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To investigate hydrogeological regime and wetland –groundwater interactions around Ropar wetland, Punjab, India.

Jasbir Kaur Taak[1]
[1]Department of Environment Studies, Panjab University, Chandigarh -160014, India.

Abstract : *In the present paper the hydrological regime and wetland – groundwater interactions around Ropar wetland is studied to know how a wetland is functioning and its influence on hydrology of the area. The subsurface lithology around Ropar wetland inferred on the basis of borehole data of Bhagowali and Purkhali sites reveals that upto the depth of 25 m bgl is non-granular zone (clay, silty clays, hard clay) followed by granular zone (coarse sand, medium sand, pebbles, gravels, and boulders) upto the depth of 30 – 35 m bgl. Again there is a thick layer of non-granular zone from 60 -72 m bgl. As we go deeper upto 95-120 m bgl, the granular and non-granular zone layers occur with 2-5 m thickness. The aquifer system is shallow and depth to water level ranges from 5-10 m bgl in Ropar area. The water level fluctuations for the period 1990 to 2012 indicate the rising and falling trend of ground water in study area; it is due to over exploitation of groundwater by tubewell for agriculture and groundwater recharge by river Satluej. The wetland – groundwater interactions reveal that Ropar wetland interacts with the top shallow aquifers by contributing recharge to the upper shallow aquifers but due to over exploitation of groundwater in Ropar and adjoining areas, the water levels show declining trend except the areas which are located close to hydrological boundaries (river Satluej and major canal such as Nangal Hydel Channel) on account of recharge made by these water bodies and lesser exploitation of groundwater.*

Keywords: *Hydrological regime, Ropar, Groundwater and Wetland.*

1. Introduction

The wetlands are more productive ecosystems and are mainly characterized by the presence of water, undrained hydric soils and support vegetation adapted to wet conditions (hydrophytes) [1]. Such ecosystems are distributed all over the Quaternary sediments and influence groundwater regime of the area. Understanding hydrogeology around wetlands is an important issue which helps in taking proper conservation measures for the protection of wetland ecosystem but this issue has not received much attention though it was highlighted in "The Ramsar Convention Manul" [2]. To understand the wetland- groundwater interactions in the area especially to know the impact of depletion of water levels on the wetlands is an important environmental issue of concern [3]. In order to fill up this gap and to understand the hydrogeological regime and wetland - groundwater interactions around Ropar wetland, an attempt has been made in the present paper by providing the detailed data regarding subsurface geology, aquifer systems, depth to water table, water level fluctuations and water table elevation contours.

2. Study area

Ropar wetland lies between $31^0 01'$ N Latitude and $76^0 30'$ E Longitude near Ropar City as shown in figure 1. Ropar wetland was formed due to the construction of Ropar head regulator in year 1952. Before that, small headwork was constructed during the year 1882, on the right side of river Sutlej near Ropar town so as to supply water to Sirhind Canal. The climate of Ropar wetland has mean maximum temperature of 42 ^{0}C during June to minimum temperature of 4 ^{0}C during January. The average annual rainfall of the area is 855 mm [4]. Ropar wetland is manmade fresh water riverine and lacustrine wetland. The ecological area of Ropar wetland is spread over 1365 hactares [5].

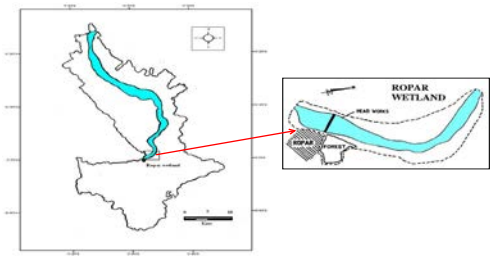

Figure 1 Showing location of Ropar wetland.

3. Geology and Geomorphological features

The regional geological map (Fig. 2) around Ropar wetland reveals that rocks of Siwalik system (lower, upper and middle) are exposed in the north east parts of the wetland. These rocks form the catchment area of the wetland. Lithologically, these are loose sand stone and silt stone which give rise to sandy and silty soils in the area. The catchment area of Ropar wetland is characterized by gentle to moderate slopes on the foot slopes of Siwaliks [6]. Satluj river forms the main drainage system in the area and flows from north to south wards [6]. The drainage pattern of Ropar wetland is sub-dendritic and sub parallel, where most of the streams have a narrow gorge and long length of flow in hilly tracts [6].

