Paper 12
Efficient Management in Water Supply: A Study at Araly Water Supply Scheme, Jaffna Peninsula

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ABSTRACT

The demands for water supply, irrigation, domestic and industrial water have increased considerably in recent past in Jaffna district. The shallow karstic aquifer in Jaffna peninsula is one of the six main groundwater aquifers of Sri Lanka. Jaffna peninsula is underlain by Miocene limestone formations which are generally 100 to 150 m thick.The karstic cavities result in a shallow groundwater table, recharged by rainfall, and groundwater forms a "lense" of fresh water floating over the saline waters. Groundwater is the major natural water source in the Jaffna peninsula and it is used for domestic, agricultural and industrial purpose. Safe drinking water supply is a vital important where the water resources are under vulnerable conditions.The vulnerability may arise from natural and anthropogenic effects including local climate, geology and agricultural practices. In Sri Lanka 40% of population has organized water supply facilities and 59.4% is depending on other sources such as wells, tube wells, streams and rivers, including 10% on unprotected sources.Water quality analysis is one of the most important phase in water supply schemes. Determination of physico-chemical characteristics of water is essential for assessing the suitability of water for various purposes like drinking, domestic, industrial and irrigation. National Water Supply & Drainage Board, Jaffna is supplying the drinking water for identified poor quality groundwater area and plays a major role in supply of drinking water for rural and urban population of peninsula by maintaining seven water supply schemes to fulfill their water requirements.Araly is the one of their scheme. It is the shallow well with the bottom depth of 4.30 m.The secondary data such as water level fluctuation, electrical conductivity of bottom and surface groundwater and production were collected analyzed on monthly basis from 2011 to 2013. Results show that during the wet season the water level varies 2.4 m to 3.8 m and during the dry season it varies as 0.3 m to 1.6 m. Electrical conductivity varies from 189 μS/cm to 6190 μS/cm. During the wet season the water quality parameters were nearly same at bottom and the surface of the well water but during the dry season those parameters show significant variation between the bottom and surface of the well water. Bottom quality values were higher than the surface values.Average production of the groundwater was 820 m^3/month. Earlier the pumping was carried out for three hours continuously but now the pattern of pumping was altered and do not pump continuously, there was a resting time after pumping of every one hour. Now the production was increased up to 2272 m^3/month. To protect the water quality deterioration and aquifer, alteration in the pumping pattern is a good practice and also usage of low pumping rate water pumps and floating foot valves during the pumping operations could facilitate further.

INTRODUCTION

Approximately 71% of the earth's surface is covered with water. Fresh water is found as underground water in large reservoirs surrounded by rock called aquifers. This groundwater has long been considered as one of the purest forms of water available in nature to meet the overall demand of rural and semi urban people.Groundwater is an essential part of the hydrologic cycle and a valuable natural resource. Clarke *et al*., (1996) stated that more than 1.5 billion people worldwide rely on groundwater for their primary source of drinking water.

Sri Lankan Government targets to provide safe drinking water supply for all by 2025 with 60% piped born water supply coverage by 2020 through, the National authority to provide drinking water, National Water Supply & Drainage Board (NWS&DB). The Jaffna peninsula is located in the Northern dry zone part of Sri Lanka. It is over 1100 km^2 in area and has a coastal line of 160 km. Area is flat with a surface gradient not exceeding 2% which is within latitudes $9^0$25'and 9°50' and longitudes 70°50' - 80°20'. It is bounded on the North and East by the Indian Ocean, on the west by Palk Strait and to the South by the Sri Lankan mainland.

Rajasooriyar *et al*., (1999) stated that Jaffna Peninsula is the Northern part of Sri Lanka which mainly depends on groundwater sources because other freshwater sources are not available. The shallow aquifer of the Peninsula occurs in the channels and cavities (karsts) of this miocene limestone. All the shallow groundwater found within the karstic cavities originates from the infiltration of rainfall, and this shallow groundwater forms mounds or lenses floating over the saline water (Panabokke and Perera, 2005).

Balendran (1969) stated that the Jaffna limestone is almost flat bedded with a slight dip to the west. Monitoring studies have confirmed a significant imbalance between the draw-off and recharge rates. This is the main problem in the Jaffna peninsula aquifer, especially around the coastal region, where the fresh water lens gets rapidly reduced in thickness thus limiting water supplies in the dry season which extends up to August – September.

Groundwater is the major natural water source in the Jaffna peninsula and it is used for domestic, agricultural and industrial purpose. Jaffna peninsula has its source of groundwater stored in the sub terrain layer of the limestone as the main aquifer. It is an excellent aquifer for storage because of its several isolated caves and caveins capable of storing groundwater without evaporation losses. The population of the Jaffna Peninsula is entirely dependent on the groundwater resources for all the purposes with seasonal rainfall. The availability of surface fresh water is limited and the entire groundwater is generated from percolated rainfall, which forms a fresh water lens beneath the Peninsula.

