Impact by Agrowells on Hydrgeological Conditions in Matale District

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Abstract

The study is focused on the groundwater challenges in the Matale district where groundwater used for irrigated agriculture is considered to be very high. Agro wells and deep tube wells are the main sources of groundwater supplement the water available from irrigation canals. The criteria for placing agro wells was also taken into consideration.

A survey was conducted to identify the distribution of agro wells, their distribution pattern, and distance between wells in five divisional secretariats of Matale district - Damubulla, Galewela, Naula, Pallepolaa, and Laggala-Pallegama. After carrying out a water quality assessment program, suitable well points were selected to monitor groundwater levels on a monthly basis to examine the relationship between water level decline and abstraction.

Hydrographs prepared show areas where heavy pumping have resulted rapid water level decline and also show recharge and discharge responses during wet and dry seasons respectively.

Carbonate and Bi-carbonate water types are dominate in the area while alkalinity, phosphate, and hardness record high values in the deep aquifer. Water quality in the shallow aquifer seems to be good with most parameters within the permissible levels. Water quality assessment was conducted during the wet and dry seasons to determine the influence of recharge and discharge on groundwater quality.

Groundwater level monitoring in wells that belong to private parties is of concern as there is no assurance of static water levels at the time of measuring. Plans are underway to install automatic data-loggers to address this problem.

Introduction

Matale district has been known to have an over extraction of ground water due to the prevalence of large number of agro wells. The process for study the priority areas of water level changes and water quality, and water quality trends associated with the over extraction situation. The area consists of high-grade metamorphic rocks belonging to the Highland Complex and post tectonic pegmatites (Cooray, 1984) including crystalline limestone, garnet-sillimanite gneiss, charnockitic gneiss and quartzite. All show a general strike trend of NW-SE and compositional layering is the prominent ductile structural feature. Large-scale upright folds are present in the middle and western parts of the area. Two sets of brittle fractures with fairly high intensity are also present trending NW-SE and E-W directions (Cooray, 1984). Matale District possesses hydrogeological conditions similar to that of many hard rock areas of other tropical regions in the world. Groundwater in the district occurs mainly in association with alluvial sediments, regolith of the basement rocks and within the bedrock, in zones of secondary porosity such as joints, faults, fractures, fissures or in solution cavities.

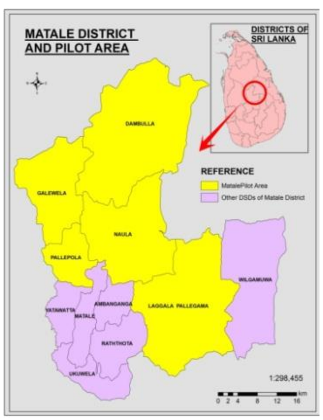


Fig.01: Study Area

Objective and Scope

Main objective of the project is to determine the groundwater level depletion by agro wells. Specific objectives are:

Identification of appropriate monitoring well location that provide necessary data to fulfill the objective of the monitoring programme.

Establishment of the frequency for groundwater level measurement and water quality sampling for each well.

Assessment of the information for groundwater level measurements and specific hydrogeological unit monitored by each well.

Establishment of procedures and methods for the review, analysis, validation, and reporting of groundwater level and quality data.

Methodology

In the dry period (September 2011), a detailed water level and ground water quality assessment was done while in wet period (January 2012), secondary data collection and sampling was done. Water samples were collected in to plastic bottles directly from the wells to study the water chemistry. The water level elevations were calculated using a digital elevation model (DEM) and ground water flow direction map and hydrographs were developed to study the actual situation in occurred. Study about the deep aquifers was done by using 20 tube well data which were selected based on several factors. In the study, wells with heavy pumping rates, industrial water supply tube wells and wells located close to the previous shallow aquifer monitoring points were considered to select these locations. Statistical analysis was used to analyze the similarities and extract the best point to long term monitoring.

