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Determination the Effects of Khanpur Dam Reservoir on Nutrition Source of Groundwater

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Abstract: The groundwater has unique importance as protected nutrition source for survival of sustainable life against the growing surface water contamination. Groundwater receives its recharge from surface water as a part of hydrologic cycle but due to filtration process through various layers remains protected. However the water in the unconfined aquifer is more quickly influenced and gets contaminated due to industrial and other anthropogenic activities. The extra ordinary recharge from dams located at elevation is capable to induce water logging conditions in the downstream areas. The investigation in the Dhamrah Kas Basin shows that the groundwater fluctuations are being controlled by the reservoir filling and depletion in the Khanpur dam. As a result the water table is forced to fluctuate between elevations of 1640 to 1670 feet. The maximum rise of 42 feet has been recorded since the construction of Khanpur Dam during 1983. Hence due to the rise of water table the probability of groundwater contamination has been increased many folds. However stagnancy trend in the water table since 1992 reveals sealing of discontinuities due to sedimentation, so there are no chances of water logging due to Khanpur dam in the study area.

Key words: Dam reservoir, groundwater, water logging, multilayered aquifer, water table

INTRODUCTION

Khanpur dam is one of the large dams of Pakistan with a total storage capacity of more than one lac acre feet. The dam was constructed in 1983, which created surface water reservoir with maximum depth of 267 feet. One of the major problems of the dam is the highly fragile nature of geology of abutments resulting huge water losses through seepage from the dam which caused extra ordinary recharge of groundwater in the downstream areas.

The shallow aquifers often become contaminated due to industrialization and urbanization (Foster *et al*., 1999; Oliver, 1999; Lerner and Tellam, 1992). Various studies performed by researchers in Dhamrah Kas Basin have revealed that multi layered aquifer system exists, with a thickness of 400 feet and spreading over an area of 250 square kilometer. Out of these aquifer layers the shallow aquifer is contaminated with respect to microbiological and other contaminants in the guide lines of World Health Organization (Whitehead *et al*., 1999; WHO, 1984; WHO, 2008). Khan and Malik (1995) performed investigation for elaboration of the hydrogeology and its application for protection of groundwater in Dhamrah Kas Basin (Fig. 1) and presented findings as," multi layered aquifer system spread over an area of about 150 square kilometer have been proven with the help of 30 test holes and 10 dugwells extending to the depth of 300-600 feet. The aquifer is classified as multilayered semi confined fresh body with an average well capacity of 200-350 gallons per minute".

In another study performed to investigate microbiological contamination in groundwater of Wah cantonment area, by examining 30 water samples, 20 samples from unconfined shallow aquifer and 10 samples from deep aquifer, Khan and Ahmad (2012) concluded that," the unconfined shallow aquifer (45-85 feet deep) has been found highly polluted where as the deep aquifer (180-300 feet depth) is still safe and found uncontaminated. Shallow aquifer has been found 100% contaminated with coliform and faecal coliform. Management measures to protect the groundwater have also been discussed for rehabilitation of the contaminated aquifer".

While investigating the nitrate concentration in groundwater in the Wah area, Khan *et al*. (2012) on the basis of analysis from 27 dugwells and 3 tubewells revealed that 26% wells related to the shallow aquifer are contaminated and have crossed the WHO recommended guidelines for nitrate level. Two zones with high nitrate contamination have been identified within the study area. Few samples collected from deep aquifer for comparison indicates that it is still safe from nitrate contamination".

This study is being performed to determine the effects of impounding of Khanpur dam reservoir on the water

