Research Paper
Impact Factor: 6.304
Peer Reviewed & Indexed Journal
www.iibarr.com

IJBARR
E- ISSN -2347-856X
ISSN -2348-0653

AN EVALUATION OF THE SPATIAL DISTRIBUTION OF COASTAL SHALLOW AQUIFER RESOURCES (CASE STUDY – KALPITIYA PENINSULA)

Piyadasa Ranjana.U.K.
Department of Environmental Technology , University of Colombo, Sri Lanka.

Abstract
Coastal Shallow aquifers constantly stressed due to the various forces induced due to the trends of coastal settlement growth pattern. Thus, this study focus on utilizing Arc GIS options in evaluating coastal shallow aquifer level fluctuations and identify the spatial patterns of ground water stress. Water level changes of selected 85 sampling dug-well locations has been monitored and GN wise spatial distribution of ground water table changes was analyzed applying inverse distance weighted (IDW) interpolation method in ArcGIS 10.3. The results indicate more than 75% of the land area in Kalpitiya Peninsula face to constant ground water stress due to the positioning of ground water lens.

Key words: Coastal Shallow aquifers, Ground Water Stress, Spatial Patterns.

1. Introduction

The Coastal Environment is a very vibrant geomorphological system which is exposed to repetitive instabilities and changes over time and space. Coastal zones in the world have been changing intensely during the 20th century with the increasing populations, economies and urbanization globally. Today, below 10 meter low-elevation coastal zones of the world contain about 10% of the world population (McGranahan et. al., 2007). The most stressed feature due to this trend of Coastal settlement growth pattern is the ground water resources in coastal areas.

Kalpitiya peninsula comprised with Shallow aquifers on coastal spits and bar type as a “compound spill” and shaped like a beckoning finger (Panabokke, C. R., 2007). This groundwater aquifer recharge only during the South-East Monsoon seasonal rainfall Period. The Indian Ocean situated on the left side and Puttalam lagoon situated on the right side of the water lens. Very less usable surface water bodies available in this region hence the inhabitants use the ground water for drinking, domestic usage and mass scale crop cultivations constantly stressing the available aquifer resources. The purpose of this study is to utilize Arc GIS options in evaluating coastal shallow aquifer level fluctuations in Kalpitiya peninsula with spatial reference according to the seasonal rainfall changes and identify the patterns of water stress.

Methodology

1.1. Procedure for Analysis

The study area, Kalpitiya peninsula is located in the North Western coast of Sri Lanka between 79° 40′*50 °79 –*′ Eastern longitude and 7° 50’– 8° 30’ Northern latitude. Kalpitiya Peninsula falls within the Puttalam district of North Western province in Sri Lanka and comprises with two District Secretarial Divisions (DSD), Kalpitiya and Mundalama. The study area bounded to the North and West by the Indian Ocean, East by the Puttalam lagoon and South by the Mukkuthoduwawa seasonal river (figure 01). To identify aquifer level fluctuations, 85 dug-wells were selected using the grid map developed in Arc GIS 10.3 considering the vulnerability of the Study area, divided by one km^2, $4km^2$ and $8km^2$ grid. Global Position System (GPS – Magellan exploits 620) was helped for navigation to the location (Center point of grid). Water level changes of the sampling well locations has been measured monthly from December 2013 to June 2014 using tape measurement. Using the measurements the average water level of each well was calculated. Then the average water levels were subtracted from point elevation from Mean Sea Level (MSL). The GN wise spatial distribution of ground water table changes was analyzed applying inverse distance weighted (IDW) interpolation method in ArcGIS 10.3 using the calculated water levels from MSL of sample well locations.

