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V.M. Mammadaliyeva[1], G.S. Haydarzada[2*]

[1]National Aerospace Agency, Azerbaijan, Baku
[2]Baku State University, Azerbaijan, Baku
*e-mail: heydarzadehg@gmail.com

INVESTIGATING THE EFFECT OF MEDIUM AEROSOL AREAS ON THE HYDROLOGCAL SYSTEM IN THE FOREST COVER OF EASTERN ZANGEZUR WITH MODERN METHODS (IN THE EXAMPLE OF LACIN, GUBADLI AND ZANGILAN REGIONS)

The effects of medium aerosol areas on the hydrological system in the forest cover of Eastern Zangezur were investigated using modern methods. The hydrological network schemes of the research area in 2000 and 2020 were drawn up, and the lengths of the river network were determined according to the grid code (degrees). The graph of the river network length change (in km) by classes (grid code) in the study area in 2000 and 2020, and the length of the river network by classes (grid code) in the growth of average aerosol areas is reflected. According to the compiled histogram, when comparing the years 2000 and 2020, the growth of the 1st, 6th, 8th, and 9th grade river networks decreased, but the total length increased by 213.18 km. The average aerosol total length increases when the area increases and decreases when it decreases, indicating that an increase in aerosol area is required for an increase in the river network.

Key words: ArcGIS, aerosol, landsat, hydrological network, Hakari river.

В.М. Маммадалиева[1], Г.С. Хайдарзада[2*]

[1]Ұлттық аэроғарыш агенттігі[1], Әзірбайжан, Баку қ.
[2]Баку мемлекеттік университеті[2], Әзірбайжан, Баку қ.
*e-mail: heydarzadehg@gmail.com

Шығыс Зәңгезүрдің орман жамылғысының гидрологиялық жүйесіне орташа аэрозольді аймақтардың әсерін заманауи әдістермен зерттеу (Лацин, Губадлы және Зәңгілан облыстары)

Шығыс Зәңгезүрдің орман жамылғысындағы гидрологиялық жүйеге орташа аэрозольді аймақтардың әсері заманауи әдістермен зерттелді. Зерттеу аймағының 2000 және 2020 жылдардағы гидрологиялық тораптарының схемалары жасалып, желілік код (градус) бойынша өзен желісінің ұзындықтары анықталды. Зерттелетін аумақта 2000 және 2020 жылдардағы өзен желісінің ұзындығының (км-мен) класстар (тор коды) бойынша өзгеру графигі және орташа аэрозольдық аудандардың өсуіндегі өзен желісінің кластар бойынша ұзындығы (тор коды) көрсетілген. Құрастырылған гистограмма бойынша 2000 және 2020 жылдарды салыстырған кезде 1, 6, 8, 9 разрядты өзен желілерінің өсімі төмендегенімен, жалпы ұзындығы 213,18 шақырымға артқан. Орташа аэрозольдің жалпы ұзындығы аудан ұлғайған кезде артады және азайған кезде азаяды, бұл өзен желісін ұлғайту үшін аэрозоль ауданының ұлғаюы қажет екенін көрсетеді.

Түйін сөздер: ArcGIS, аэрозоль, landsat, гидрологиялық желі, Хакари өзені.

В.М. Мамедалиева[1], Г.С. Хайдарзаде[2*]

[1]Национальное аэрокосмическое агентство, Азербайджан, г. Баку
[2]Бакинский государственный университет, Азербайджан, г. Баку
*e-mail: heydarzadehg@gmail.com

Исследование влияния средних аэрозольных площадей на гидрологическую систему в лесном покрове Восточного Зангезура современными методами (на примере Лачинского, Губадлинского и Зангеланского районов)

С использованием современных методов исследовано влияние средних аэрозольных площадей на гидрологическую систему лесного покрова Восточного Зангезура. Составлены схемы гидрологической сети района исследований на 2000 и 2020 годы, определены длины речной сети по сетевому коду (градусам). Отражен график изменения длины речной сети (в км) по классам (код сетки) на исследуемой территории в 2000 и 2020 гг., а также длины речной сети по классам (код сетки) при росте средних аэрозольных площадей. Согласно составленной гистограмме, при сравнении 2000 и 2020 годов прирост речных сетей 1, 6, 8 и 9 классов снизился, но общая длина увеличилась на 213,18 км. Средняя общая длина аэрозоля увеличивается при увеличении площади и уменьшается при ее уменьшении, что свидетельствует о том, что для увеличения речной сети необходимо увеличение площади аэрозоля.