Groundwater quality in an area is a function of physical and chemical parameters that are greatly influenced by geological formations and anthropogenic activities (Subramani *et al*., 2005). Araly is a one of the water supply scheme of the NWS&DB, Jaffna. It is located near to coastal area.

As per the Jaffna Feasibility studies, Jaffna peninsula having four major underground water resources such as Point Pedro, Kayts, Palai and Chunnakam. The Chunnakam aquifer is most reliable source in Jaffna peninsula, comparably having high quantity of the water. Except these spots other areas facing sea water contamination because the peninsula surrounded by sea and lagoons. Due to this, the surrounding area water electrical conductivity is showing high values and the areas facing drinking water scarcity. And these areas are showing high quality variation with seasonal.

BACKGROUND OF THE STUDY

Araly south water supply scheme is situated in Valikamam west of the Jaffna district in Northern Province. This is located in the west border of the Chunnakam aquifer, scheme is serving to Araly South J/162, Araly centre J/161, Araly East J/163, Araly west J/160 areas. And the scheme has two shallow dug wells as source of the scheme.

Dug well Number one can able to produce 60 m^3 water per day where as the number two well can able to produce only less than 10 m^3 water per day. These wells are producing good quality water during wet season and high saline water in dry season. But the demand is vice versa. And the well water column is showing high water quality differences in the top and bottom in the drought season.

Continuous pumping also show high quality variation and required proper pumping pattern and necessary time interval for recharge.

METHODOLOGY

Araly supply scheme well water conductivity was measured in the top and bottom of the layer at monthly interval from 2011 to 2013. And specific sampler was used for collection of sampling from top and bottom. The "SensIon^{+}" conductivity meter was used for measuring the electrical conductivity of the water and other data water level, electrical conductivity of supply water were collected from Regional Office of NWS&DB, Jaffna.

Floating foot valve was design as shown in the diagram 01 and constructed with the locally available items. Floatable rigiform balls, stainless steel rods, stainless ring and jet type foot valve were used for the above purpose. Floating foot valve was installed in December 2013.

Pumping pattern also were changed and provided time intervals for recharging.

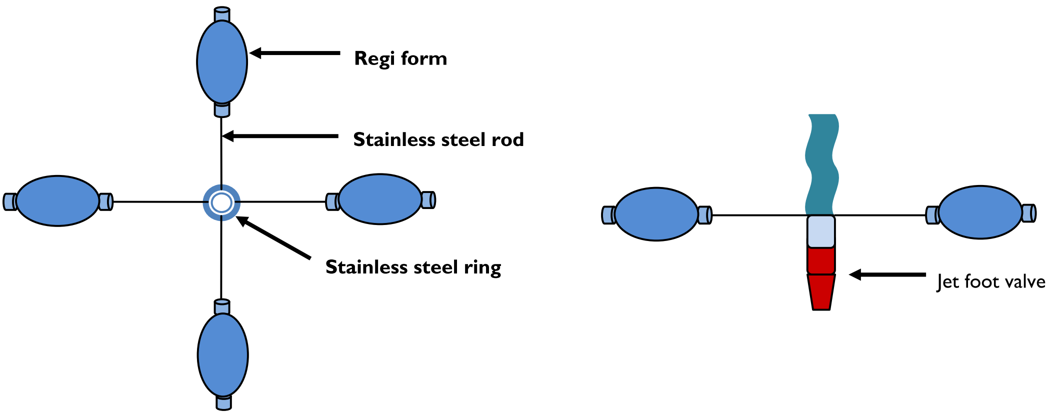

Diagram 01: Top and Side diagrammatic view of the Floating Foot Valve

RESULTS AND DISCUSSION

Results show that during the wet season the water level varies from 2.4 m to 3.8 m and during the dry season it varies as 0.3 m to 1.6 m. The figure 01 shows the electrical conductivity variation of bottom and surface groundwater and the electrical conductivity of scheme supply water (distribution Water quality) of Araly water supply well one from 2011 to 2013. According to the figure 01, the conductivity of groundwater trend shows high peaks during drought months as from July to September in each years and also the surface and bottom's electrical conductivity trends showing high differences in drought months and almost same in wet season. Electrical conductivity of scheme supplied water was mostly showing the bottom electrical conductivity of groundwater during wet season and in dry season in between the level of bottom and surface groundwater and exceed the SLS 614 (1983) maximum permissible level.