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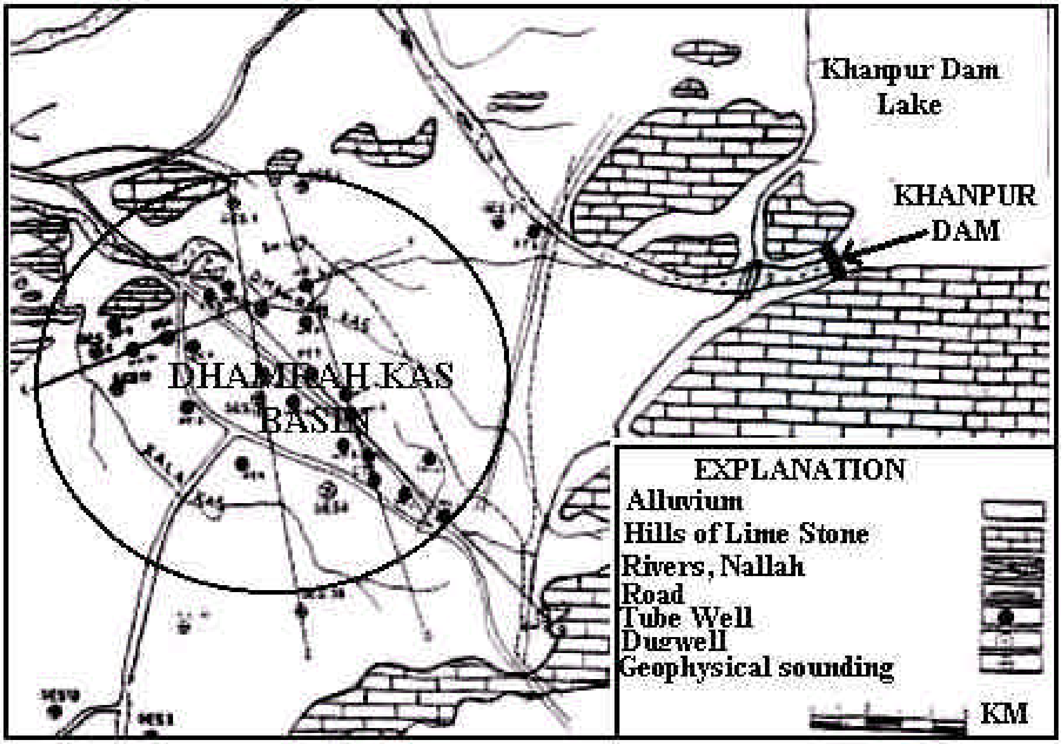

Fig. 1: Location map of the study area indicating Khanpur Dam and effected area of Dhamrah Kas Basin (Modified from Khan, 1997)

recharge and groundwater quality of Dhamrah Kas Basin especially in the deeper horizon. This study has been performed as a part of Ph.D. research project and partial results are being published through this article.

Fig. 2: A view of very old Dugwell with stairs, Lowser Bowly of Shair Shah Soori (1550 AD) which was used for monitoring of groundwater fluctuations. in the study area

MATERIALS AND METHODS

Data was collected from Khanpur Dam for ten years of reservoir levels on mid and end day of every month. The groundwater table data was obtained from Pakistan Ordinance Factories Wah Cantonment. Measurements of water table from wells located downstream of dam prepared by the WAPDA Khanpur dam before and after the construction of dam are also used to assess effects of Khanpur dam on groundwater. The major data input for Dhamrah Kas Basin is for the period 1989-1994, which was generated for groundwater development project, POF Wah and monitoring data of Khanpur Dam from 1995-2002.

RESULTS AND DISCUSSION

The results of water level fluctuations before and construction of dam are given in Table 1. It is clear from the comparison before and after impounding of the dam that rise in wells downstream of the dam took place. Historic data from Dhamrah Kas Basin (Table 2) reveals that water table in the central zone of the basin measured from Lowser Bowly (Fig. 2) remained almost constant 83-86 feet reported between the year 1950 to 1980 (Khan, 1997). However a sharp rise in the water table took place during the year 1983 which is directly related to the impounding of Khanpur dam reservoir.

Typical hydro graph plotted for depth to water table given in Fig. 3 is indicating a sharp rise and then gentle slope. The rise in the hydro graph is attributed to the recharge from Khanpur dam where as the gentle slope after 1990

Table 1: Groundwater monitoring data from selected water wells downstream of Khanpur dam, before and after impounding of reservoir (Ali, 1993)

Location	Top elevation (feet)	Water level before dam impounding (feet)	Water level after dam impounding (feet)
Tarnawa	1798	-	1726
Chitti	1782	1683	1693
Mora	1744	1634	1640
Bhera	1739	1614	1620
Kotha	1708	1576	1582
Garhi Sadden	1690	1592	1597
Sultalpur	1670	1572	1578
Usman Khater	1629	-	1535
Gohdo	1569	1503	1513`
Ghari Afghanan	1540	1488	1500
Near Mora Muradu	1718	1629	1635
Nikra	1689	1579	1585
North east Gangu	1657	1600	1616
Rahb\ar colony HMC	1605	1518	1522
Kolian	1567	1502	1518

Table 2: Historical data of depth to water table measured in feet for the central zone of Dhamrah Kas Basin

Year of Measurement	Depth to water table (ft.)	Remarks
1950	86	The data of depth to water table from 1950-1988 is taken from the record of the Pakistan Ordnance Factories Wah and reported by Khan (1997). The remaining data was collected during the groundwater development project for POF Wah during 1989-2000
1955	86	
1960	85	
1965	84	
1970	85	
1975	84	
1980	83	
1985	55	
1990	45	
1995	43	
2000	42	

