006 and 2020. Of course, this volume does not satisfy the demand for fish products in the country, and therefore the import of honey products increases.

Table 5. Natural resources group sub-index of Azerbaijan economy and its components.

Years	I_1	$I_{3,4}$	I_6	I_{10}	$NR-(10)$	$NR-(11)$
2005	0.0028	0.0044	0.5491	0.12	-0.1077	0.9044
2006	0.0029	0.0054	0.5492	0.12	-0.1079	0.9045
2007	0.0028	0.0056	0.5492	0.12	-0.1080	0.9045
2008	0.0026	0.0055	0.5493	0.12	-0.1081	0.9045
2009	0.0025	0.0045	0.5493	0.12	-0.1078	0.9045
2010	0.0024	0.0048	0.5504	0.12	-0.1082	0.9049
2011	0.0025	0.0050	0.5507	0.12	-0.1083	0.9050
2012	0.0026	0.0045	0.5506	0.12	-0.1081	0.9049
2013	0.0025	0.0041	0.5508	0.12	-0.1081	0.9050
2014	0.0024	0.0036	0.5508	0.12	-0.1080	0.9050
2015	0.0024	0.0028	0.5507	0.12	-0.1078	0.9050
2016	0.0024	0.0032	0.5511	0.12	-0.1080	0.9051
2017	0.0025	0.0036	0.5517	0.12	-0.1082	0.9053
2018	0.0024	0.0040	0.5519	0.12	-0.1084	0.9054
2019	0.0025	0.0037	0.5519	0.12	-0.1083	0.9054
2020	0.0024	0.0028	0.5520	0.12	-0.1081	0.9054
2021	0.0026	0.0037	0.5520	0.12	-0.1083	0.9054
2022	0.0026	0.0047	0.5520	0.12	-0.1085	0.9054

Azerbaijan is a country with fewer forest massifs compared to Georgia and the North Caucasus republics. The area of the country's forest massifs covers only 12% of the country's territory. Forest massifs have an exceptional service in air purification and oxygen supply, as well as groundwater collection. Increasing the area of forest massifs is one of the main goals of the Green Economy model. Unfortunately, opportunities for expanding forest massifs in Azerbaijan are very limited. In the post-independence period, as a result of measures taken by the government to increase the area of specially protected nature areas, the area of the areas increased slightly.

4 Conclusion

Based on Azerbaijan's position on the above-mentioned indicators included in the "natural resources group" of the "green economy" model, it can be noted that the possibilities of our country's transition to the "green economy" model for these indicators are somewhat limited. However, the state policy towards the introduction of new technologies in oil and gas production, the measures taken by the government in recent years on water supply, the use of "green" technologies on land areas allocated for the agricultural sector, and the increase in forest areas are bearing fruit.

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