

THE INFLUENCE OF RAINFALL ON GROUND WATER QUANTITY AND ITS CHANGES; A STUDY IN SELECTED AREAS OF PORATIVUPATTU DS DIVISION IN BATTICALOA.

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ABSTRACT: Groundwater is an essential natural resource for sustaining domestic life and environment. Rapid development of agriculture, economy and increase of population growth due to the resettlement of past war recovery were caused to the water quantity. Moreover, due to uneven distribution of rainfall in both time and the space, water resources are dwindling.

The study is undertaken to identifying the seasonal changes ground water especially the drinking water. Through this, the changes of water level, influence of rainfall were examined with appropriate data. Rainfall data of 146 years from the meteorological department, the formula and 5, 11 years standard deviation of moving average were used to analyze the groundwater quantity. Meteorological department's reports, images were utilized for this study, published reports and statistical records were employed to collect as secondary data. MS Excel, GIS software were used for data analysis.

Seventy domestic wells were randomly selected for the study. The different measurement tools were used to measure the well water level. The water level was measured in equal six times in one year.

The results confirm that the positive and higher value of groundwater by the rainfall during Northeast monsoon period. This established with deviation of rainfall and the measured well water level.

Thus, keeping the balance of tank water level, surface runoff and groundwater level, the performance of the water level could be stabilized. The development of the new tanks, its irrigation system and drinking water supply also reduce the water shortages in the study area. Temporary water retaining structures should be constructed to facilitate the infiltration. Further, rainfall water should be saved for future use. Controlling the intensive use of water pumps for drainage and making the farmers aware about the water wastage and pollution is also important for the water stability.

Key Words: Domestic, Runoff, Agriculture, Monsoon, Irrigation.

1. INTRODUCTION

Groundwater defined as the water beneath the earth's surface, often between the saturated soil and rock that supplies wells and springs. Many factors are determined the ground water level and nature as topographic, geology, climate conditions, natural vegetation and an important feature is rock.

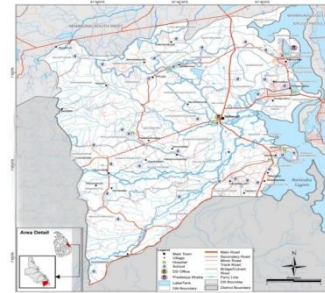
The demand of water has gradually increased more than past century because of the trends of the global population. Intense agricultural activities, industrial activities and domestic uses are caused to the over consumption of groundwater. When there

is not enough potable water for a given population the threat of water problem is realized (Panabokke, 2007).

However, the study areas' physical features and climate conditions are indicating the dry zone characteristics. While water protection and conservation differ from country to country, in these area is taken the most suitable.

2. STUDY AREA

The District of Batticaloa itself consists of several administrative divisions, of these; Porativupattu Divisional Secretariat division has been located in Southwest part of Batticaloa district. It has an extent of 180 sq. m. It consists of 43 Grama Niladhari divisions and 136 villages. Its population is 47,180 and consists of 12,883 families. 22,902 males and 24,278 female live it (Divisional Secretariat Porativupattu, 2014).



(Source: Retrieved on GIS, 2015)

3. OBJECTIVES

- ✓ Identifying the seasonal changes of ground water table by the domestic wells in Porativupattu
- ✓ Refining the ground water quantity for domestic usage through the changes of ground water table
- ✓ To formulate the solution for the high wastages of domestic water for future generation

4. METHODS AND MATERIALS

4.1. Primary Data

The sampling of 70 households has been randomly selected for the study from 7 GN Divisions, as well as questionnaire survey has been done for 70 households. These 140 households' data were used to the study.

Further, the water level for June, August, October, December in 2014 and February and April have been measured in a particular order, of these, the water level measured in the end of these months to identify the changes of ground water quantity. Monthly and annual rainfall changes and the trends of vapour and vaporization were calculated on the research that depending on rainfall.

Different equipment has been used to measure the water level of each well. They are measuring tape, bell, rope and cone shape tool by aluminum. Hereby, well depth, well water level, sea level elevation and the changes of season-to-season have been observed.

4.2. Secondary Data

Rainfall and temperature data from Department of Meteorology, census report of Sri Lanka, Reports and Documents from Porativupattu Divisional Secretariat, published researches, maps and collections from the web were secondary data of the survey.

4.3. Data Analysis

The water level measurement tool were used to measure the water level of selected wells and observed the seasonal changes that used the formula is,

$$W = (B+G) - L$$

W – Water level from sea level

L – Water level from well top

B – Well height from surface

G – Elevation of particular area.

The groundwater levels of June 2014 were filed in the end of month and, depth of wells, water level and sea level elevation were considered on the measurement, as same as, August, October, December 2014 and February, April 2015 water level were measured. The average consumption of drinking water was calculated from 70 users. To examine the ground water changes due to the trend of rainfall variation for the period of 146 years, obtained from meteorological department were analyzed using the moving average and average deviation techniques. MS Excel, GIS software were used for the study.