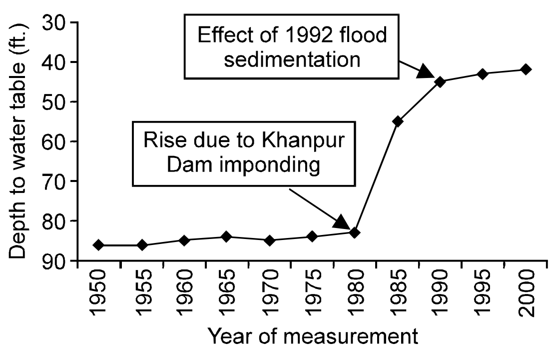

Fig. 3: Typical hydro graph of depth to water table for the central zone of Dhamrah Kas Basin

is due to the effect of 1992 flood sedimentation in the reservoir of dam. The high level of sedimentation greatly contributed in sealing the seepage cavities and discontinuities in the reservoirs which slowed down the rise of water table in the downstream areas.

The subsurface geological set up of the Dhamrah Kas Basin in given in Table 3 which shows that the basin is mostly composed of thick alluvial deposit with a number of aquifer layers. At the boundary of the basin there are limestone hills (Fig. 1) which may also contribute toward the recharge of groundwater.

Table 3: Lithological characterization of subsurface aquifer system of Dhamrah Kas Bosin

Depth in feet	Lithological characterization
0-45	Clay and silty clay with 3-5 feet top soil
45-65	Silt to very find grained sand, with water table
65-90	Clay, hard and compact with kankers at places
90-110	Gravel up to ½ inch size. with water table
110-120	Hard and compact clay
120-140	Gravel with course gain sand
140-170	Clay with some lenses of silt.
170-180	Gravel with course grain sand
180-220	Clay, hard and compact with silt lenses in the lower horizon.
220-390	Medium to course grain sand which constitute the major aquifer

The shallow aquifer has been reported as contaminated by Khan and Ahmad (2012) and Khan *et al.* (2012) with respect to nitrate and microbiological contamination.

The rise and fall of water table has become under the influence of Khanpur dam recharge. During high reservoir level in the dam, the upwards moving water table overlaps the regime of shallow contaminated aquifer. Hence the probability of migration of dissolved contaminants from shallow aquifer to deep horizon is greatly increased when it moves downwards during low reservoir levels in the dam.

Conclusion: The study reveals that the impounding of Khanpur Dam reservoir has influenced the recharge of groundwater system of Dhmrah Kas Basin. The induced cyclic rise and fall of water table is directly controlled by Khanpur Dam reservoir filling and depletion. As a result of cyclic rise and fall the probability of groundwater contamination has been increased and this may affect the overall nutrition intake of local inhabitants.

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REFERENCES

Ali, S.M., 1993. Third periodic inspection report for Khanpur dam project Associated Consulting Engineers, Lahore.

Foster, S.S.D., B.L. Morris and P.J. Chilton, 1999. Groundwater in urban development, a review of linkages and concerns. Proceedings of the International symposium by IAHS. Publication No. 259, pp: 3-12.

Khan, M.S. and M.H. Malik, 1995. Elaboration of subsurface hydrogeology and its application for protection of groundwater in Dhamrah Kas Basin, Pakistan. Bangladesh J. Environ. Sci., 1: 31-45.

Khan, M.S., 1997. Estimation of groundwater contaminants and establishment of protection zones in Wah Cantonment area, Ph.D thesis University of the Punjab, Lahore.

Khan, M.S. and S.R. Ahmad, 2012. Microbiological contamination in groundwater of Wah area. Pak. J. Sci., 64: 20-23.

Khan, M.S., S.R. Ahmad and Z.U. Rehman, 2012. Estimation and distribution of nitrate contamination in groundwater of Wah Town, its causes and management. Pak. J. Nutr., 11: 332-335.

Lerner, D.N. and J.H. Tellam, 1992. The protection of urban groundwater pollution. J. Inst. Water Environ. Manage., 6: 28-37.

Oliver, T.N.S., 1999. Groundwater contamination by organic chemicals in industrializing countries, the unseen threat. Proceedings of the International symposium by IAHS. Publication No. 259, pp: 23-28.

Whitehead, E., K. Hiscock and P. Dennis, 1999. Evidence for sewage contamination of the Sherwood sandstone aquifer beneath Liverpool, Uk. Proceedings of the International symposium by IAHS. Publication No. 259, pp: 179-185.

WHO, 1984. World Health Organization, Guidelines for drinking water quality. Recommendations, Vol. 1, Geneva, pp: 1-127.

WHO, 2008. Guidelines for Drinking-Water quality, 3rd Edn., Incorporating the First and Second Addenda, Recommendations, 1: 107-112.