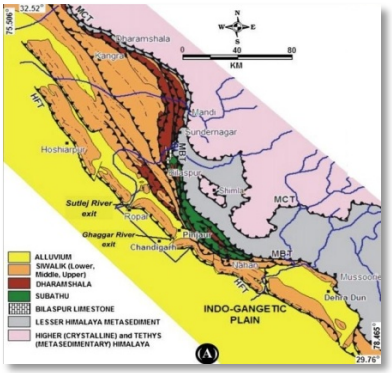

Figure 2. Showing the regional geology of area around Roparwetlands.(Source:https://www.academia.edu/12446522/Matching_geomorphological_study_of_Pinjaur_du_with_the_archaeological_reality_of_90_degree_deflection_of_Satluej_River_at_ Ropar).

4. Methodology

A. Data Collection

A different type of data was collected from different organizations to study hydrogeology around Ropar wetland. Some unpublished reports were collected from Central Ground Water Board, Chandigarh [4] to know the water level depth, existing aquifer systems, aquifer characteristics and overall hydrogeological regime around the study area. Year wise water level data was collected from Central Ground Water Board, Chandigarh for different sites in the Ropar district near to wetland area (from period 1985 to 2013) to monitor water level fluctuations.

B. Data Analysis and Mapping

The lithologs for two bore wells i.e. Bhagowali and Purkhali was prepared in Rockwork software. The water level data from period 1990 to 2012 in Ropar area was analyzed in an excel spread sheet for monthly and annual values for each bore well site. The hydrographs were plotted for May month (Pre monsoon period) and November month (post monsoon period) using word excel chat for the study area. The elevation contour maps were processed in Surfer 12 to study the ground water flow in the study area.

5. Results and Discussions

To understand the hydrogeological regime and wetland – ground water interaction around Ropar wetland, the subsurface geology; aquifer system; depth to water tables; water level fluctuations and ground water flow pattern are studied and discussed below:

I. Subsurface geology

The subsurface geology inferred on the basis of Bhagowali and Purkhali boreholes indicates that upto the depth of 25 m bgl, a non granular zone (clay, silty clay, hard clay) is followed by the granular zone (coarse sand, medium sand, pebbles, gravels, and boulders) upto the depth of 30 - 35 m bgl. Again

there exists a thick layer of non granular zone from 60 to 72 m bgl. As we go deeper upto 95-120 m bgl, the granular and non granular zones occur having thickness of 2-5 m. The depth to static water level ranges from 21.11 to 30.24 mgbl in these bore wells.

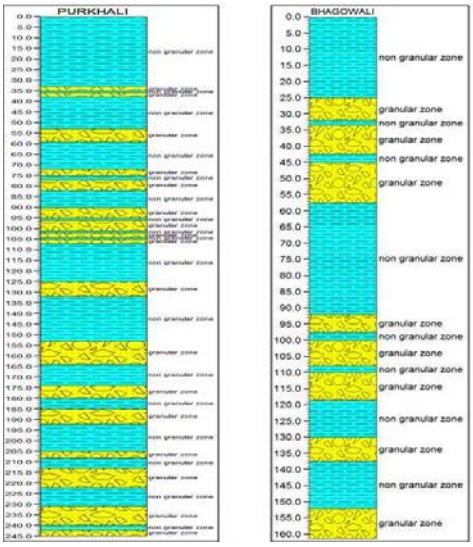

Figure 3. Showing the borehole hydrogeology of Bhagowali and Purkhali locations around Ropar wetland [7].

II. Aquifer system –

According to C.G.W.B [4], the groundwater occurs under unconfined conditions in the shallow aquifers and under leaky confined to confined conditions in the deeper aquifers in Ropar area. C.G.W.B [4] reported transimissivity values of deeper aquifer ranging from 123 to 1180 m^2/day and storativity values ranging from 1.7 $\times 10^{-4}$ to 7.8 $\times 10^{-4}$ in Ropar.

III. Depth to water table –

The figure 4 shows that depth to water level in Ropar area ranges between 5 and 10 m bgl during pre monsoon season [4].