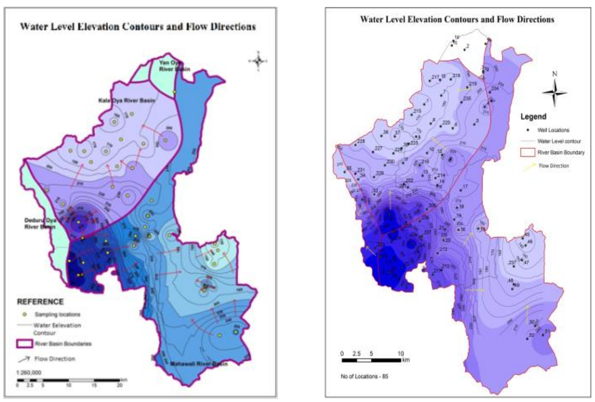


Fig.02: Potentiometric Contour maps

Potentiometric contour maps (Figure: 02) indicate three main flow directions

Results and Discussion

North- West, South-East, and South-West. Southwestern part of the project area, where shallow regolith aquifer exists, and contour lines of potentiometric level are characterized by steep slope. The direction of ground water flow and water divides is generally controlled by the geomorphological formations, and structures that are dominant in the study area.

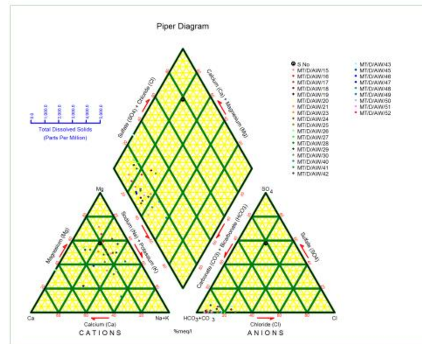


Fig. 03: Piper Diagram of Kala Oya Basin

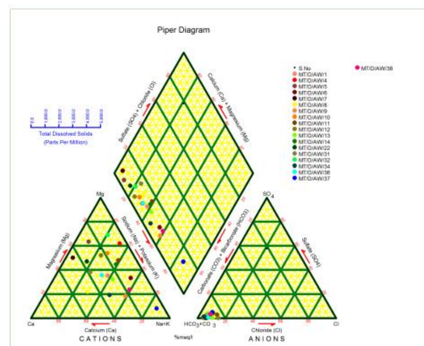


Fig. 04: Piper Diagram of Mahaweli Basin

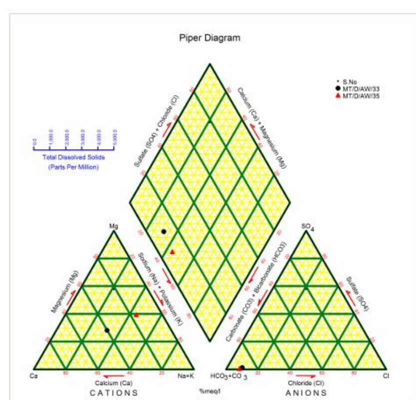
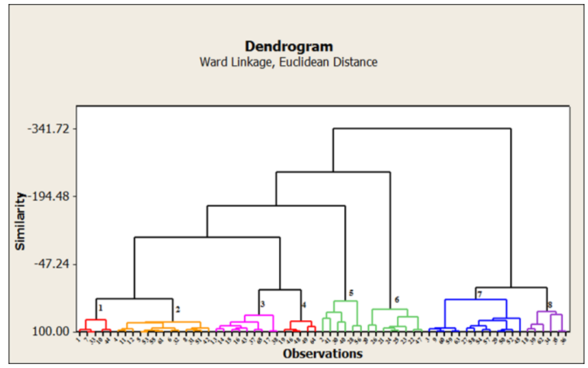


Fig. 05: Piper Diagram of Deduru oya Basin

Piper diagram shows that all the samples have very high amounts of HCO_3^- and CO_3^{2-} and lower amounts of SO_4^{2-} and Cl^-. Accordingly, this water is carbonate bi carbonate type water which may be due to the existence of carbonate rocks in the area.

According to the analysis (in dry period and wet period), chemical constituents present in water (Appendix A Figure: A1, A2) are not highly effecting to humans or environment. Alkalinity, total hardness, TDS, pH and turbidity values exceeded the drinking water standards given by Sri Lanka Standards but other constituent studied lies well below the desirable levels. In most places pH values are higher than the desirable level. That is due to certain dissolved minerals, such as Calcite, Dolomite etc. this high values occurring relatively dry area in the pilot area. Turbidity is high due to surge effect of the pumping for agriculture. Mud particle is the main reason for high turbidity in the wells. Fluoride concentration is high at the upper part of the pilot area that is close to Anuradhapura district that contains Hornblende Biotite Gneiss like rocks constitutes in F- rich minerals.

Statistical results displayed as a Dendrogram providing a visual summary of the clustering process. In this case sampling locations were divided into eight main groups. According to the result of this study long term monitoring points were selected in the area



Graph .01: Dendrogram of Q-mode HCA of the investigated location from Matale pilot area

Considering all these results and information, final monitoring network was stabilized using 42 wells including 34 agro wells and 8 test tube wells.

