World Bulletin of Social Sciences (WBSS)
Available Online at: https://www.scholarexpress.net
Vol. 29, December 2023
ISSN: 2749-361X

FACTORS AFFECTING THE HYDRODYNAMIC STATE OF THE SOKH GROUNDWATER DEPOSIT

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Article history:
Received: 4th October 2023
Accepted: 3rd November 2023
Published: 4th December 2023

Abstract:
This study delves into the intensively developed Burganda massif in the southeastern Ferghana Valley, focusing on the technogenic impacts on groundwater deposits. The research examines the hydrogeological shifts triggered by irrigation, reclamation efforts, and industrial activities in neighboring Kyrgyzstan, notably affecting the Sokh River's flow distribution. It investigates the altered hydrogeological conditions, revealing rising groundwater levels, changes in hydrochemical composition, and challenges faced by regions like Rishtan. Employing hydrogeodynamic models and modern methodologies, the study outlines the hydrogeological characteristics of various aquifers, emphasizing their usage and susceptibility to contamination. It identifies factors contributing to groundwater changes, highlighting the dual influence of natural hydrometeorological and structural-lithological factors alongside anthropogenic reclamation. Overall, this research sheds light on the intricate interplay between human interventions and natural processes, crucial for managing transboundary impacts on the geological environment

Keywords: Ground water level, hydrodynamics, flooding, technogenic impact, Hydrogeological Shifts, Technogenic Impact, Groundwater Deposits, Transboundary Territories, Hydrochemical, Composition, Reclamation Effects.

INTRODUCTION. The intensive development of various industries require extensive use of water resources.

The study area is located in the southeastern part of the Ferghana Valley. The relevance of studying the issue of studying the technogenic impact on groundwater deposits located in transboundary territories is increasing due to the fact that the resources of many deposits are formed outside the Republic of Uzbekistan and are subject to varying degrees of these impacts [1-3].

The sustained growth of industries has placed an immense demand on water resources, particularly evident in the southeastern Ferghana Valley. This region, known for its diverse ecological landscapes, has increasingly grappled with the intricate interplay between human activities and the delicate balance of nature. One of the critical focal points of concern revolves around the utilization of water resources and its consequential impacts on the region's hydrogeological framework [3-6].

Within this context, the study area situated in the southeastern part of the Ferghana Valley has emerged as a focal point for understanding the complex dynamics of water resources. Notably, the region's significance has surged due to the growing relevance of comprehending the technogenic influences on groundwater reservoirs. These influences are particularly crucial as many of the vital resources are formed beyond the borders of Uzbekistan, experiencing varying degrees of impact owing to extraneous factors. The Ferghana Valley, famed for its natural beauty and ecological diversity, has faced an intricate ecological situation [2,7-8]. This has primarily been triggered by extensive irrigation practices, ambitious reclamation endeavors, and industrial developments notably emanating from the neighboring Republic of Kyrgyzstan. The consequences of these activities have led to pronounced ecological and hydrogeological challenges within the transboundary territories of the Ferghana Valley, with significant implications for the region's sustainability and environmental equilibrium [9-13]. One distinctive area of focus within this intricate web of interrelated issues is the Burganda newly irrigated massif. Nestled on the right bank of the Sokh River, this massif represents a microcosm of the technogenic impacts stemming from extensive reclamation efforts. Spanning over 20 kilometers in length and reaching up to 1.5 kilometers in width, this inter-adyr plain slopes gently from the foothills of the Alai Range towards the regional center of Rishtan [14-17].

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As human interventions have intensified since the mid-1970s, marked by the cultivation of vast fallow lands and the utilization of a substantial percentage of Sokh river runoff for irrigation purposes, a pressing issue has emerged. This revolves around the equitable distribution of the Sokh River's flow between different republics, leading to complexities in managing water resources sustainably. Furthermore, the transformative impact of the Burganda massif's development, positioned higher than the primary Ferghana region territory, has significantly elevated groundwater levels in regions such as Rishtan and Altyaryk within the Republic of Uzbekistan. This has resulted in significant portions of land, approximately 6313 hectares in the Rishtan region alone, becoming economically non-viable [5-6,18-21].