Ключевые слова: ArcGIS, аэрозоль, landsat, гидрологическая сеть, река Хакари.

Introduction

Rivers are fed by both surface and underground water. Generally, there are four types of food sources: rain, snow, glaciers, and groundwater. The first refers to the surface water.

One of the main factors of river nutrition is climatic conditions, and the famous meteorologist A.I. Voeykov stated that rivers are a product of climate [7,8].

The dominance of this and other food sources in different river basins depends on the local conditions. It is sometimes impossible to determine the type of food that is superior to basins. In this case, the concept of mixed nutrition was used. [14,15,16]

In addition to climate, vegetation, soil, relief, and anthropogenic factors also have a significant influence on the formation of flow in rivers. The role of groundwater in nutrition can be determined based on the geological structure of river basins. Rainfall feeding is mainly caused by showers and prolonged rains [20,21]. Heavy rain lasts for a short time, during which the water content of the rivers increases sharply, and after the rain, it gradually decreases. Long-lasting rain covers a large area and feeds the river for a long time. The rivers of the equatorial and climatic zones in the Lankaran natural region are mainly fed by rainwater. [9,10,11]

The snow accumulated during winter begins to melt in spring, and the meltwater feeds the rivers. Nutrition from snow water depends on the water resources in the snow and weather conditions during the melting period. More than 50% of the lowland river flow in Eastern Europe is snow water. Glacier water feeding is typical for rivers in high mountain regions. The water content in rivers fed by glacier water increases in summer (Amu Darya, Syr Darya). When snow melts and after rain, part of the water seeps into the soil-rock layer and increases the underground water supply. He then fed the river regularly throughout the year. [17,18,19] From south to north, the role of groundwater in feeding rivers has increased. In areas where permanent frost is common, the groundwater recharge is very low. Groundwater accounts for 30% of the annual flow of the Volga River. In general, 2-3 sources of nutrients are involved in feeding rivers with water. This mixed diet is typical for most rivers. [12,13].

Materials and method

The research area was the Hekari River and its tributaries. The river flows through the Lachin, Gubadli, and Zangilan regions. A group of hydrological tools was used to construct the river network of the study area. In the ArcGIS program, these tools are used in the modeling of surface water flow with a group of pu.[1]. Landsat-5 2000 and Landsat-8 2020 images were obtained for the regions indicated in the study to perform the processing. Landform information can be used in various industries such as rural and forestry regional planning, agriculture, and forestry. The main goal in these fields is to know the principles of water movement on the surface, as well as the effect of changes in flow in a certain area.[2]

To carry out the survey, it was first necessary to obtain digital elevation model (DEM) files. For this, the following images of the ASTER satellite of the year 2000 were obtained on one of the sites of the US Geological Survey – Earth Explorer:[3]

ASTGTMV003_N38E046; ASTGTMV003_N39E045; ASTGTMV003_N39E046.

In addition, the 2020 image of the ASTER satellite was obtained from an online resource using Global Mapper software.

The ASTER satellite images of the 2000s were assembled by combining three images into one image state as a mosaic using the ENVI software.

Thus, the lengths of the river network according to gridcode (degrees) are shown in figure 2.

Let us create a table based on the results shown in Figure 2, and the results are shown in Table 1.

Based on the results shown in Table 1, we can say that there was an increase in the 8th degree of the river network, and a decrease in other degrees, while the overall river network was shortened [4-5].