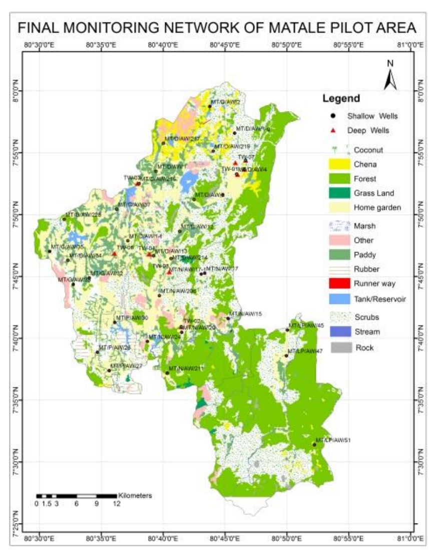
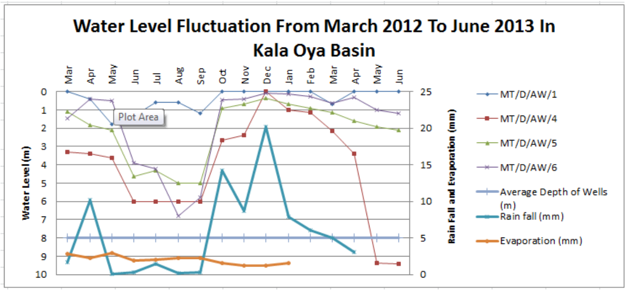
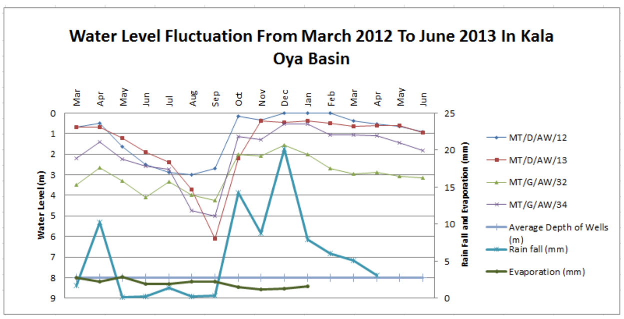


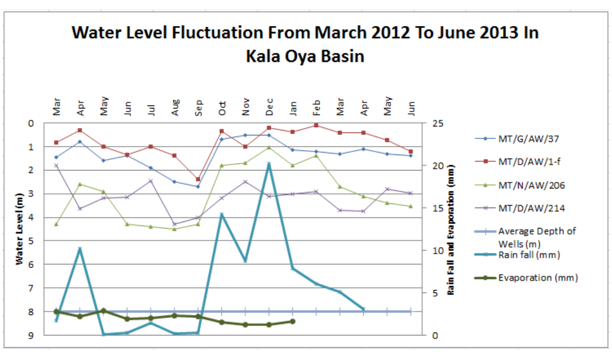
Fig.05: Selected long term monitoring network



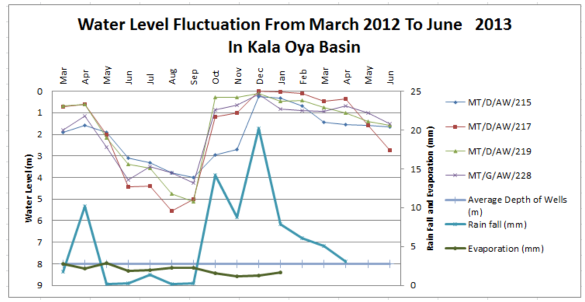
Graph. 02: Water level fluctuation of selected agro wells in Kala Oya basin from March 2012 to June 2013



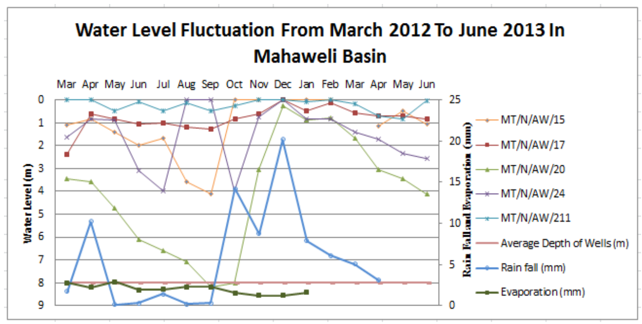
Graph. 03: Water level fluctuation of selected agro wells in Kala Oya basin from March 2012 to June 2013