The consequential alterations in hydrogeological conditions, including shifts in groundwater levels and changes in the chemical composition of water sources, have exacerbated challenges in the affected regions. There's a notable trend of rising groundwater levels by significant margins, leading to localized flooding and rendering underground water unsuitable for supplying rural settlements in certain sectors of the Sokhskoye field. This complex tapestry of human-induced changes overlaying the natural hydrogeological fabric has necessitated the adoption of modern methodologies and hydrogeodynamic models to understand and manage these alterations effectively. The study area, positioned in the southern and southwestern Ferghana artesian basin, exists within the alluvial fan of the Sokh River, bounded by geological features such as adyr uplifts and intercone depressions, while adjoined by the alluvial valley of the Syr Darya River [17,20].

MATERIAL AND RESEARCH METHODS. The Burgandy massif has been intensively developed since the mid-1970s. At present, tens of thousands of hectares of fallow lands have been developed, and almost 23-30% of the Sokh river runoff is used for irrigation. In this regard, there is a problem with the distribution of the flow of the Sokh River between the republics. The development of the Burganda massif, which, being a foothill, is located above the main territory of the Ferghana region, has led to a significant increase in the level of groundwater in the Rishtan and Altyaryk regions of the Republic of Uzbekistan. As a result, only in the Rishtan region, 6313 hectares of land practically went out of economic circulation.

Technogenic loads have led to a change in the hydrogeological conditions of the adjacent territories. In this regard, the level regime and salt composition of groundwater has changed.

The analysis of hydrogeological data on the dynamics of the groundwater level and hydrochemical conditions of the downstream territories, namely, the territory of the Rishtan region, shows that in this area the groundwater levels increased by 1.0-3.38m. In some areas, flooding of settlements is observed. According to the results of regime observations, since 1990, in the areas of the Rishtan and Baghdad regions, an intensive increase in the total mineralization and general water hardness has been noted. Moreover, the area of change in the hydrochemical composition of groundwater has doubled compared to the 1980s. Currently, in the eastern sector of the Sokhskoye field, up to a depth of 150 m, underground water is not suitable for water supply to rural settlements. Therefore, there is a need to study the current state of water management activities, ameliorative state, their changes in order to take measures to prevent negative consequences arising under the influence of transboundary loads on the geological environment. [1,15,21]

RESEARCH RESULTS. To solve the problem of related hydrodynamic variability of the territory and management it is necessary to adopt modern methods. When solving such problems, the compilation of hydrogeodynamic models using modern software gives good results. The development of a hydrogeological model provides greater clarity in assessing the hydrogeodynamic state of groundwater in the study area.

The study area is located in the southern, southwestern part of the Ferghana artesian basin, it is confined to the alluvial fan of the river. Sokh and is bounded from the south by adyr uplifts, from the east and west by intercone depressions, in the north it adjoins the alluvial valley of the river. Syrdarya.

Groundwater of aquifers of the Upper-Middle- and Lower-Quaternary deposits circulate in a single stream in the alluvial-proluvial formations of the alluvial fan of the river. Sokh, thus forming the "Sokh Groundwater deposit", which is unique in its scale. The formation of this deposit begins in the modern valley of the river. Sokh and occurs due to infiltration through the modern alluvium of the surface runoff of the river into the conglomerates of the Sokh complex, which, within the plain (i.e., the alluvial fan of the Sokh River), pass mainly into pebbles. The decisive role in the formation

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of groundwater deposits, thus, is played by surface runoff into the underground runoff of the river valley Sokh. Atmospheric precipitation plays an almost negligible role in the supply of groundwater due to their small average (100 m) amount [22-26].

The regional area of groundwater discharge is the river. Syr Darya, as well as spring and channel wedging out, drainage flow (along horizontal and vertical drains) and, finally, evaporation and transpiration - on the periphery of the alluvial fan.

On the study area, the following hydrogeological characteristics of groundwater are distinguished according to their stratigraphic confinement:

Aquifer of modern alluvial deposits aQ_{IV} - groundwater of this horizon circulates in loose-clastic sediments of the modern valley of the river Sokh with a total thickness of up to 30-50 m.

