Irrigation of Agro-Wells and Its Impacts on Groundwater Quality: A Study Based On Kuchchaveli Area in Trincomalee District

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ABSTRACT

Kuchchaveli is 313.30 Km² in an area situated in Northern part of Trincomalee District in Sri Lanka. In Kuchchaveli, land accounts 254.82 Km² and water catchment area is 58.48 Km². It includes 58 per cent agricultural land consists of 5723 ha for paddy cultivation, 1849 ha for home garden and 17 ha utilizes for coconut cultivation. Kuchchaveli is inhabited by 35685 populations from 9753 families in 24 GN Divisions (Census, 2012). Shallow agro-wells system was introduced for irrigation to the agricultural practices to meet the food demand of increasing amount of population. Due to the increased amount of cultivation, shallow agro-wells water quality got worsened. This study has three objectives that identifying the effects of ground water quality by the agro-wells, exploring the impacts of the groundwater quality by the usage of agro-wells and suggesting the efficient usage of management of agro-wells, in Kuchchaveli. Further, this study attempts to inquire the problems affected of surface water resources by the excessive usage of agro-wells and the importance of conserving surface water in the context of increasing demand of water. The study was carried out using primary and secondary data. The primary data were gathered through discussions, questionnaire, random sampling of 50 household and chemical analysis in 50 agro-wells from 24 GN Divisions. Meteorological and irrigation Department's repots, images were utilized for the study, published reports and statistical records were employed to collect secondary data. MS Excel, GIS software were used for data analysis. Having experimented of water PH level, electrical conductivity, concentration of nitrate, phosphate, salphate, calcium and chloride results were identified. Due to the high concentration of these solutes, the water quality was getting affected in Kuchchaveli. As a result, it leads to many ecological impacts. Manageable devices have been advised to the enhancement of future-surface water quality. The ground water contamination should be concerned because; the large-scale usage of nitrate, other chemical fertilizers and improper irrigation systems lead to the soil and ground water contamination. Eventually, by means of chemical solutes' scale variation, 85 per cent of wells' water are not in a position to drink in Kuchchaveli.

Keywords: Agro-wells, Groundwater Quality, Irrigation.

INTRODUCTION

Water, being an indispensible resource for Agriculture, comes directly by the rainfall in rainy seasons but rest times, the agricultural practices are carried out by irrigation, stored on the surface or in to the ground. Utilizing the groundwater for the agricultural practices by drilling wells is called agro-wells (Panabokke, 2002).

The ground water is inconstant for place to place as well as monsoon variations. The wells are drilled for the water on the ground that used for the agricultural practices (Padmasiri, 2002). The water availability of shallow agro-wells relies on the perpendicular and horizontal movement of the water (Surendran, 1997). When the water moves it contacts with rocks, minerals, other surface and ground solutes rather than the soil. Moreover, natural solutes, removal of domestic and other wastages, removal of sewage water, the condition of wastages, agricultural practices and sea

water intrusion such activities may lead to the shallow wells' water contamination and degrade the drinking quality (Amarasiri, 2015).

STUDY AREA

This area, being almost coastal lowland, has paddy cultivation lands in Nilaveli and Pulmottai. However, due to the increased amount of settlement, the paddy land in Kuchchaveli is fewer amounts relatively. Presently, there are 1108 domestic wells, 932 agro-wells and 303 abandoned wells available. Quite a lot of agro-wells are available in such areas where paddy cultivation highly carried out.



OBJECTIVE OF THE STUDY

- 1. Identifying the effects of ground water quality by the agro-wells in Kuchchaveli
- 2. Finding the impacts of the ground water quality by the usage of agro-wells in Kuchchaveli
- 3. Suggesting the efficient usage of management of agro-wells in Kuchchaveli

RESEARCH METHODOLOGY AND DATA COLLECTION

Primary data

The samplings of 50 households from 24 GN Divisions of the study area were analyzed. 05 wells as sampling for each village namely, Nilaveli, Gopalapuram, Valaiyoortu, Irakkankandy, and Kumburupitty were selected respectively. Rest samplings were selected from other 19 villages. The continuous fortnightly monitoring on the samplings was from August to November in 2011, and samples water were analyzed chemically once a month to find out the chemical variations.

Secondary Data

The reports of meteorology and irrigation department reports, images, published research reports and statistical records are the secondary data of this study.

Data Analysis

To investigate groundwater changes due to the trend of rainfall variation for the period of 130 years, obtained from Trincomalee meteorological station were analyzed using the moving average and average deviation techniques. MS EXCEL, SPSS, GIS software were used for the study.

