

Statistical Analysis of Changes in Ground Water Level in the Fergana Valley

by

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Abstract

This article provides a statistical analysis of the groundwater levels of the Ferghana Valley. In this case, the amplitude of the groundwater in the river basins of the valley and the mean squared deviation is calculated. When analyzing the groundwater statistics of the Fergana Valley, the absolute height and depth of the observational well in the river basins were taken into account. The mean depth of groundwater level, altitude above sea level, and differences between them are also presented.

Keywords: statistical analysis, groundwater, Ferghana Valley, amplitude, river basins, mean squared deviation, absolute height

Introduction:

One of the priorities is the assessment of the global groundwater regime and the impact of other natural and man-made processes on the ground. Therefore, the developed countries are implementing government programs aimed at identifying the causes of the change in the groundwater regime and reducing its negative impacts. Statistical analysis of changes in groundwater levels is also important.

Decree of the President of the Republic of Uzbekistan dated May 4, 2017, N PP-2954 "On measures for control and accounting of rational use of groundwater resources in 2017-2021" Resolution "On Measures for Further Regulation of Activities." The study and comprehensive statistical analysis of groundwater variability helps to minimize and prevent problems associated with them.

Analysis:

The average depth of groundwater obtained by calculating the variation in groundwater levels in the Ferghana Valley, its variability, and the depth of the observation wells and their absolute altitude are presented in Table 1. As can be seen from the table, wells are located between 357 and 936 m above sea level. Depth of wells 5 - 200 m. The water level in these wells is between 356 and 931 m above sea level. The annual amplitude is 0.72 - 18.0 m. In one river basin, the surface water varies from 70 m to 386 m. The data presented in it show that the groundwater amplitude, absolute, and squared deviation is decreasing from the upper part of the relief (Table 1).

Table 1 Statistical Indicators of Fergana Valley Groundwater¹

River basins	Surveillance well			Groundwater levels				
	number	absolute high-lig (H), m	deep-ligi, m.	on average depth, m.	sea level higher than liga (h), m.	Difference	amplitude (A), m.	medium square vertical nickel D), m.
Sokh River	9	406 – 680	5 – 188	1,95 – 95,2	403 – 667	264	2 – 18	0,40 – 4 ,8
Shohimardonsay	7	487 – 885	6 – 115	1,26 – 54,5	462 – 848	386	2,42 – 5,3	0,55 – 3,59
Isfairamsay	8	460 – 664	5 – 200	1,58 – 34,05	457 – 657	200	1,78 – ,98	0,32 – 2,09
Karariver	4	643 – 792	8 – 63	0,94 – 8,72	639 – 783	144	1,03 – 2,56	0,25 – 0,70
Andijansay	3	474 – 670	12 – 40	2,94 – 22,9	468 – 667	199	4,55 – 7,39	1,42 - 2,07
Shakhrihonsay	5	470 – 675	5 – 29	1,81 – 13,75	465 – 668	203	1,55 – 6,92	0,36 – 1,63
Akriver	4	600 – 669	7 – 190	2,41 – 7,33	593 – 664	71	1,8 – 7,76	0,39 – 2,07
Akbura	2	675 – 809	30 – 100	7,29 – 47,74	668 – 761	93	2,68 – 6,31	0,71 – 1,71
Tentaksay	1	523	20	3,05	520	-	9,04	2,22
Maylisu	2	469 – 681	10 – 35	4,12 – 4,19	465 – 677	212	2,2 – 2,9	0,57 – 0,79
Naryn River	5	397 – 498	5 – 103	1,32 – 27,73	396 – 470	74	1,45 – 16,59	0,34 – 5,35
Podshootasay	6	746 – 936	16 – 150	6,36 – 62,02	732 – 874	142	5,27 – 17,6	1,36 – 5,32
Cosonsay	3	646 – 812	9 – 200	0,76 – 31,18	614 – 811	197	1,76 – 6,95	0,44 – 5,17
Gavasay	7	638 – 934	8 – 150	0,94 - 36,78	601 – 931	330	1,17 - 13,92	0,26 – 3,65
Central Fergana	32	427 – 357	5 – 150	0,40 - 9,06	356 – 426	70	0,72 - 2,44	0,19 - 0,54

The table is based on the data of the Ferghana Hydrogeological Expedition Stations compiled by the authors.

The groundwater variability coefficients are the largest in the 26r observation well located in the Podshootasai Basin in the north of the Fergana Valley. The groundwater amplitude of this observation well is 17.6 m, absolute deviation 4.95, and squared deviation 5.32. Groundwater variability can also be seen in the observational well 558, located in the southern sector of the 567 Soh River Spill, located in the Naryn River Basin. Of wells with absolute and quadratic deviations greater than 1, 136 surveillance wells in the Soh range are distinguished by their low altitude - 451.5 meters (Table 2). Consequently, groundwater level variability coefficients are higher in most of the river basins of the valley, and in the center of the marsh are small values.