Water-bearing rocks are boulder-pebbles, pebbles, gravel, sand, among which there are separate thin layers of loams and sandy loams up to 1-3 m.

In the formation of groundwater, the main role is played by infiltration losses of the surface runoff of the river itself.

Alluvial Proluvial Upper Quaternary sediments aquifer aQ_{III} - distributed only in the northern part (on the periphery of the cone of the Sokh River), the main sources of aquifer formation are groundwater and surface flows coming from the mountain framing (along the alluvial valleys of the Sokh River), as well as infiltration of irrigation and atmospheric waters..

The static groundwater levels of the first aquifer from the surface are 0.2-2.0 m; specific flow rates are about 1.2-1.4 l/s. The coefficient of water permeability of the face is 480-520 m2/day. Water mineralization is 0.3-0.4 g/l, with a total hardness of 4-6 meq/l. Type of water sulfate-hydrocarbonate magnesium-calcium. The underground waters of the horizon described by us are currently used for irrigation. Recommended for irrigation and technical needs.

Aquifer of alluvial proluvial Upper Quaternary deposits apQ_{II} - Distributed within the Sokh-Haidarkan intermountain trough and mapped as the first from the surface; in the Sokh River alluvial cone area this aquifer is uncovered under the Upper Quaternary sediments.

In the first case, the formation of groundwater occurs due to surface flows (R. Sokh, Kuli-Zadarsay, Oksu). Water-containing rocks boulder-pebbles, pebbles, gravel, sands. The thickness of the aquifer is suitable up to 100-120 m. Static groundwater levels from 22.0-73.0 m; specific flow rates vary from 0.01 to 1.6 l/s. The water conductivity of the aquifer is 10-250 m2/day. Mineralization of water 0.2-0.7 g/l; total hardness 4-6 mg-eq / l. The type of water is sulfate-hydrocarbonate calcium-magnesium. Groundwater in this area is used for domestic and drinking purposes [27-28].

In the second case, the formation of groundwater occurs due to groundwater and surface flows coming from the side of the mountain frame. Water-bearing rocks are boulder-pebbles, pebbles, gravel and sands, which are exposed.

The aquifer of alluvial proluvial Upper Quaternary deposits apQ_{I} is developed in the flat part of the region (in the Sokh-Khaidarkan intermountain depression and on the alluvial fans of the Sokh River). Groundwater is formed by underground and surface runoff from the valley of the river. Soh. The water-bearing stratum is represented by boulder-pebbles, pebbles, gravel, sand, conglomerates, sandstones and gravelstones. The aquifer of the proluvial Middle Quaternary deposits apQII is distributed within the adyr part of the region (the northern slopes of the Rishtan and Sokh-Isfara adyrs). The formation of groundwater occurs mainly due to groundwater flows from the Burgandy massif, which is located outside the territory of the study area (in Kyrgyzstan) and plays a particularly important role in feeding the groundwater of the ancient alluvial fan. only the upper part of the section is exposed, represented by boulder-pebbles with sand-gravel filler and pebbles with sandy-loamy filler. The revealed thickness of this aquifer was 150-200 m deeper. The water content here is low. The static groundwater levels of the first aquifer from the surface are 90-120 m; specific debits within 0.2-0.8 l/s. The water conductivity of the aquifer is from 40 to 500 m3/day. Mineralization of underground waters 0.9-2.0 g/l. The type of water is sulfate-chloride sodium-calcium.

Irrigated agriculture in the area of work is characterized by a long history. Irrigation water sources are rivers, tributaries of the Sokh and the Big Fergana Canal (BFC). All these tributaries do not carry their waters to the Syr Darya River, because water is disassembled for irrigation through its systems.

Alluvial cone Sox has an exceptionally regular geometric shape. The horizontal lines that outline its surface are represented by almost regular semicircles, having a common center at the top of the alluvial cone. The absolute marks of the top of the alluvial cone are 690 m, on the periphery the absolute marks of the surface of the alluvial fan are reduced to 375-380 m.