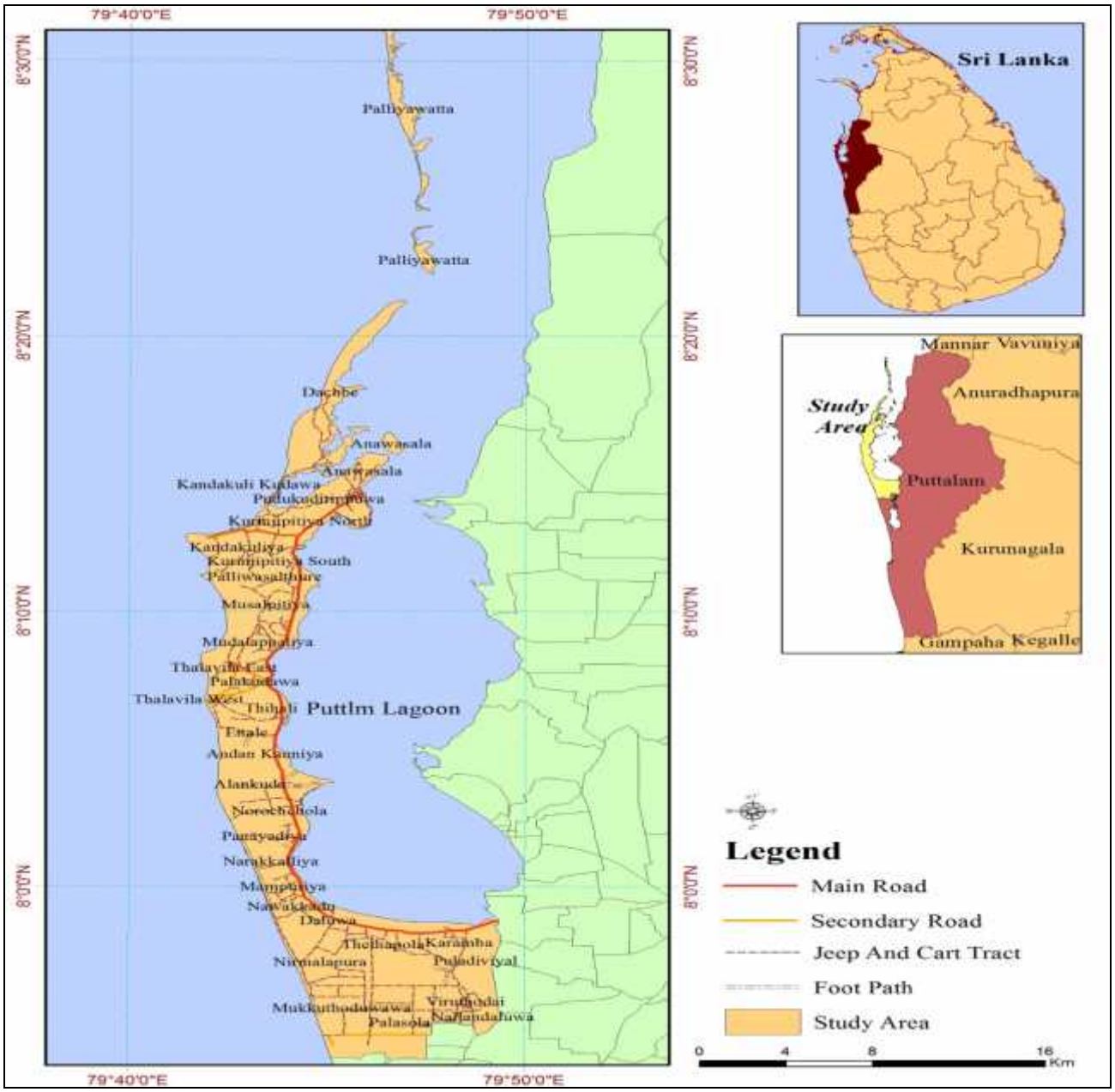

Figure 01: Study area- Kalpitiya

2.Results

According to the results, more than 75% of the ground water table of Kalpitiya Peninsula positioned below 7m (from MSL) height level. Less than 10% represent above 15m height level and highest level is 29.4m. The highest average ground water capacity of wells recorded in Mukkuthoduwawa, Palasola, Mampuri, Nawakkaduwa and Daluwa area. It is more than over 3 meters. The Norochchola, Panayadi, Ettale, Thalavila, Narakkalliya and Mudalappaliya were recorded between 0.5 – 3.0 meter water capacity. 49.4% from the total area was covered by 0.5 to 1 meter water capacity and 24.7% was covered by 1 meter to 1.5 meter water capacity. 4.7% covered by over 2 meter ground water capacity of wells. Duchbe, Anawasala, Mandalakudawa, Alankudawa, Thethapola and Norechcholea areas situated below 2m height level and some areas are with minus elevation values as illustrated in figure 1.

Ground Water Depth (meter from MSL)	**Area (Sq./km)**	**(%) From total study area**
> 0.5	22.6	12.5
0.5 - 1.0	89.5	49.4
1.0 - 1.5	44.8	24.7
1.5 - 2.0	15.5	8.5
2.0 - 2.5	4.2	2.3
2.5 - 3	2.8	1.5
3.0 <	1.7	0.9
Total	**181.1**	**100.0**

Table 1: Ground water capacity and distribution in Kalpitiya peninsula according to the analysis

Table 1 indicates the area wise Ground water capacity and distribution in Kalpitiya peninsula according to the analysis results. Accordingly, more than 75% of the land area in Kalpitiya Peninsula comprise with coastal shallow aquifer resources which face to constant ground water stress due to the positioning of ground water lens.