Based on the results in Table 1, we created a graph, as shown in Figure 3.

In Figure 4, the increase in average aerosol areas in 2000 and 2020 is represented by the length of the river network by class (grid code).

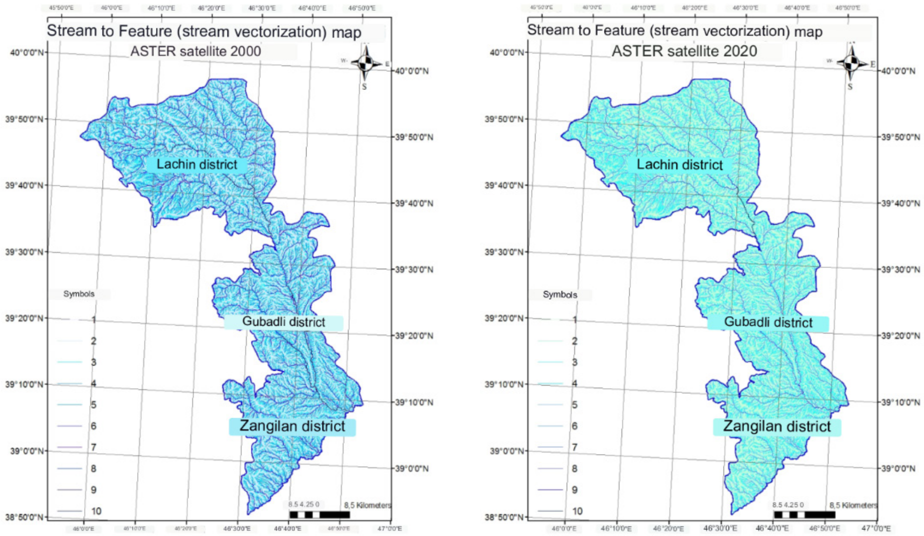


Figure 1 – Schemes of the hydrological network of the study area in 2000 and 2020

Table

feature_2000_dis

FID	Shape *	grid	length
0	Polyline	1	59845
1	Polyline	2	18750
2	Polyline	3	7041
3	Polyline	4	3424
4	Polyline	5	1655
5	Polyline	6	778
6	Polyline	7	358
7	Polyline	8	173
8	Polyline	9	116
9	Polyline	10	35

(0 out of 10 Selected)

feature_2020... feature_2000...

Search Table

Table

feature_2020_dis_1

FID	Shape *	grid	length
0	Polyline	1	65984
1	Polyline	2	15130
2	Polyline	3	5468
3	Polyline	4	2800
4	Polyline	5	1391
5	Polyline	6	687
6	Polyline	7	291
7	Polyline	8	186
8	Polyline	9	72
9	Polyline	10	18

(0 out of 10 Selected)

feature_2020_dis_1

Search Table

Figure 2 – Lengths of the study area over the years 2000 and 2020 (in km)

Table 1

Gridcode (degrees)	Longitudes by years		Dynamics (2000-2020)
	2000	2020	
1st degree	59845	65984	6139?
2nd degree	18750	15130	3620?
3rd degree	7041	5468	1573?
4th grade	3424	2800	624?
5th grade	1655	1391	264?
6th grade	778	687	91?
7th grade	358	291	67?
8th grade	173	186	13?
9th grade	116	72	44?
10th grade	35	18	17?
General	92175	92027	148?