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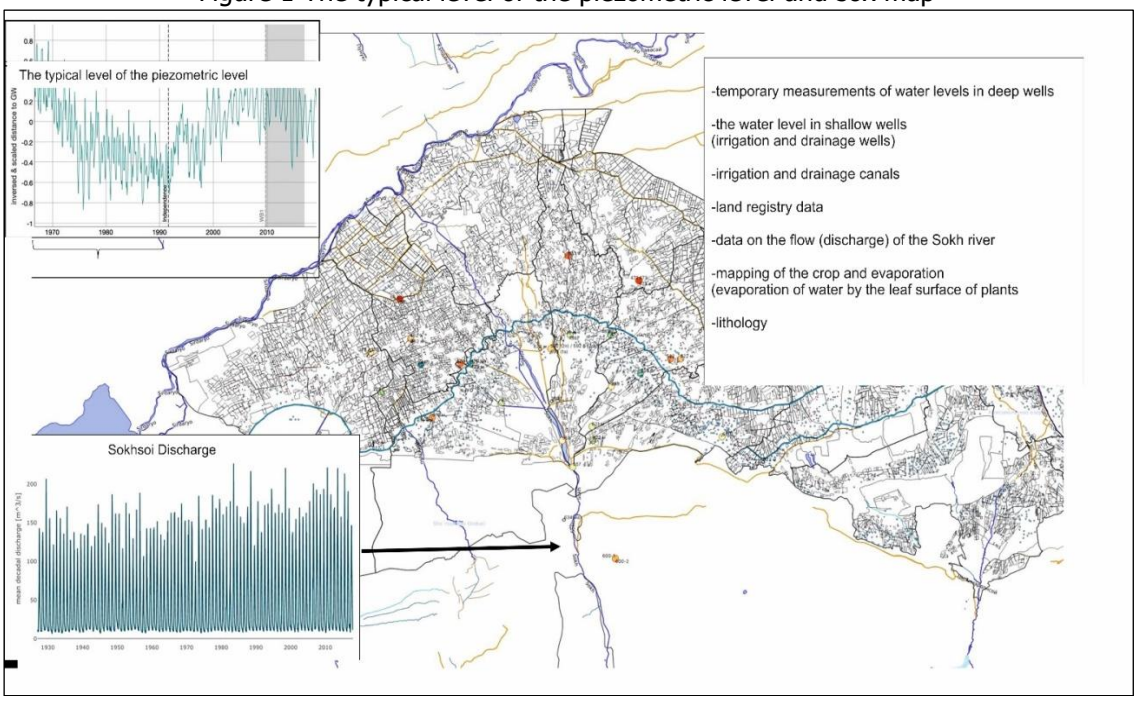
Vol. 29, December 2023
ISSN: 2749-361X

Figure 1 The typical level of the piezometric level and sox map



The alluvial fan is mainly composed of deposits of the Golodno-Steppe complex, on the eroded surface of which deposits of the Syrdarya complex lie in places. In the south, the alluvial cone adjoins hilly foothills - adyrs. The latter are composed of dislocated conglomerates, which in their origin represent an older alluvial fan of the river. Sokh, uplifted by mountain-building processes. The river Sokh cut through the adyrs, having worked out in them a narrow valley with steep slopes.

The structure is cut by the river in the core to massageta clays, to the north the river valley is worked out entirely in the conglomerates of the Tashkent complex. The flat bottom of the valley is composed of alluvium, merging at the exit of the river from the adyrs of the alluvial fan. In the north, the alluvial cone of the river. Sokh borders on the alluvial deposits of the Syr Darya, in the west and east it is separated by intercone depressions from smaller adjacent alluvial fans. According to the geological structure on the alluvial fan of the river. Sokh, the head part is clearly distinguished, entirely composed of coarse-grained material by pebbles with interlayers of conglomerates, and the periphery where the pebble surface of the alluvial fan plunges under fine earth, and the pebbles themselves are split by layers of loams and clays and gradually turn into sands.

The head and pebble part of the alluvial fan at the border with the fine earth part is outlined by a semicircle with a radius of 16 km, has an area of 416 sq. km, an average surface slope of 12-14 m per 1 km. The thickness of the pebbles, according to exploratory wells, exceeds 250 m. The periphery of the alluvial fan, located below horizontal 440, has a length of 15-25 km, an area of 1400 sq. km, the slope of its surface at the beginning is 5 m per 1 km, and then decreases to 1.5 - 2 m per km.