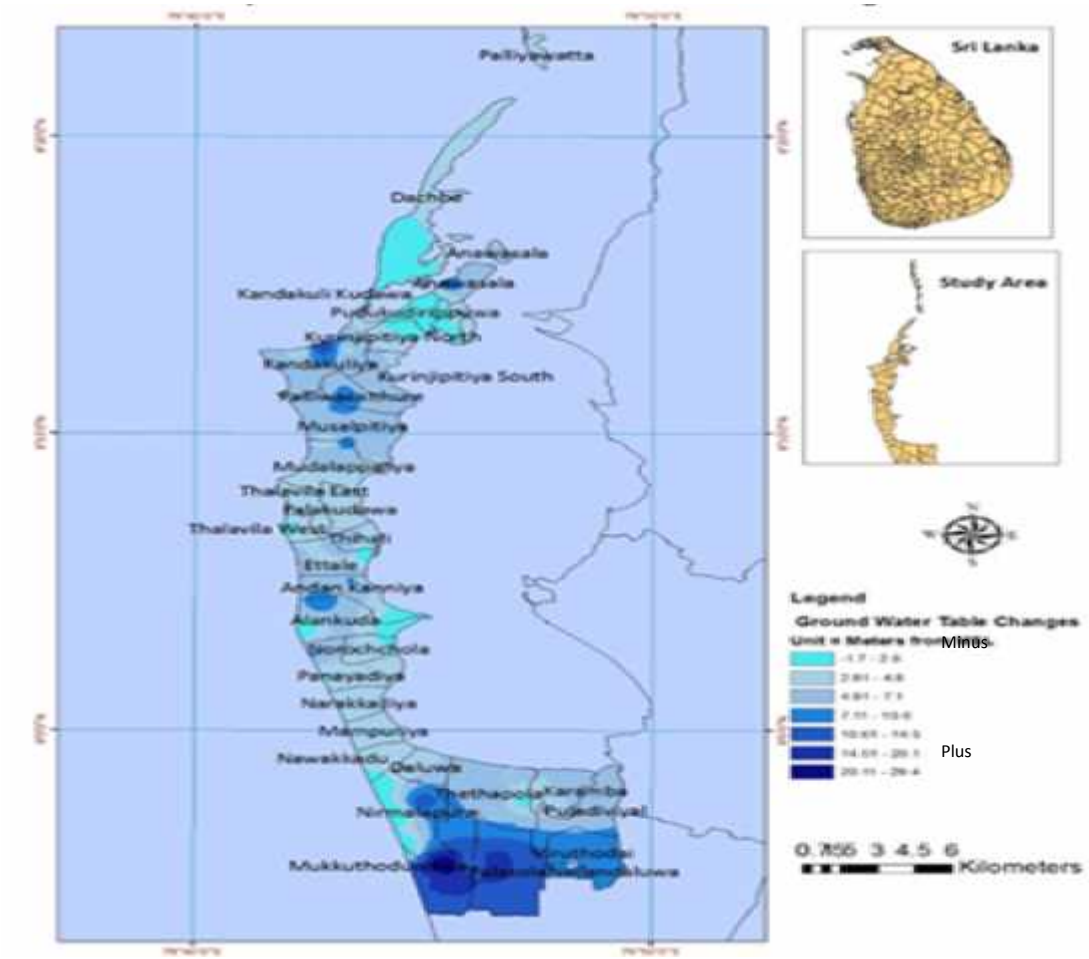

Figure 1: Spatial distribution of average shallow aquifer groundwater level changes (Map source: compiled by authors, 2016)

3. Conclusion

This study reveals that the precious Ground water resource of Kalpitiya peninsula is at a very high stress. The main drinking water source of this area is ground water and most of the time it is the only available water source for e inhabitants. Over exploitation of Ground water for the mass scale agro cultivations increases this ground water stress and also will bring the threat of saline water intrusion in to the ground water table. The agriculture activities of the area totally depend on the ground water table and using higher amounts of chemical fertilizer and pesticides will increasingly cause to the changes of chemical compounds in the ground water as well. Therefore according to this evaluation of the spatial distribution of coastal shallow aquifer resources it is evident that due to the constant pressure and stress on the shallow aquifer resource will burden the livelihood options of the Kalpitiya peninsula.

References

1. McGranahan, G.,Balk, D., & B. Anderson., (2007), *"The rising tide: assessing the risks of climate change and human settlements in low elevation coastal zones*.", Environment and Urbanization, International Institute for Environment and Development (IIED), Vol .9(1): 17–37.
2. Panabokke, C.R., (2007), *"Groundwater conditions in Sri Lanka"*; Published by National Science Foundation of Sri Lanka: ISBN 978-955-590-079-9, Retrieved on http://dl.nsf.ac.lk/ bitstream/ handle/1/ 5392/NA333.pdf?sequence=2&isAllowed=**.**
3. Konikow, L. F. (2011), *"Contribution of global groundwater depletion since 1900 to sea-level rise"*, Geophys. Res. Lett., 38, L17401, doi: 10.1029/ 2011GL048604.