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Soil-melioration peculiarities in valley of Kish river

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A B S T R A C T

The presented study explains the scientific approach to the creation of mathematical models based on the concept of a systematic approach to solving the existing problems of the impact of floods on soil ecosystems in the Kish river valley, increasing their adequacy and applying research results to practical problems. The article presents some results of studies carried out on the Kish River and its floodplains over 3 years. Soil sections were placed at different depths, soil samples were taken and examined for their morphogenetic properties. At the same time, samples of groundwater and river irrigation water were taken for laboratory analysis at different times of the year (spring, summer, autumn). In accordance with the hydrographic regime and relief of the Kish River, the qualitative composition of the water flowing in different parts of the river, dependent particles, impurities, and the degree of clay content were studied. It has been clarified that the use of river water for irrigation of agrocenoses is expedient. Mathematical models have been developed to calculate floods.

Keywords: Valley of the river, Agroecology, Soil formation, Agrochemistry, Soil fertility, Floods.

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Introduction

The hydrographic network also plays an important role in soil formation. In the river valleys of Azerbaijan, there are widespread alluvial-hydromorphic soils with high potential fertility, different landscape characteristics and different stages of development, formed in a complex geomorphological structure, microrelief and bioclimatic conditions. However, in comparison with zonal soils, morphogenetic diagnostics and classification of alluvial-hydromorphic soils of river valley with a complex soil cover structure have been insufficiently studied. The Kish River has a well-developed river network. The use of ICT (information and communication technologies) in solving many practical problems, such as assessing soil fertility and forecasting productivity, product quality management, etc is very important. The results are based on the rational use of natural resources and environmental protection.

Objects and methods of investigations

Systems of coordinates of investigate section were determined with GPS - GPS. N 41° 15' 22'' E 47°12' 30''; N 41° 15' 24'' E 47°12' 37''; N 41° 14' 51'' E 47° 11' 49''; N 41° 14' 57'' E 47°11' 50''; N 41° 14' 36'' E 47°11' 11''; N 41° 15' 25'' E 47°12' 37''; N 41° 15' 31'' E 47°12' 23''.

Investigations were done in valley of the Kish river, which is a tributary of the Ayrichay river; its length is 33 km^2, and its area is 265 $km^{2.}$ [1]. The Kish river, one of the most flooded rivers in the Caucasus, begins at an altitude of 2900 meters from the southern slope of the Greater Caucasus Range. The valley of the Kish River, whose channel is located near the western part of Sheki, is considered one of the strongest floodplains [2, 3].

To study the soils of the studied river valleys, we used geographical comparisons, cartographic, stationary and statistical calculation methods. Field work was carried out to determine of alluvial soils in the cones of the Kish River tributary.

Field work was carried out on the basis of soil cartographic material. In each individual contour, in characteristic places for them, ditches were made, where the structure of the soil, the depth of occurrence of carbonates (boiling from 10% HCl) and groundwater, particle size distribution, degree of erosion, as well as climatic conditions of the territory in the form of bioclimatic potential were determined, the degree of culture, the contrast of the relief, rockiness, bushiness and others. Soil and groundwater samples were taken from soil plots at a depth of 1.5 and 2 meters for laboratory analysis. At the same time, water samples were taken from certain places in the Kish river valley, pH was measured immediately, and the samples were delivered to the laboratory for analysis.

Modern methods of laboratory analysis of soil and water samples were used. Analysis of readily soluble salts in soil and groundwater E.V.Arinushkina [4], hygroscopic humidity -105 ^oC, drying in a drying oven 6 hours by weight, particle size distribution - N.A.Kachinsky [5] - $Na_2P_2O_7$, soil density - with a cylinder in the field according to the method N.A. Kachinsky [5], the degree of rockiness of the soil was determines at a depth of 0-30 and 30-50 cm.

Soil genesis wee investigate according international soil classification system [6].

Determination of the surface area of plants (5 times repeat) of soil on an area of 1 m^2 2 cm above the surface of the grass were cut, after drying in air, the dry weight per hectare was determined and calculated. The amount of root mass was investigated in 3 replicates at a depth of 0-20, 20-50 cm using a monolithic method (25x25 cm^2).

