

**VARIATION OF IRRIGATION WATER QUALITY WITH
PUMPING DURATION AT TWO COASTAL VILLAGES OF
BATTICALOA DISTRICT**



**BY
GNANACHELVAM NIROASH**



**DEPARTMENT OF AGRICULTURAL ENGINEERING
FACULTY OF AGRICULTURE
EASTERN UNIVERSITY
SRI LANKA**

2018

PROCESSED
Main Library, EUSL



ABSTRACT

There is an increasing concern regarding groundwater quality degradation in many parts of the world, especially in agricultural areas. Kaluthavalai and Cheddipalayam are the important farming villages located in the coastal area of Batticaloa district, Sri Lanka. Farmers in these areas are using tube wells for pumping water from the aquifers for irrigation. Depletion of groundwater level by continuous pumping from an aquifer may degrade water quality. In this view, the present study aimed to investigate the variation of groundwater quality with pumping duration in these farming areas by assessing the groundwater quality at different time interval. A total of twelve farms, six from each village, were selected in this study. Water samples were taken at different pumping durations (1, 21, 41 and 61 minutes) and analysed for some important water quality parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Suspended Solids (TSS), concentrations of Calcium ion (Ca^{2+}), Magnesium ion (Mg^{2+}), Sodium ion (Na^+) and Potassium ion (K^+) and concentrations of Carbonate ion (CO_3^{2-}) and bicarbonate (HCO_3^-) ion by using standard procedures.

The results revealed that there is variation in the level of water quality parameters with pumping duration. However, the variation is not significant (≤ 0.05). The level of pH, EC, TDS and TSS of groundwater ranged from 6.94-7.04, 0.5 dS/m-1.53 dS/m, 250 mg/l-760 mg/l and 32 mg/l-464 mg/l, respectively. Concentration of Ca^{2+} , Mg^{2+} , Na^+ , K^+ , CO_3^{2-} and HCO_3^- ions varied from 4 mg/l-12 mg/l, 1.2 mg/l- 6 mg/l, 0-49.6 mg/L, 0.11 mg/l- 0.3 mg/l, 0 - 240 mg/l and 488 - 2806 mg/l, respectively. The values of Sodium Adsorption Ratio (SAR), Residual Sodium Carbonate (RSC), Soluble Sodium

Percentage (SSP) and $\text{Ca}^{2+}/\text{Mg}^{2+}$ ratio varied from 0 - 3.94, 7.5 meq/l-45.40 meq/l, 0 - 81.2% and 0.43-6, respectively.

High level of EC and TDS was observed in Kaluthavalai area. However, Cheddipalayam area has high level of Mg^{2+} , Na^+ , K^+ , HCO_3^- , SAR and SSP. According to mean comparison, significant variation (≤ 0.05) was observed in EC, TDS, SAR and SSP between Kaluthavalai and Cheddipalayam areas for all pumping durations. However, one-hour pumping duration does not have significant impact on groundwater quality. Even though some parameters are at high level, groundwater in these areas can be used for irrigation with proper soil and water management practices.

TABLE OF CONTENTS

	Page No
ABSTRACT	I
ACKNOWLEDGEMENT	III
TABLE OF COTENTS	IV
LIST OF FIGURES	VII
LIST OF TABLES	X
ABBREVIATIONS	XI
CHAPTER 01 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement and Justification	2
1.3 Objectives	3
CHAPTER 02 REVIEW OF LITERATURE	4
2.1 Status of Groundwater	4
2.1.1 Groundwater in Sri Lanka	4
2.2 Quality of Groundwater for Irrigation	6
2.3 Water Quality Analysis.....	7
2.4 Water Quality Parameters	8
2.4.1 Physical parameters.....	8
2.4.1.1 Total Dissolved Solids (TDS)	8
2.4.1.2 Turbidity.....	9
2.4.1.3 pH	9
2.4.1.4 Electrical Conductivity (EC).....	10
2.4.2 Chemical parameters	11
2.4.2.1 Alkalinity	11

2.4.2.2 Hardness.....	11
2.4.2.3 Sodium, Potassium	12
2.4.2.4 Salinity	12
2.4.2.4.1 The problem with salinity	13
2.4.2.4.2 Managing irrigation water with salt or sodium.....	14
2.5 Criteria for evaluation of irrigation water.....	15
2.5.1 Sodium Adsorption Ratio (SAR).....	15
2.5.2 Soluble Sodium percentage (SSP)	16
2.5.3 Residual Sodium Carbonate (RSC).....	16
2.6 Pumping Rate on Groundwater Quality	17
2.7 Groundwater Pollution.....	17
2.8 Seawater Intrusion	18
2.9 Irrigation Water Quality and Plant Growth	19
CHAPTER 03 MATERIALS AND METHODS	22
3.1 Description of the study area.....	22
3.2 Site selection and sampling.....	23
3.3 Analysis of samples.....	24
3.4 Data analysis	26
CHAPTER 04 RESULTS AND DISCUSSION	27
4.1 Variation of water quality parameters with pumping duration.....	27
4.1.1 Effect of pumping duration on pH.....	27
4.1.2 Electrical Conductivity (EC)	29
4.1.3 Total Dissolved Solids (TDS).....	31
4.1.4 Total Suspended Solids (TSS).....	33

4.1.5 Calcium (Ca^{2+}).....	35
4.1.6 Magnesium (Mg^{2+}).....	36
4.1.7 Sodium (Na^+).....	38
4.1.8 Potassium (K^+).....	39
4.1.9 Carbonate and Bicarbonate.....	41
4.2 Derived water quality parameters.....	44
4.2.1 $\text{Ca}^{2+}/\text{Mg}^{2+}$ ratio.....	44
4.2.2 Residual Sodium Carbonate (RSC).....	46
4.2.3 Sodium Adsorption Ratio (SAR).....	47
4.2.4 Soluble Sodium Percentage (SSP).....	49
4.3 Homogenous subsets and multiple comparisons of water quality parameters.....	51
4.4 Mean comparison of water quality parameters.....	57
4.5 Dissemination of results.....	59
CHAPTER 05 CONCLUSIONS	60
CHAPTER 06 SUGGESTIONS AND RECOMMENDATIONS.....	61
REFERENCES	62
APPENDICES.....	71