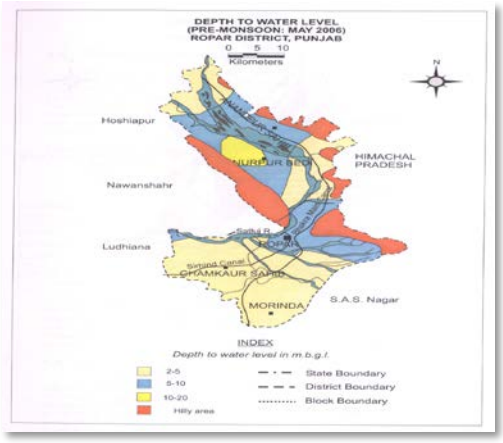

Figure 4- Showing depth to water level for Pre Monsoon Season (May, 2006) in Ropar area. (Source: C.G.W.B [4])

IV. Water level fluctuations –

The year wise water level data was collected from Central Ground Water Board (CGWB), Chandigarh for Ropar area for the period 1990 to 2012 to monitor the long term water level fluctuations around Ropar wetland.The hydrographs for May month (Fig. 5) and November month (Fig. 6) show the rising and falling trend of ground water for the period 1990 to 2012. The rate of fall/rise in water levels of observation wells located near Ropar wetland for the period 1990-2012 (Table 1) indicate that in two observation wells i.e. Ropar and Bajrur the rate of water level shows declining trend in both pre monsoon (May) and post monsoon (November) period, it is due to over exploitation of groundwater by tubewells in these areas. However, at Chakdera and Ahmedpur, a rising water level trend has been noticed. As Chakdera well is located close to river Satluej which makes substantial recharge which is reflected in the rising water levels. Similarly, Ahmedpur is located close to major canal (Nangal Hydrel Channel). Therefore, rise in water level in this well is attributed to the recharge made by the canal.

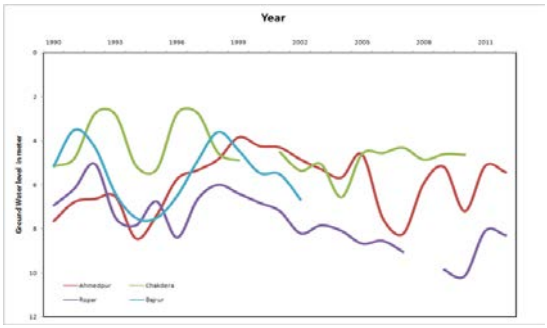

Figure 5 - Showing hydrograph for May (Pre monsoon) month in Ropar wetland

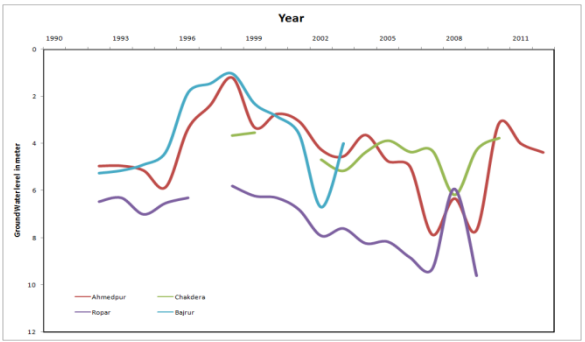

Figure 6- Showing hydrograph for November month in Ropar wetland

Table 1 Showing the rate of fall/rise of water level of observation wells near to Ropar wetland [From 1990 - 2012].

Sr. No.	Locations	Rate of fall /rise of groundwater level (cm/year)	
		May (Pre Monsoon)	November(Post Monsoon)
1.	Ahmedpur	+10	+4.18
2.	Chakdera	+8.86	+0.409
3.	Ropar	-6.22	-19.09
4.	Bajrur	-6.95	-7.04

II. Water table elevation contours

The groundwater elevation contour maps of Ropar area for May and November month are shown in figures 7 (A) and 7(B) for years 1990, 1996, 2001, 2006 and 2012. These maps reveal that the regional ground water flow direction is from north east to south west.