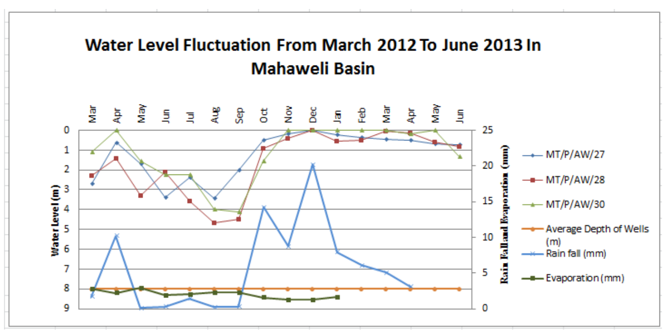
Graph . 04: Water level fluctuation of selected agro wells in Kala Oya basin from March 2012 to June 2013



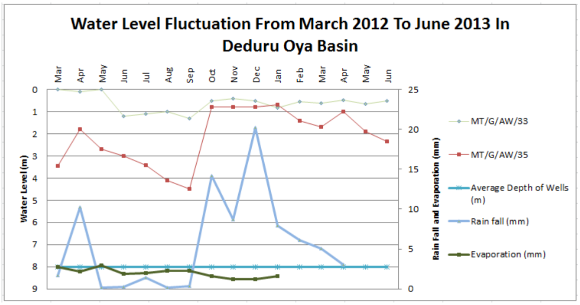
Graph. 05: Water level fluctuation of selected agro wells in Kala Oya basin from March 2012 to June 2013



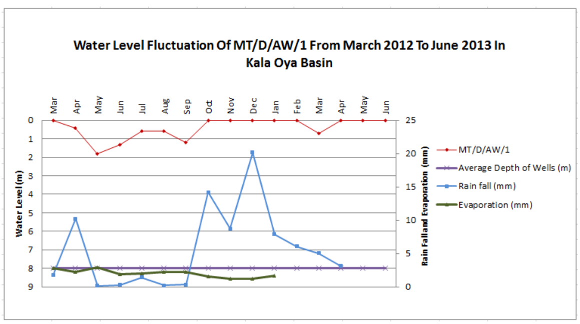
Graph. 06: Water level fluctuation of selected agro wells in Mahaweli basin from March 2012 June 2013



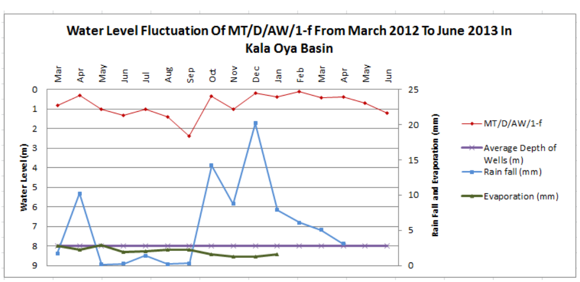
Graph. 07: Water level fluctuation of selected agro wells in Mahaweli basin from March 2012 to June 2013



Graph. 08: Water level fluctuation of selected agro wells in Deduru Oya basin from March 2012 to June 2013



Graph. 09: Water level fluctuation of selected agro wells in Kala Oya basin from March 2012 to June 2013



Graph. 10: Water level fluctuation of agro well MT/D/AW/06 in Kala Oya basin from March 2012 to June 2012

Conclusions

This study provided information on the changes to water level and water quality variation with respect to related environment, recharging pattern, seasonal climate, cultivation pattern and cultivation area, during the dry and wet season.

The over abstraction situation should be studied according to the seasonal pattern and crop cultivation pattern

According to this study (in dry period and wet period), chemical constituent present in water is not highly effecting to humans and environment.

Quality data was also useful for advising users how long it will take before water is safe to use for drinking, and to take an idea about selecting monitoring points which can be arranged for the long term monitoring and for the development of monitoring network.

The results of this study should be used to direct further investigations before being used as a basis for water management actions.

The study result was used to select the long term monitoring network in the pilot area. 34 agro wells and 8 test wells have been selected for this network. This should be done in conjunction with check of each river basin for over extraction based on geology, land degradation, potential point sources and any anthropogenic activity at present.

Recommendations

The water level measurements and information should be collected monthly and considered crop growing stages.

References

Cooray, P.G., 1984. An introduction to the geology of Sri Lanka.

Panabokke C.R. & Perera A.P.G.R.L. (2005). Ground water Resources of Sri Lanka.