Taking into account the geomorphological structure, relief, alluvial sediments, soil and vegetation, the level of groundwater, the seasonal nature of river floods in the Sheki region, key study areas were selected.

In the valley of the Kish river, a large number of land plots have been laid along the routes (from bedrocks to ancient terraces in the direction of the width of the floodplain) and the stages of evolution of alluvial hydromorphic soils have been studied. In the last 60-70 years, anthropogenic impacts have replaced forests with arable land.

Physical-geographical conditions of Kish river valley

It is known that the role of parent rocks in the process of soil formation is very great. Thus, the rock transfers its physical, chemical and biological properties to the soil. Soil-forming rocks in the Sheki region, located on the southern slope of the Greater Caucasus, developed mainly on eluvial-diluvial deposits [1].

The mountainous part of the area is composed of limestone, dolomite, andesite, shale, sandstone. In addition, diluvial-proluvial deposits are widespread in the foothills, valleys and depressions of gentle slopes [2].

The initial development of alluvial-hydromorphic soils with high natural potential fertility at the research site began with deforestation by humans. Currently, due to the protection of forests, the area of land for agriculture is limited [3].

The annual number of hours of sunshine in Sheki region is 2350 hours. 40 % of hours of sunshine are in the summer months. During the year, there are 122 kcal of solar radiation per 1 square centimeter of the earth's surface. The climate of the Sheki region is influenced by cyclones and anticyclones, various air masses and local winds. In winter, the influx of arctic and moderate air masses forces the weather to pass at relatively moderate temperatures. In summer, local winds are formed in the mountains and valleys.

This is due to the pressure drop between mountains and valleys. The mountains of the Greater Caucasus block the cold masses coming from the north. Thus, the average January temperature in Sheki is 0.5℃. The average annual temperature is 11℃. The average temperature in June-August ranges from 20-25℃.

Strong winds (with a speed of more than 15 m/s) are rarely recorded, only 1012 days a year.

In Sheki, winds are often observed at a speed of less than 1 meter per second. The amount of precipitation is 730 mm. Half of them are in May, June, July, September and October. The smallest amount of precipitation is in August (35 mm), January (29 mm) and February (36 mm).

The amount of precipitation is 775 mm in the village of Kish, Sheki region and more than 1000 mm on the Khan plateau. Natural phenomena such as floods, storms and heavy hail are typical of Sheki and the surrounding mountains and plains.

Here atmospheric phenomena such as storms and hail are closely related. The mountainous terrain causes hail and heavy evaporation during the summer months. The average annual number of hail days is 1.4. 14 hail days in 10 years.

At an altitude of 500-850 meters above sea level, the surrounding mountain forests protect the city from overheating. At an altitude of 500-850 meters above sea level, the surrounding mountain forests protect the city from overheating. The hydrographic network also plays an important role in soil formation. The main rivers are fed by snow, small rivers and canals, groundwater and partial rainwater. The amount of precipitation varies from year to year and from month to month. A drought has been observed here for several years.

In the summer months, the relative humidity sometimes drops to 6-7 %, and many hot and dry winds blow. All this plays an important role in the abundant flow of the river. Due to the large slope of the Kish river, the water dries up and flows quickly in the spring and summer months.

Kish river is very destructive and it plays a large role in the topography and soil fragmentation. The role of artificial canals and groundwater in the natural hydrographic network of the Sheki region is also great.

The nature of the soil formation process in the river valleys of the republic and the morphogenetic characteristics of soils depend on the density of the river network, the annual flooding regime, the degree of turbidity, the lithological and chemical composition of alluvial deposits, the degree of groundwater mineralization, and other processes have a significant impact.

These soils are mainly used as summer pastures and hayfields, partly for sowing tilled crops. The ecological significance of these soils is not limited to agricultural aspects and play an important role in the hydrological mountain areas.

Results of investigation

The problems of land reclamation in the South Caucasus are very urgent and great scientific and practical importance is considered to their solution [7-14].

According to preliminary estimates, in the foothills of Azerbaijan, especially in the tributaries of mountain rivers, there are about 80,000-100,000 hectares of alluvial-stony soils. However, most of this land is not used for agriculture. This is explained by insufficient knowledge of the physicochemical properties of these soils and the degree of rockiness. Stony soil is one of the main properties that reduce its low economic value.