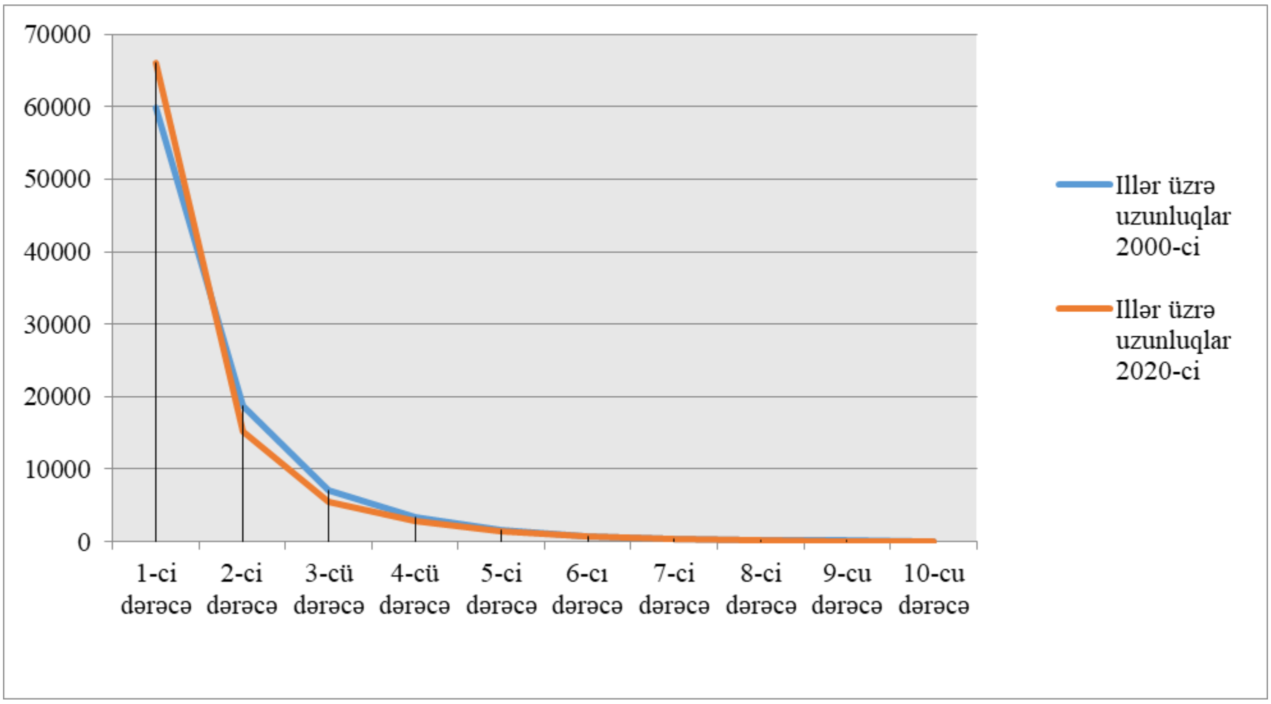
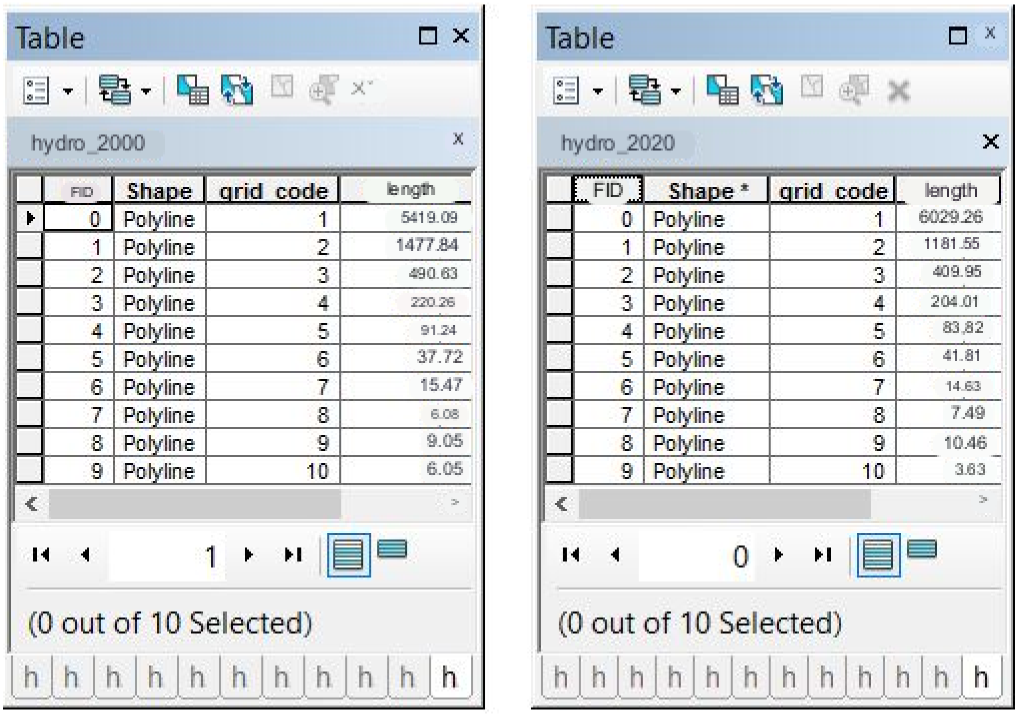