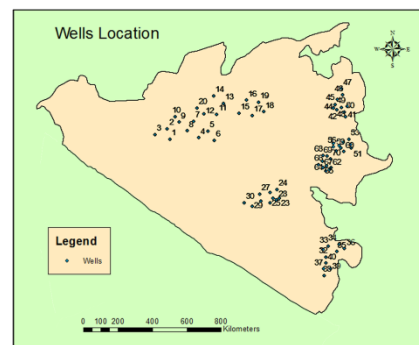
5. RESULT AND RECOMMENDATION

Water is the most precious resource for the human beings. Since the earliest times, water from beneath the ground or groundwater, has been exploited for domestic use, livestock and irrigated agriculture.

5.1. Well types and its distribution in Porativupattu

There were two types of wells identified during the visit, seasonal wells and permanent wells. Surface water has been decreasing due to the dry season at the same time water demand is increasing to meet the needs of people. Thus, people extract the water from ground water by domestic wells coming from the precipitation.

The resulting loss of ground water has high level by the vaporization of the study area



that is in July and August of the year, wells are getting dry during this period and some wells in May. Around 85% of wells are seasonal wells, whatever, 15% of wells are permanent wells. The 67% of study area's people are suffering to get the fresh water during the dry season.

(Source: Retrieved on Arc GIS 10.0)

5.2. Water level changes in selected areas of Porativupattu

Groundwater occurs in many different geological formations. The volume of water contained in the rock depends on the percentage of these openings or pores or voids in a given volume of the rock, which is termed the porosity of the rock. More pore spaces result in a higher porosity and more stored water.

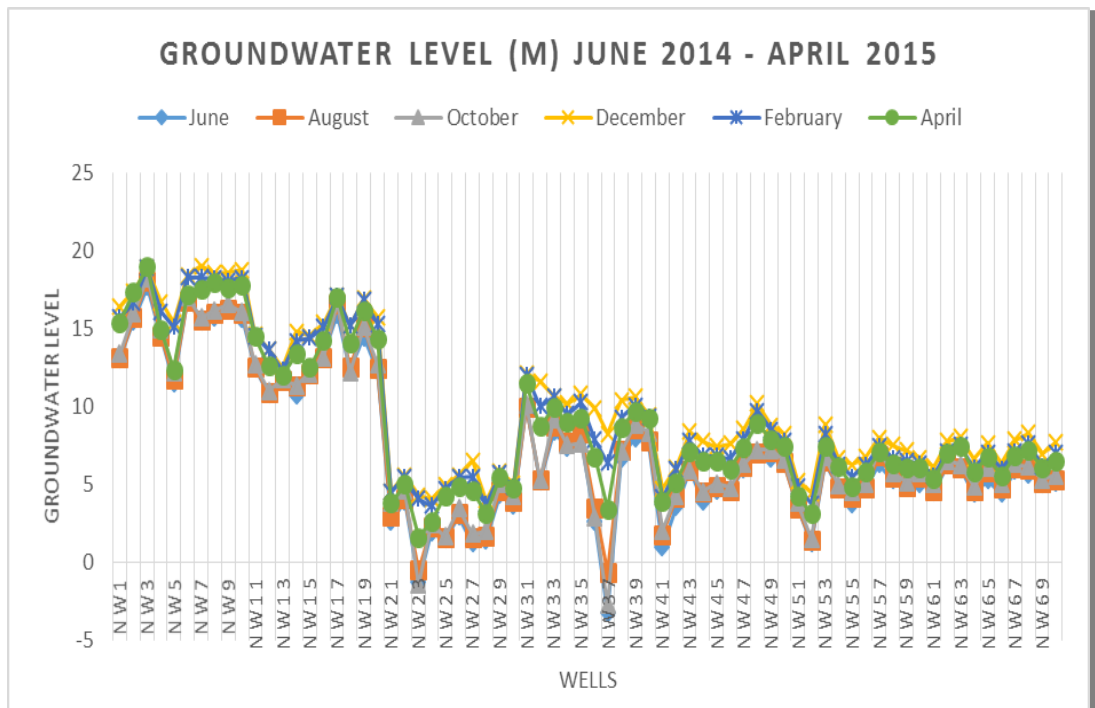


Figure 1. Groundwater level 2014 -2015

The figure 1 illustrates the water level changes in between the selected wells. The water level is high from sea level in NW1 to NW20 wells' area and it is average in NW21 to NW30 wells and NW41 to NW50 wells.