Thus, stones of different sizes and quantities in the surface and profile of the soil, reducing the fertility of the soil, make it difficult to carry out the necessary agrotechnical and reclamation measures of technology on these soils.

For the restoration of stony soils for the needs of agriculture, first of all, the study of the degree of rockiness and physical and chemical properties, as well as the collection and cleaning of stones from these territories is one of the most important agrotechnical measures and is one of the most important measures of agricultural technology and has valuable scientific and practical significance. Mineralization of groundwater increases to 25-70 g/l, and in some cases up to 100 g/l. Depth of placement ranges from 2 meters to 10-15 meters. Although the main source of irrigation in this area is river water, other sources of water are also used - artesian wells and kakhriz shafts. Mineralization of artesian wells is 0.4–1.1 g/l, and in the waters of Kakhriz shaft - 0.3–0.6 g/l.

There are freshwater deposits in the Sheki region. There are 2 deposits of fresh water with reserves of 128.8 thousand m^3/day. And one deposit of mineral waters with reserves of 0.284 thousand m^3/day. In the course of our study, it was found that the average diameter of water-resistant aggregates in the first 25-30 years on newly irrigated alluvial meadow soils is 0.28-0.30 mm. However, on irrigated lands (up to 100 years of irrigation), this indicator is 0.31-0.33 mm, which must be taken into account when adapting the degree of erosion of ancient irrigated accumulative soils to the modern classification.

Dependent small particles that enter with irrigation water deteriorate the particle size distribution, and the particles move inside the field under the action of the water flow.

On smooth areas, these changes are equal, but on sloping areas they are concentrated below. Since ancient times, irrigated lands are mainly heavy clay and clayey. Changes affect soil density, porosity, structural composition and water regime. Excavation and embankment of leveled soil reached 30-40 cm. Although this process facilitated irrigation, drilling and spilling destroyed the structure, displacing 1000-3000 m^3 of fertile soil per hectare.

In the process of alluvial-hydromorphic soil erosion, and especially for studying the important role of vegetation in the formation of humus, the surface phytomass and the mass of plant roots were determined over 3 years. The amount of phytochemicals is determined once a year, with the maximum growth of the growing season (end of May).

The Kish River has a well-developed river network.

The amount of nitrogen and ash elements in the composition of plant species prevailing in the herbariums was determined.

Most of the foothills and plains in the Sheki region are irrigated. Erosion resistance in these soils is significantly improved.

Indicators are a source of information on the quantity and quality of the final state of land. Anthropogenic impacts play an important role in the depth of groundwater, the dynamics of mineralization, and water-salt balance.

A diagram of the distribution of humus at different depths in anthropogenically altered soils of natural cenoses and agrocenoses of river basins has been established, showing that the amount of humus in the upper layers is large and decreases with depth.

Dependent river tributaries provide a sufficient amount of humus (1.19-1.59%) and nitrogen (0.09-0.17%), a slightly alkaline medium (pH = 7.3-7.5). Low mineralization of groundwater is characteristic (0.85–1.98 g/l). The total chemical composition of the alluvial deposits forming the soil is SiO_2 (59.4-64.7%) and R_2O_3 (Al_2O_3=20.0-25.6%; Fe_2O_3=8.4-10.7%) prevails in the composition. The amount of dry residue in the middle reaches of the river is 0.47 g/l, and in the lower reaches of 0.92 g/l.

The salinity of groundwater in the river beds increased to 1.53–3.46 g / l, and in microdepressions to 4.28–9.35 g/l, which led to varying degrees of soil salinity.The amount of physical clay (particles <0.01 mm) in irrigated meadow-gray soils is 81.24-88.0 % in wet soils and 45.72-81.40 % under cereals. According to agrochemical indicators, the amount of humus in meadow gray soils is 0.41-2.92 % and 0.53-2.45 %, respectively, and the highest carbonization rates are 12.32% and 13.90 %. This variation is considered to be an indicator that the soil samples are suitable for cultivation.

$$S_{or} = k \cdot \frac{v^m}{H^n \cdot u^k}$$

The following formula is most often used as a result of processing field research results:

$$S_{or} = 11 \cdot v_{or} \sqrt{\frac{RI \cdot v_{or}}{u}}$$

R is the hydraulic radius of the flow,

$$S_{or} = 0{,}0022(v_{or} / u)^{1,5} \cdot \sqrt{RI}$$

the following dependencies are suggested for small items.