Figure 3 – The graph of the change of river network length (in km) by classes (gridcode) in the study area in 2000 and 2020



Table

hydro_2000

FID	Shape	grid_code	length
0	Polyline	1	5419.09
1	Polyline	2	1477.84
2	Polyline	3	490.63
3	Polyline	4	220.26
4	Polyline	5	91.24
5	Polyline	6	37.72
6	Polyline	7	15.47
7	Polyline	8	6.08
8	Polyline	9	9.05
9	Polyline	10	6.05

(0 out of 10 Selected)

Table

hydro_2020

FID	Shape *	grid_code	length
0	Polyline	1	6029.26
1	Polyline	2	1181.55
2	Polyline	3	409.95
3	Polyline	4	204.01
4	Polyline	5	83,82
5	Polyline	6	41.81
6	Polyline	7	14.63
7	Polyline	8	7.49
8	Polyline	9	10.46
9	Polyline	10	3.63

(0 out of 10 Selected)

Figure 4 – Hydrological condition of the study area in 2000 and 2020
(at the time of increase of average aerosol areas)

Let us reflect on the indicators shown in Figure 4 in Table 2.

Based on the histogram shown in Figure 5, we can say that comparing the years 2000 and 2020, the growth of the 1st, 6th, 8th, and 9th grade river networks has occurred, while others have decreased, but the total length is 213.18 km has increased.

Now let's examine the impact of the reduction of average aerosol areas on the hydrological situation.[6] In Figure 6, the lengths (in km) reflecting the hydrological situation of the years 2000 and 2020 are shown in the reduction in the average aerosol areas.

We reflect the indicators shown in Table 2 as a histogram in Figure 5.

Table 3 lists the indicators shown in Figure 6.

So Let create a histogram based on the indicators mentioned in Table 3 and show them in Figure 7.

Table 2

Class (grid code)	For different years		Dynamics
	2000	2020	
1	5419.09	6029.26	610.17?
2	1477.84	1181.55	296.29?
3	490.63	409.95	80.68?
4	220.26	204.01	16,25?
5	91.24	83,82	7.42?
6	37.72	41.81	4.09?
7	15.47	14.63	0.84?
8	6.08	7.49	1.41?
9	9.05	10.46	1.41?
10	6.05	3.63	2.42?
General	**7773.43**	**7986.61**	**213.18?**