RESULTS AND RECOMMENDATIONS

The study area, situated in arid zone has 28.7° C as annual average temperature. It subjects to the seasonal variations, and the annual average rainfall ranges from 400mm to 2086 mm.

Evaporation is the vaporization of water from the surface. The annual average water scarcity accounts for 510mm (10.9%) meanwhile; annual average water abundance is 304 mm (9.9%). Accordingly, the net water scarcity is prevailing as 208mm in the study area.

Results of the Chemical Analysis P^H level

In the study area, all the wells' water P^{H} level is >7. The wells, having P^{H} 7-8 are, NW1, NW13, NW16, NW19, NW24, NW26, NW35, and NW38. NW10, NW12 numbered wells have P^{H} >8.

Electrical Conductivity (EC)

The water with EC>2.25 μ S/CM, is saline (Amarasiri, 2015). In the study area, NW05, NW07, NW08, NW09, NW10, NW18, NW23, NW27, NW29, NW33, NW35, NW39, NW41, NW47, NW49 numbered wells have EC >800 μ S/CM. And, NW01, NW02, NW03, NW04 numbered wells have the EC >1000 μ S/CM. According to the fact, the wells water in the study area is in contaminated condition.

Nitrate

NW02, NW03, NW04, NW05, NW10, NW17 numbered well's water have <5Mg/L nitrate concentration. NW01, NW06, NW08, NW19, NW24, NW32, NW39, NW39, NW45, NW50 numbered wells' water nitrate concentration is >35 Mg/L.

Phosphate

NW02, NW03, NW04, NW05, NW06, NW07, NW08, NW09, NW10, NW23, NW25, NW41, NW44, NW46 numbered wells' water phosphate concentration is <1Mg/L and NW01, NW30 numbered well's water phosphate concentration is very high level.

Salphate

NW05, NW50 numbered wells' water salphate concentration is < 60 Mg/L. And, NW01, NW02, NW04, NW06, NW15, NW23, NW32, NW39, NW47, NW50 numbered wells' water have the high level salphate concentration.



Calcium

NW01, NW05, NW06, NW07, NW08, NW09, NW10 numbered wells' water calcium concentration is < 100 Mg/L and NW04, NW14, NW21, NW22, NW39, NW40, NW42, NW43, NW47, NW49 numbered wells' water calcium concentration is > 100.

Chloride

NW05, NW06, NW07, NW08, NW09, NW10, NW11 numbered wells' water chloride concentration is < 200 Mg/L and NW01, NW02, NW14, NW28, NW29, NW31, NW32, NW34, NW37, NW42, NW49 numbered wells' water chloride concentration is > 200 Mg/L.

CONCLUSION

In the study area, the excessive usage of chemical fertilizers and pesticides in the agricultural practices that accounts for 90%, lead to the high chemical concentration directly in the agro-wells as well as the infiltration in to the ground. The usage of high efficient water pumps, cause to the inward pressure and sea water intrusion. So, the salinity of water in Kuchchaveli gradually is increasing.

Further, the agro-wells are highly available in the agricultural practice area. During the arid season, the excessive usage of the agro-wells for agricultural practices, water became as brackish water. The people who live in the coastal and lagoons nearby areas said that identifying the chemical variation of water is rather difficult by the continuous usage. Significantly, in the coastal and lagoon area such intrusions are high level relatively. And, rainwater balances the salinity of this water during the rainy season. Moreover, the abandoned wells some diseases are arising. In the analytical view using the data derived by the field survey, show that the ecological problems higher than 80 per cent triggered by the agro-well chemical contamination.

The agricultural officials have to take measures in the usage of natural compost instead of chemical fertilizers as well as the ancient methods in the application of chemical pesticides. Therefore solutions will balance the PH level, nitrate, phosphate, salphate concentration of the water.

Proper management of the effluents and burying the wastage from the small-scale factories or recycling the wastages, may safe the water from contamination. In Kuchchaveli, the farmers who pump 250 l/m water waste the water considering highest yield and arid season yield average surface water pumping 6 hours per day. For controlling this water wastage, farmers should be educated, conducting the workshops and seminars by experts. Furthermore, the constructing water tank for rainwater harvesting and usage of harvested rain water for agricultural practices can decrease the amount of water extraction from the agro-wells.

It should also be noted that, preventing all the ways that chemical solutes reach the groundwater and proper usage of agro-wells for agricultural practices may conserve the groundwater quality.

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