The Araly water supply well is in border of the Chunnakam aquifer. Usually the foot valve is fixed at the bottom of the water level to abstract maximum amount of groundwater for the supply. It was the practice at the Araly water supply well also. Then the quality; electrical conductivity of supply water was close to the value of bottom level electrical conductivity. After the installation of floating foot valve, the electrical conductivity of the supply water was close to the surface water electrical conductivity since it is floating the surface water.

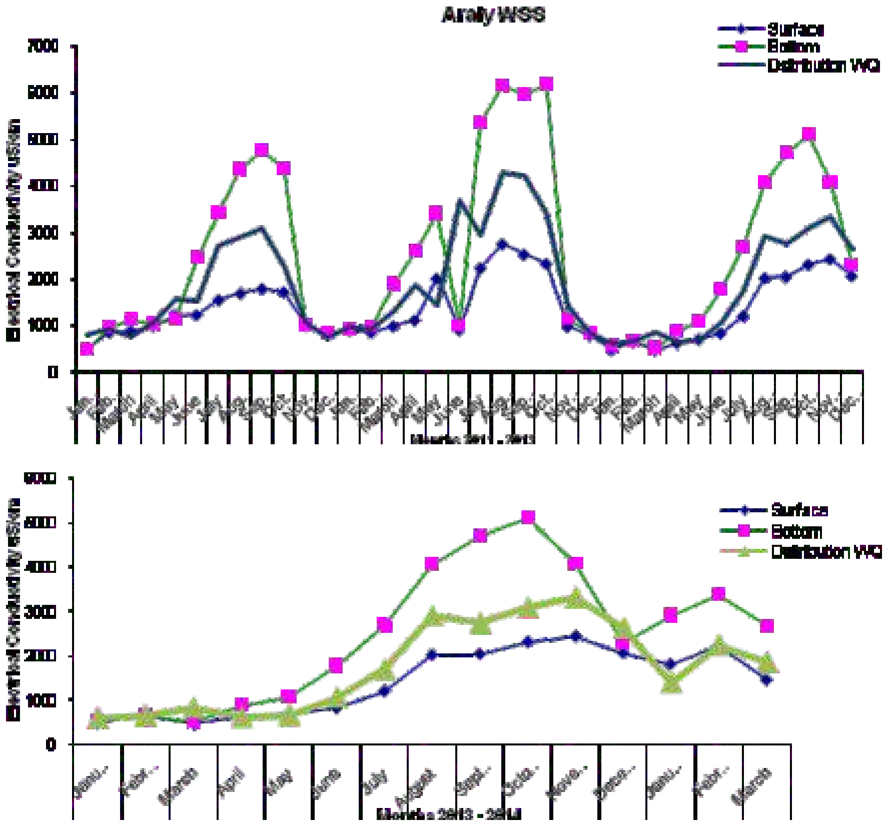

Figure 02: Seasonal Changes of Electrical Conductivity after the installation of Floating Foot Valve at Well No 01, Araly

As per above the figure 02, after the installation of floating foot valve, from December 2013 the distribution water electrical conductivity was showed the surface water electrical conductivity trend pattern and almost same of the surface water quality.

The production was increased from 820 m^3/month to 2272 m^3/month by adjusting the pumping pattern. Earlier the pumping was carried out for three hours continuously but now the pattern of pumping was altered and do not pump continuously, there was a resting time after pumping of every one hour for recharge.

CONCLUSION

The good practice of floating foot valve and giving resting time for recharge rather than continuous pumping is yield good quality water with increased production. Usage of low rate of pumping water pumps during the pumping operations could facilitate further.

REFERENCE

Balendran, V.S., 1969. Salt water fresh water interface studies in the Jaffna Peninsula. Report III, Geological survey department, Colombo, Sri Lanka.

Clarke, R., Lawrence, A., and Foster, A. 1996. Groundwater: A threatened resource. United Nations Environment Programme Environment Library No. 15, Nairobi, Kenya.

Panabokke, C.R, and A.P.G.R.L. Perera., 2005. Groundwater resources of Sri Lanka. Water Resources Board, Colombo, Sri Lanka

Rajasooriyar, L., Mathavan, V., Dharmagunawardhane, H.A. and V. Nandakumar. (2002). Groundwater quality in the Valigamam region of the Jaffna Peninsula, Sri Lanka. In: Sustainable groundwater management. Hiscock, K.M., Rivett, M.O. and Davison, R.M. (Eds). Geological Society, Londan. 193: 181 – 197.

Sri Lanka standard 614: part 1 (1983). Specification for potable water physical and chemical requirements.

Subramani, T. and E. L. Damodarasamy., 2005. Groundwater quality and its suitability for drinking and agricultural use in chithar river basin, Tamil Nadu, India. Environ. Geol., 47: 1099-1110