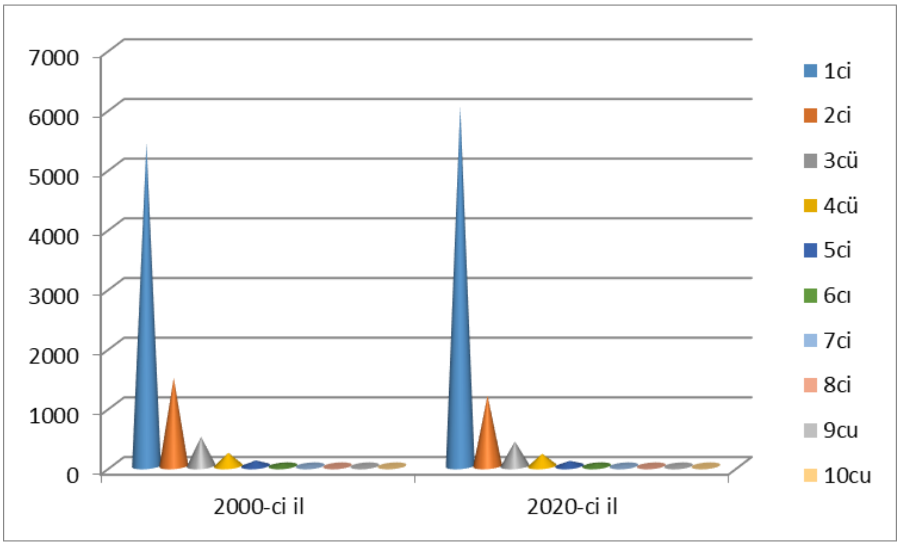


Figure 5 – Histogram showing the hydrological condition of the study area in 2000 and 2020 (in the increase of average aerosol areas) length in km

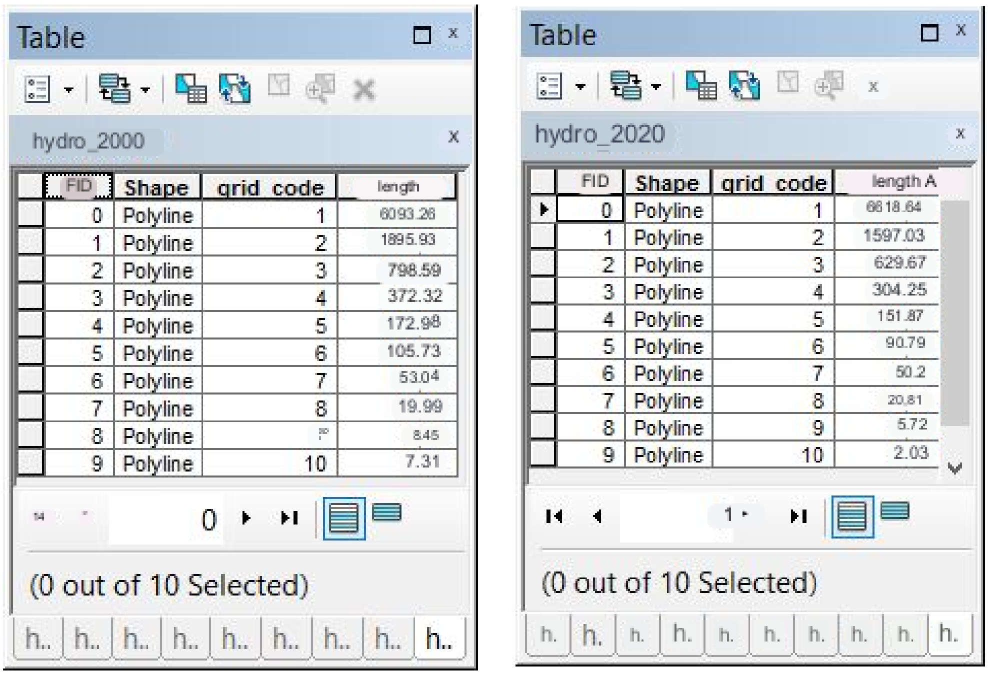


Table — hydro_2000

FID	Shape	grid_code	length
0	Polyline	1	6093.26
1	Polyline	2	1895.93
2	Polyline	3	798.59
3	Polyline	4	372.32
4	Polyline	5	172.98
5	Polyline	6	105.73
6	Polyline	7	53.04
7	Polyline	8	19.99
8	Polyline	[illegible]	8.45
9	Polyline	10	7.31

(0 out of 10 Selected)

Table — hydro_2020

FID	Shape	grid_code	length A
0	Polyline	1	6618.64
1	Polyline	2	1597.03
2	Polyline	3	629.67
3	Polyline	4	304.25
4	Polyline	5	151.87
5	Polyline	6	90.79
6	Polyline	7	50.2
7	Polyline	8	20.81
8	Polyline	9	5.72
9	Polyline	10	2.03

(0 out of 10 Selected)

Figure 6 – Hydrological condition of the study area in 2000 and 2020 (when average aerosol areas decrease)

Table 3

Class (grid code)	For different years		Dynamics
	2000	2020	
1	6093.26	6618.84	525.58?
2	1895.93	1597.03	298.9?