Main physical-chemical indexes in naturally chenos and agrochenos are shown on the two characterization soil profile (Table).

Main soils in basin of Kish river are Fluvisols, Cambisols, Leptosols [6].

Fluvisols accommodate genetically young soils in fluvial, lacustrine or marine deposits. This soils are characterized by regular flooding and the sedimentation of new alluvial layers. Latin fluvius – river. This soil characterized by various hydrological regimes, conctructions and properties. Its properties are mainly determined by the nature of the basin, where these soils are developed. The soil profile usually has the following structure: A-BC-C-CD. Predominantly recent, fluvial, lacustrine and marine deposits. River plains and fans, valleys, lake depressions and tidal marshes on all continents and in all climate zones; no groundwater and no high salt contents in the topsoil; many Fluvisols under natural conditions are flooded periodically. Profiles with evidence of stratification; weak horizon differentiation but a district topsoil horizon may be present. The good natural fertility of most Fluvisols and attractive dwelling sites on river levees and on higher parts in marine landscapes were recognized in prehistoric times. Later, great civilizations developed in river landscapes and on marine plains.

Cambisols combine soils with at least an incipient surface soil formation. Transformation of parent material is evident from structure formation and mostly brownish discoloration, increasing clay percentage, and/or carbonate removal. Brown forest soils profile has the following horizons: Ao-A-Bm-C; Cinnamonic soils has next structure:

A-B(Ca)-BC(BCCa)-Cca.Soils with at least the beginnings of horizon differentiation in the subsoil, evident from changes in structure, colour, clay content or carbonate content. Medium and finetectured materials derived from a wide range of rocks. This soils are characterized by slight or moderate weathering of parent material and by absence of appreciable quantities of illuviated clay, organic matter, Al and/or Fe compounds.

Leptosols comprise very thin soils over continuous rock and soils that are extremely rich in coarse fragments. Leptools are particularly common in mountain regions. Leptosols are thin soils; from Greek leptos, thin. Various kinds of continuous rock or unconsolidated materials with less than 20 percent (by volume) fine earth. Leptosols have continuous rock at or very close to the surface or are extremely gravelly.

Conclusion

1. In the channel of the Kish river marks increase of the bed water and in microrelief cause different degree of soil salinization.
2. Main soils in basin of Kish river are Fluvisols, Cambisols, Leptosols, The ecological significance of these soils is not limited to agricultural aspects and play an important role in the hydrological mountain areas.