¹ Source: Author's own work

Table 2 Groundwater statistics in the Soh and Podshootasai basins²

Surveillance well			Groundwater levels				
No	absolute height (H), m	depth (M), m	mean depth (m), m	the sea from the surface height (h), m	amplitude (A), m	absolute deviation (C), m	Quadratic deviation (D), m
Sokh River basin							
557	679,7	124	12,70	667,0	11,66	1,79	2,35
558	647,8	88	67,17	580,6	18,17	3,53	4,80
258	546,8	188	95,21	451,6	9,56	1,82	2,21
257	508,3	170	66,68	441,6	6,61	1,22	1,53
439д	456,8	43	1,95	454,9	4,26	0,87	1,11
136	451,5	20	7,08	444,4	7,18	1,43	1,79
21	405,7	10	2,44	403,3	2,13	0,31	0,40
Podshootasay Basin							
26 P	936,03	150	62,02	874,01	17,6	4,95	5,32
9M	878,62	30	8,36	870,26	7,95	1,95	2,25
9MA	878,62	16	8,19	870,43	8,79	2,0	2,39
9MB	878,62	50	8,1	870,52	8,34	1,88	2,22
518	746,41	28	14,39	732,02	5,27	1,24	1,36
The table was compiled by the authors based on the data of the Ferghana Hydrogeological Expedition Stations. (Note: 439d groundwater tracking well number)							

Table 2 shows the correlations between the altitude (h) of the groundwater level and the absolute height (H) of the area of the observation well (H) calculated from the data of the Ferghana Hydrogeological Expedition Stations. Depending on the altitude of the groundwater-surface to the absolute altitude of the area, the correlation coefficient is 0.99 (Figure 1).

The high correlation between these two indicators allows the prediction of groundwater levels above sea level based on absolute altitude in the Ferghana Valley. You can use the following formula:

compiled by the authors (Note: 439d groundwater tracking well number).

$$h = 0.97H + 4.63$$

The table is calculated based on the data of the Ferghana Hydrogeological Expedition Stations, and the average error of this formula is 2.05%. In the sub-region, the errors are much larger. The biggest mistake lies in the observation wells in the center of the Soh distribution. Errors in the Central Fergana region account for around 1 % (Note: 439d groundwater tracking well number).

² Source: Author's own work

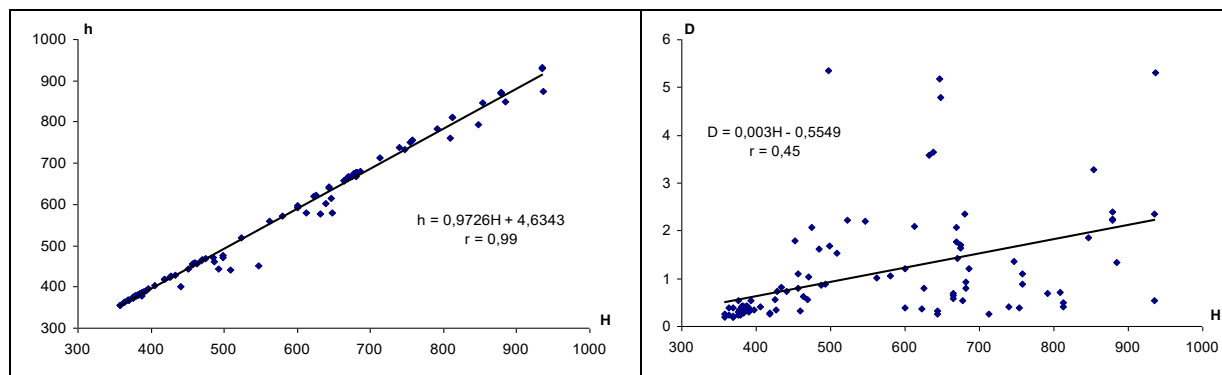


Figure 1. The correlation of groundwater levels and variability with absolute altitude

The correlation coefficient between absolute height (H) and groundwater level variability in the area where the monitoring well is located is 0.45, indicating a moderate correlation.

Conclusions:

The above analyzes allow us to arrive at the following conclusions:

- i. Groundwater variability (mean squared deviation) is large in the lowlands, low in plains and in swamps, and should be taken into account in groundwater management and regional organization of agriculture.
- ii. The correlation between the groundwater level and the region's altitude above the sea level, and the linear equation based on it, can often be calculated with a small error in the depth of the groundwater-surface at a given location. The general error of the linear equation for the Fergana Valley is 2%.

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