Table continuation

Class (grid code)	For different years		Dynamics
	2000	2020	
3	798.59	629.67	168.92?
4	372.32	304.25	68.07?
5	172.98	151.87	21.11?
6	105.73	90.79	14.94?
7	53.04	50.2	2.84?
8	19.99	20,81	0.82?
9	8.45	5.72	2.73?
10	7.31	2.03	5.28?
General	**9572.6**	**9471.21**	**101.39?**

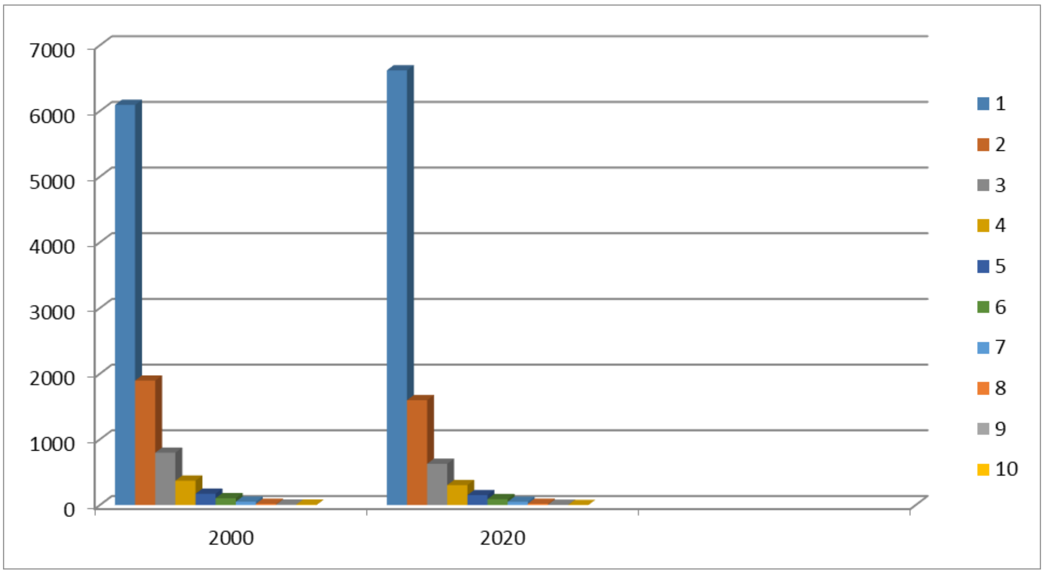


Figure 7 – Histogram showing the hydrological condition of the study area in 2000 and 2020 (in decreasing average aerosol areas) length in km

In the histogram shown in Figure 7, there was an increase in classes 1 and 8 in 2020, a decrease in other classes, but a decrease in the length of the total river network was observed[7].

Based on the results mentioned in Table 4, we can say that the total length increases when the average aerosol area increases, and decreases when it decreases, and these results show that the increase of aerosol areas is required for the increase of the river network. Based on the results mentioned in Table 4, we can say that the total length increases when the average aerosol area increases and decreases when it decreases, which indicates that an increase in aerosol areas is required for the increase in the river network.

Table 4

Class (grid code)	Growth	Decrease
1	610.17?	525.58?
2	296.29?	298.9?
3	80.68?	168.92?
4	16,25?	68.07?
5	7.42?	21.11?
6	4.09?	14.94?
7	0.84?	2.84?
8	1.41?	0.82?
9	1.41?	2.73?
10	2.42?	5.28?
General	**213.18?**	**101.39?**

Conclusion

Based on our results, we can say that there was an increase in the 8th degree of the river network and a decrease in other degrees, while the overall river network was shortened.