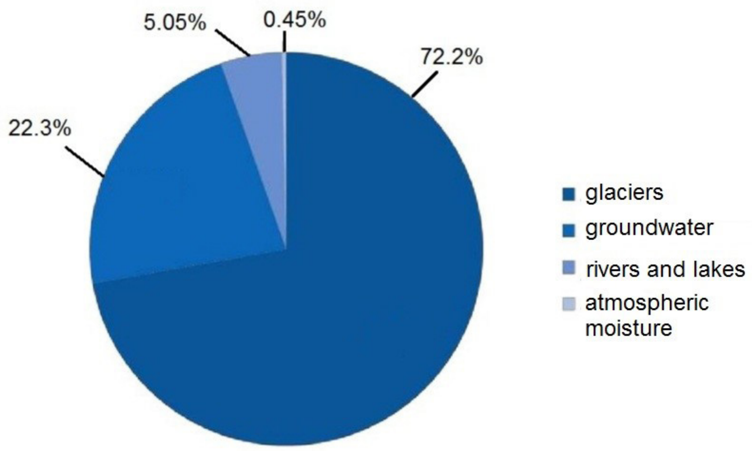

Fig. 1. Water content of Kish river valley

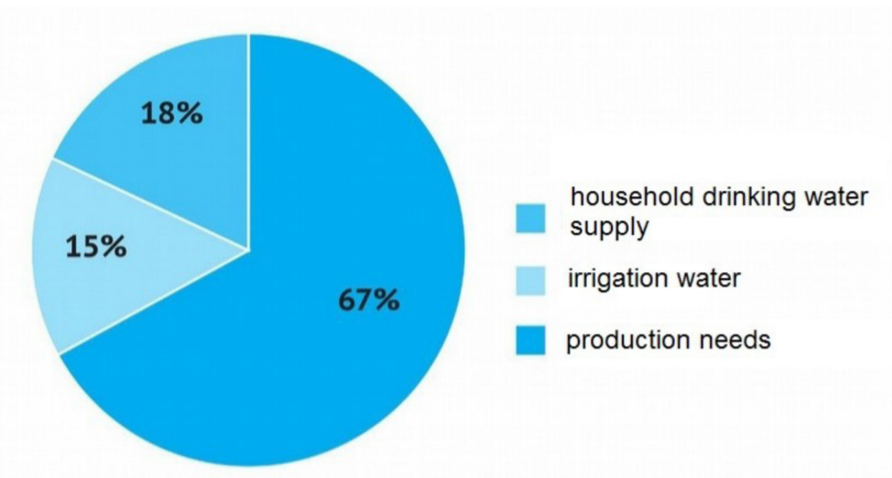

Fig. 2. Kish river water use scheme

Fig.3. Laboratory analysis of soils taken from the riverbed

Fig. 4. Some of the land plots and water samples

Fig. 5. Kish river in Sheki region

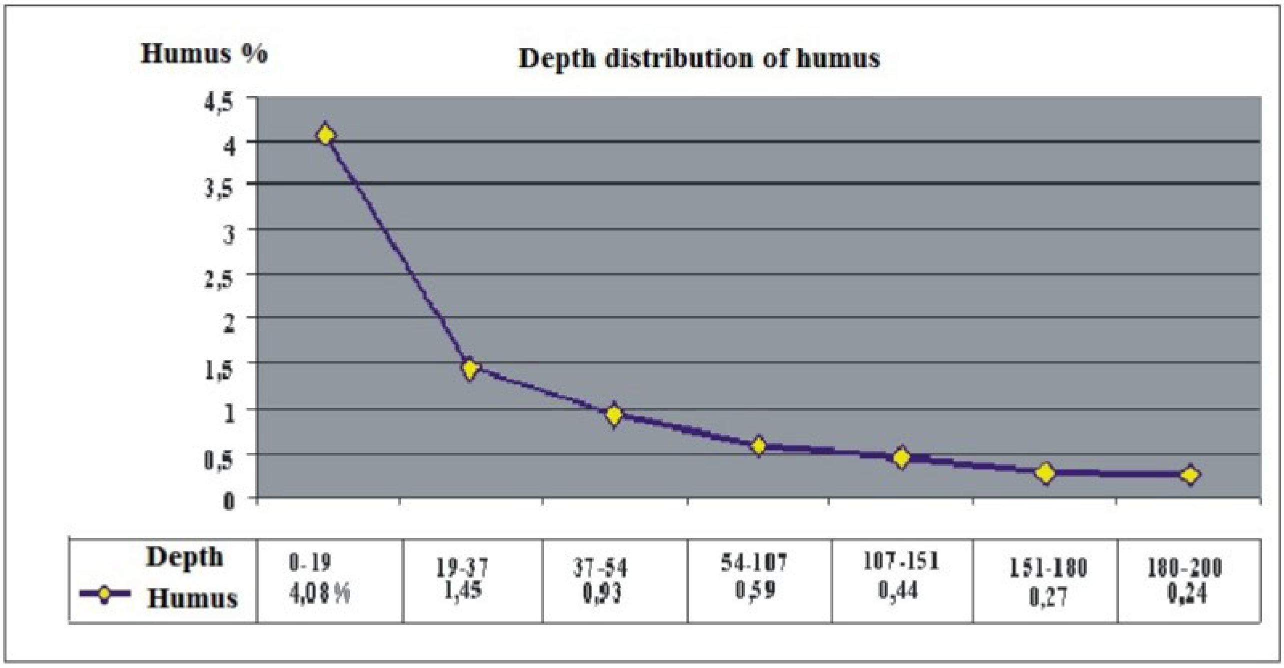

Fig. 6. Distribution of humus at different depths in the soils of natural thenoses in river valley