When compare with June's, August's and October's water level, the water level of February is massively increased and compare with December's water level this has a little bit decreased. The water level was totally varied when compare with past months. We can see the trend of the water level, NW3, NW7, NW8, NW9, NW10, NW11, NW14, NW15, NW16, NW17, NW31, NW33, NW34, NW39, NW40, NW47, NW48, NW53, NW57, NW58, NW59, NW60, NW62, NW64, NW65, NW66, NW67, NW68, NW69, NW70 numbred wells are high level of water and the other wells have average level of water. If we see this, each area has not contained the equal

water level. We can see the wells NW20 – NW40, NW60 – NW70 has almost balanced the water level.

5.3. Temperature

Sri Lanka has two main climatic seasons, wet zone and dry zone, of these; the study area has been in the dry zone. The annual average temperature of study area is 28.3°C that changes due to the seasons. The temperature or rainfall are determined the ground water level.

When the temperature increases in a particular area, the water level will decrease because of water vapour and vaporization. When the rainfall increases in a particular area, the ground water will increase because, the soil contains much water from the runoff. Therefore, the seasonal changes of water level were measured from June 2014 to April 2015. Through this, experience different water level in different seasons as well as the different areas (Department of meteorology, 2015).

5.4. Rainfall

The trends of rainfall deviates in this area, 2011 had being 298.4mm as a high average rainfall of the years and 1968 had being 72.1mm as a low average rainfall of the years. The standard deviation of moving average illustrates the figure 2, 3 as follow in order to 5, 11 years moving average.

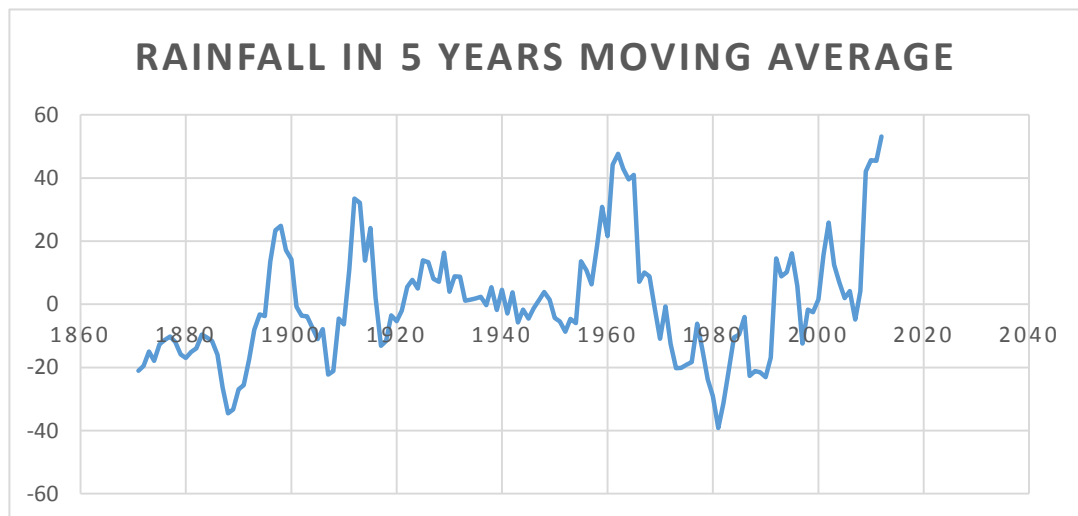


Figure 2. Rainfall in 5 years moving average

The figure 2 shows that the selected 146 years rainfall, there were 11 dry season and 11 wet season. The long term of dry season were occurred from 1871 to 1895 for 25 years and the long term of wet season were occurred from 1922 to 1936 for 15 years. The first wet season was being from 1871 to 1895 for 25 years and the

first dry season was being from 1922 to 1936 for 15 years. The rainfall seasons are imbalanced in each other. Nonetheless, we had experienced the long term of dry season in between the years.