Within the limits of the Sokh alluvial fan, the regime of underground pressure waters, located near the feeding area, to the northernmost one.

Based on the brief description of the conditions for the formation of artesian waters noted above, the formation of their seasonal and long-term regime is due to the regime of water flow of the river. Sokh, which is the main source of formation and replenishment of groundwater reserves in the field of nutrition.

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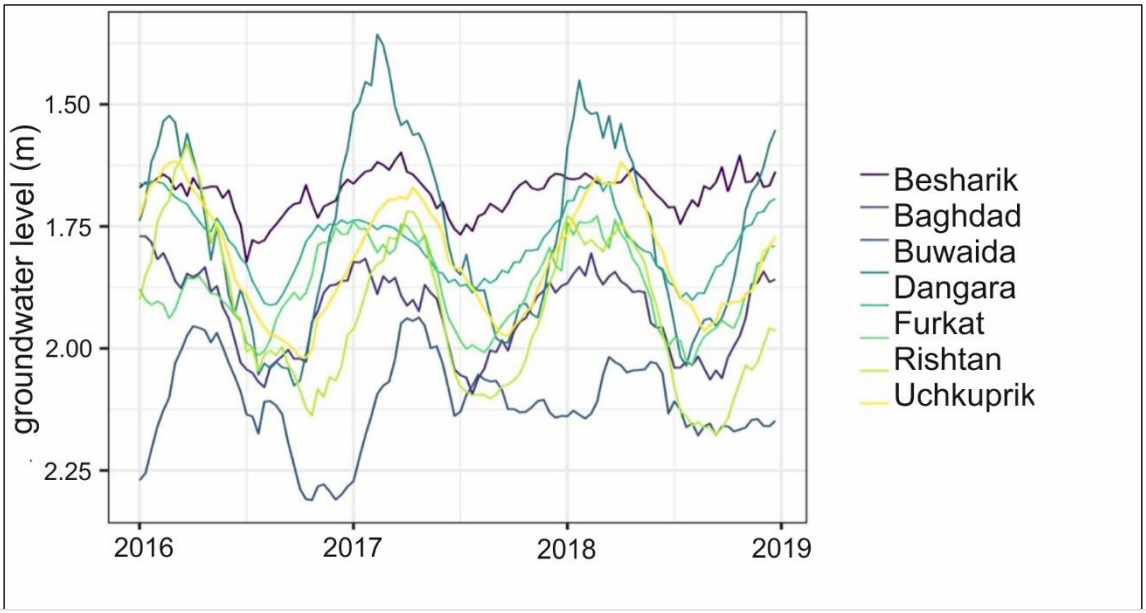