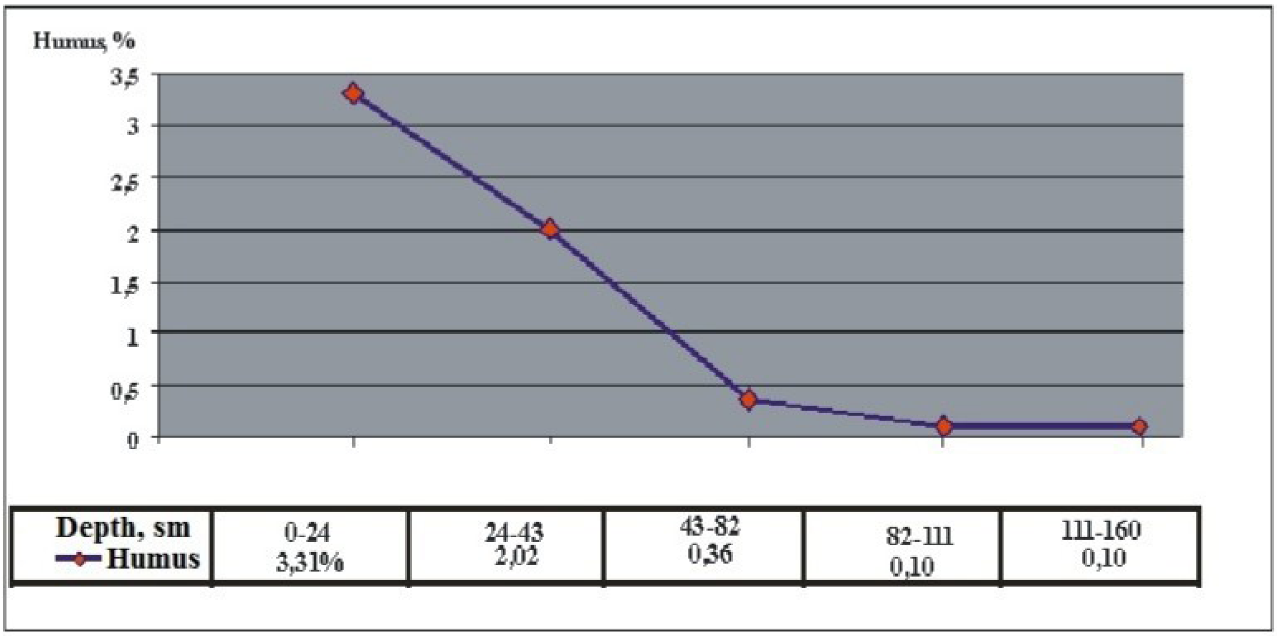

Fig. 7. Distribution of humus at different depths in the soils of cultivated thenoses in river valley

Table. Basic physicochemical indicators in the soils of natural thenosis and agrothenosis

Cenoses	Depth, sm	Humus %	Azot %	$CaCO_3$ %	Dry residure %	Absorbed bases mg/ekv		pH in solution	Hygros-copic humidity %	Ca/Mg
						Ca	Mg			
Soils of natural cenosis	0-19	4.08	0.29	47.64	0.200	0.77	1.26	7.1	3.09	0.61
	19-37	1.45	0.12	52.18	0.120	0.63	0.49	7.2	2.33	1.28
	37.54	0.93	0.09	50.52	0.154	0.49	0.49	7.0	2.36	1.00
	54.107	0.59	0.07	47.46	0.162	0.49	0.56	7.4	2.38	0.87
	107-151	0.44	0.06	48.43	0.216	0.56	0.63	7.3	2.45	0.89
	151-180	0.27	0.05	48.45	0.220	0.58	0.65	7.3	2.47	0.90
	180-200	0.24	0.03	47.40	0.200	0.57	0.64	7.2	2.46	0.90
Soils of agrosen oces	0-29	3.58	0.26	18.04	0.165	0.91	0.42	7.2	4.90	2.17
	29-57	3.12	0.23	16.33	0.184	0.91	0.35	7.1	5.23	2.60
	57-102	2.24	0.17	36.32	0.155	0.84	0.42	7.4	4.23	2.00
	102-150	1.87	0.15	45.12	0.167	0.56	0.63	7.4	3.62	0.89
	150-170	0.27	0.05	42.78	0.165	0.70	0.42	7.3	8.95	1.67

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