When we compare the hydrological condition in 2000 and 2020, length in km (during the increase of average aerosol areas) and those years, the increase of the 1st, 6th, 8th and 9th degree river network has occurred, while others have decreased. the total length increased by 213.18 km.

The total length increases when the average aerosol area increases and decreases when it decreases, indicating that an increase in aerosol area is required for the increase in the river network.

References

1. Site GIS ArcGIS [Electronic resource]: – Access mode HYPERLINK "http://www.arcgis.com/home/index.html" http://www.arcgis.com/home/index.html
2. Mamma dov _ _ _ G. , Mahmudov X. , Ecology , Traffic _ A hit _ etc _ Man , see " Science " _ 2006, 608 p .
3. Site Program products of ArcGIS family [Electronic resource]: – "http://www.credospb.com/arcgis.html"
4. Movsumov E., Guliyeva L., Environmental chemistry, Baku "MBM" 2010, 184 p.
5. Gorbacheva, E.N. Software complex ENVI professional solution for complex processing of multispectral, hyperspectral, and radar data/EN. Gorbacheva/Geomatics, no. 2, 2013 — P. 50-54.
6. AFRI-aerosol free vegetation index (2001-Karnieli_AFRI_RSE_01.pdf)
7. Bykov V.D., Vasiliev A.V. Гидрометрия.- Л,: Гидроме – geoizdat , 1977.-448 p.
8. Imanov F.A. Theoretical foundations of hydrology. Baku, Nafta-Pres. 2014.-212p.
9. Imanov F.O. River flow. Baku, BSU Publishing House, 2002.- p. 2008.
10. Mammadov M.A., Imanov F.A., Mahmudov R.N. Hydrometry. Baku, NPM "Nurlan", 2000.-210 p.
11. Alekseevskii N.I. Formation and movement of river sediments.-M.: Изд-во МГУ, 1998.-202 p.
12. Anthropogenic impacts on water resources of Russia and neighboring states in the end of the XX century/ Edited by. N.I. Koronkevicha, I.S. Zaitseva. – M.: Наука, 2003.-367 с.
13. Babkin V.I., Vuglinsky B.C. Water balance of river basins.-L.: Hydrometeoizdat, 1982.-191 p.
14. Berkovich K.M., Chalov R.S., Chernov A.V. Ecological linguistics. – M.: ГЕОС, 2000.-332 p.
15. Важнов А.Н. Hydrology rec. – M.: Изд-во МГУ, 1976.-339 p.
16. Vendrov С.Л. Life is our river. – L.: Hydrometeoizdat, 1985-112 p.
17. Evstigneev V.M. River flow and hydrological calculations.- M.: Изд-во МГУ, 1990.-304 p.
18. Izdan P.F. Forests and water resources. – M.: Наука, 1980.-153 p.
19. Karaushev A.V. Theory and methods of calculation of river sediments. – Л,: Hydrometeoizdat, 1977.-392 p.
20. Krestovsky O.I. Влияние вырубок и доставка лесов на водность рек.- L.: Gidrometeoizdat, 1986.-118 p.
21. Makkaveev N.I., Chalov R.S. Русловые процессии. – M.: Изд- во МГУ, 1986.-264 p.
22. Mikhailov V.N. River mouths of Russia and neighboring countries: past, present and future. – M.: ГЕОС, 1997.-413 p.
23. Mikhailov V.N. Hydrology of river mouths. – M.: Изд-во МГУ, 1998.-176 p.
24. Shiklomanov I.A. Anthropogenic changes in river water quality. – Л,: Hydrometeoizdat, 1979,-302 p.
25. Shiklomanov I.A. Influence of economic activity on river flow. – L.: Hydrometeoizdat, 1989.-334 p.