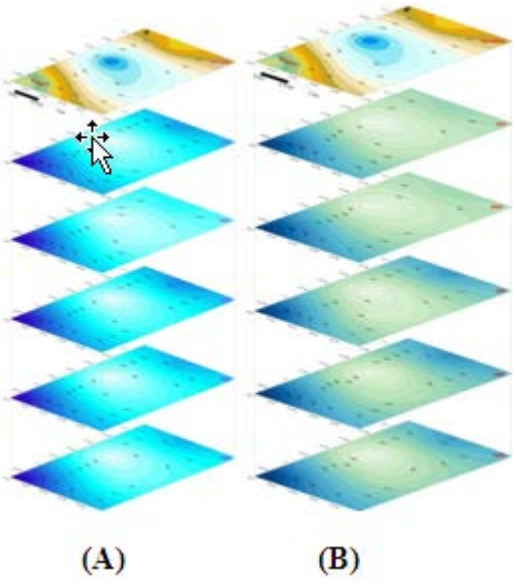

Figure 7 (A) and 7(B) - Showing water table elevation contour map of Ropar (November).

III. Wetland – groundwater interactions

On the basis of hydrogeological regime discussed above, it can be inferred that Ropar wetland interacts with the top shallow aquifers by contributing recharge to the upper shallow aquifers but due to over exploitation of groundwater in Ropar and adjoining areas, the water levels show declining trend except the areas which are located close to hydrological boundaries (river Satluej and major canal such as Nangal Hydrel Channel) on account of recharge made by these water bodies and lesser exploitation of groundwater.

6. Conclusions

The subsurface lithology around Ropar wetland inferred on the basis of borehole data of Bhagowali and Purkhali sites reveals that upto the depth of 25 m bgl is non granular zone (clay, silty clays, hard clay) followed by granular zone (coarse sand, medium sand, pebbles, gravels, and boulders) upto the depth of 30 – 35 m bgl. Again there is a thick layer of non granular zone from 60 -72 m bgl. As we go deeper upto 95-120 m bgl, the granular and non granular zone layers occur with 2-5 m thickness. The aquifer system is shallow and depth to water level ranges from 5-10 m bgl in Ropar area. The water level fluctuations for the period 1990 to 2012 indicate the rising and falling trend of ground water in study area. In two observation wells i.e. Ropar and Bajrur the rate of water level shows declining trend in both pre monsoon (May) and post monsoon (November) period, it is due to over exploitation of groundwater by tubewells for agriculture in these areas. However, at Chakdera and Ahmedpur, a rising water level trend has been noticed. As Chakdera well is located close to river Satluj which makes substantial recharge which is reflected in the rising water levels. Similarly, Ahmedpur is located close to major canal (Nangal Hydrel Channel). Therefore, the rise in water level in this well is on account of its location close to the canal.

The wetland – groundwater interactions reveal that Ropar wetland interacts with the top shallow aquifers by contributing recharge to the upper shallow aquifers but due to over exploitation of groundwater in Ropar and adjoining areas, the water levels show declining trend except the areas which are located close to hydrological boundaries (river Satluej and major canal such as Nangal Hydel Channel) on account of recharge made by these water bodies and lesser exploitation of groundwater.

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8. References

[1] Mitsch, W.I. and Gosselink, I.G., "Wetlands"VanNostrand Reinhold, New York, 1986.

[2] Ramsar, "The Convention on Wetlands text", http://www.ramsar.org/key conve.htm, 1994.

[3] Llamas, M.R., "Wetlands: An Important issue in Hydrogeology", In Selected Papers on Aquifers Overexploitation (Eds.) Simmers, I., Villarroya, F. and Rebollo, L.F., *International Association of Hydrogeologists, Hannover: Heise*, 3, 1992, pp 69-86.

[4] Central Ground Water Board, "Report on Ropar District Punjab", *Central Ground Water Board, Ministry of Water Resources, Government of India, North Western Region, Chandigarh*, 2007.

[5] Ladhar, S.S., "Ropar Wetland", *Punjab State Council for Science and Technology, Chandigarh*, 2005.

[[6] Verma, V.K., Chopra R., Sharma, P.K. & Singh C., "Integrated Resource study for Conservation and Management of Ropar Wetland Ecosystem, Punjab",*Journal of the Indian Society of Remote Sensing*, 4, 1998, p 26 .

7] Central Ground Water Board, "Report on Ropar District Punjab", *Central Ground Water Board, Ministry of Water Resources, Government of India, North Western Region, Chandigarh*, 1986.