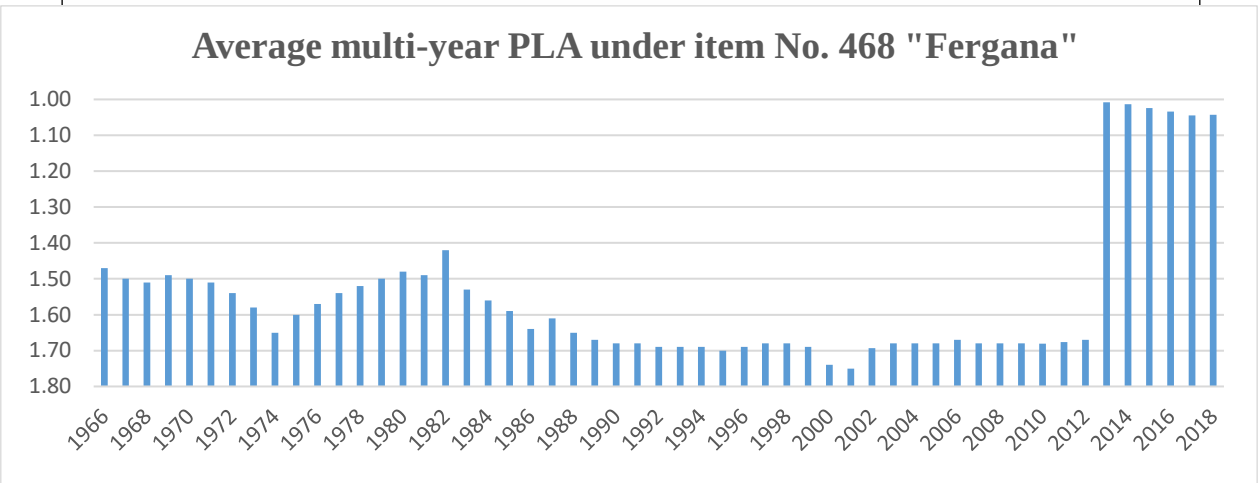

The average distance to groundwater sometimes increases, sometimes decreases during the year. Let's suggest about 0 stock change in the aquifer for the water balance.

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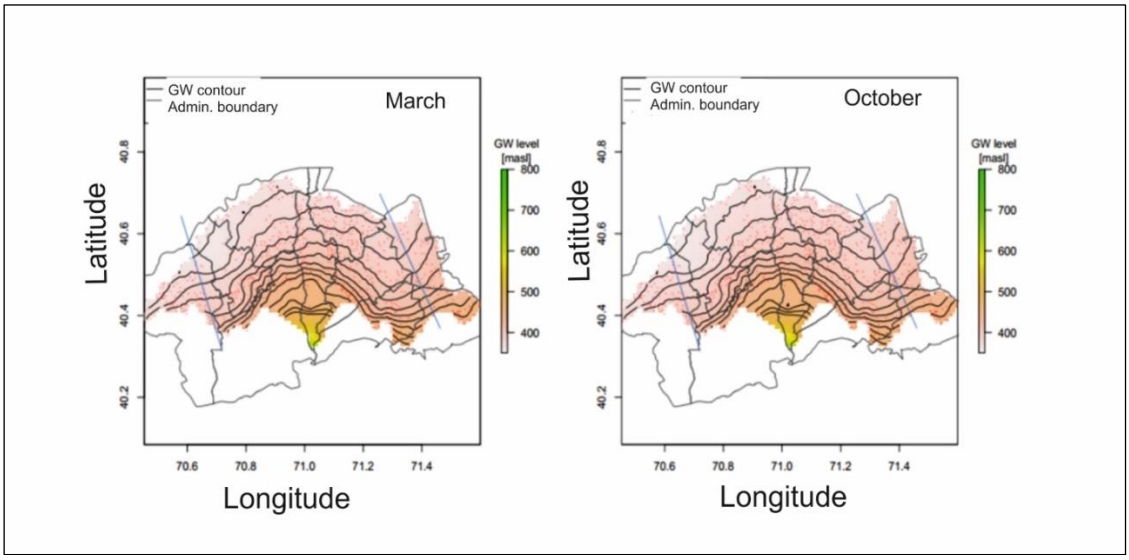

Minor changes in groundwater levels on a regional scale. The boundaries of the water balance in the east and west along the current lines are acceptable.

CONCLUSIONS:

- On the territories of the Sokhskoye groundwater deposit, the main exploited aquifers and complexes are confined to deposits of the Quaternary, Neogene and Paleogene ages;
- At the above deposits, intensive irrigation of adyrs and pebble areas, the alluvial fan of the river. Cox, started from the mid-70s, the impact on the deterioration of hydrodynamic conditions;
- The main factor influencing the formation of groundwater in natural conditions is hydrometeorological and structural-lithological, and technogenic is reclamation.

This study focuses on the Burganda massif's intense development in the southeastern Ferghana Valley and its impact on groundwater deposits. Investigating the repercussions of irrigation, reclamation, and industry from neighboring Kyrgyzstan on the Sokh River's flow distribution, the research uncovers altered hydrogeological conditions. It reveals rising groundwater levels and shifts in hydrochemical composition, particularly affecting regions like Rishtan. Employing modern methodologies and hydrogeodynamic models, the study outlines aquifer characteristics and their susceptibility to contamination, shedding light on natural and anthropogenic influences on the geological environment. This comprehensive analysis highlights the intricate balance between human interventions and natural processes, essential for effective transboundary management.

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