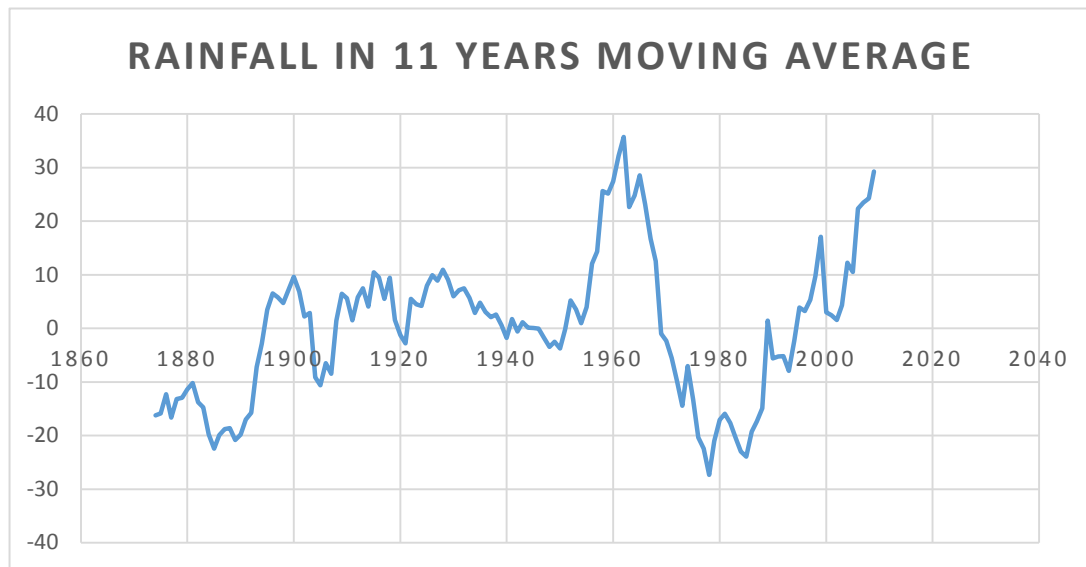


Figure 3 Rainfall in 11 years moving average

According to the figure 3, the selected 146 years, there were 8 dry season and 8 wet season. The first wet season was being from 1895 to 1903 for 9 years, in between 1908 to 1939 of 30 years wet season, in 1920 to 1921 was dry season and again 1940, 1942 were dry season, 1941, 1943, 1944, 1945 were wet season. Thereafter, experienced 17 years wet season, in between 25 years dry season from 1969 to 1994, there was a wet season in 1989 and then, 15 years wet season were being from 1995 to 2009. When control much runoff by making sand ridge in this area, this will support to recharge much ground water, this is helped to control the water pollution and the high infiltration occurs in this area. **Optimum use of rainfall**, the re-use of irrigated water and avoiding the construction of deep wells help to prevent salinity. Through this, can be improved the ground water quantity.

5.5. Water Vapour and vaporization

The annual rainfall of Batticaloa is 2518mm but, the annual water vapour and vaporization is higher than the rainfall. As per that, water shortage and access water storage are remained here. The annual water shortage occurs from February to September as per 8 months and the water level balanced during October, access water availability is during November, December and January.

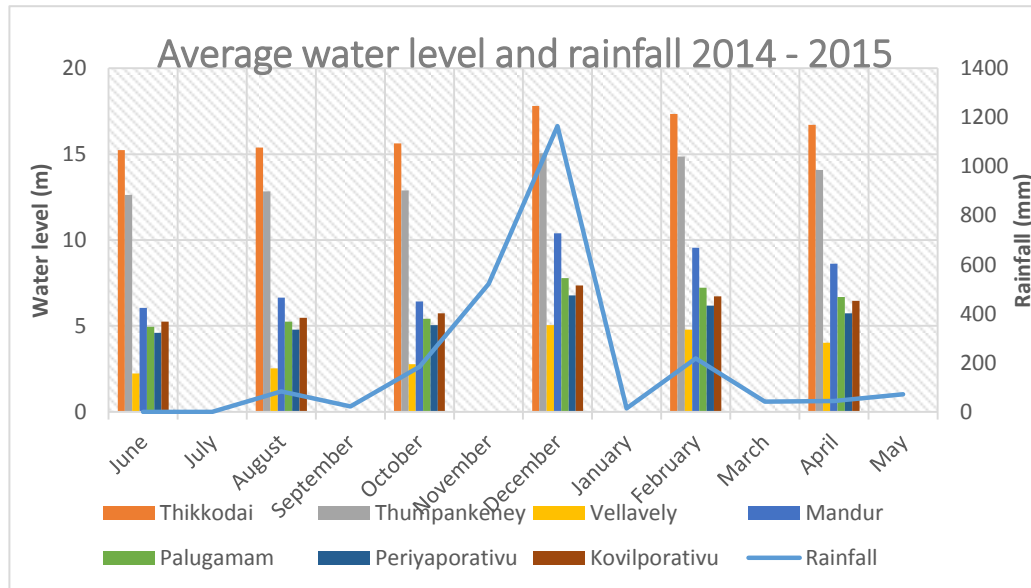


Figure 4. Average water and rainfall 2014 – 2015

According to the figure 4, the average amounts of water level were observed in June, August and October 2014. The main reason for this, very less mm rainfall were recorded in June (0mm), August (82.7mm), October (184.1mm), 2014 and April (43.7mm), 2015. Very high rainfall was registered in December (1,164.2mm) 2014 and the average rainfall 217.7mm got in February. The water level is also very high in this period. Nevertheless, June, August, October, and April were got the very low rainfall but seem the water level was above the rainfall. The possibility of this, the irrigation got the major role to produce the water. Otherwise, there were no another source for the water.

In order to solve the problems, the following recommendations are suggested from the research. Through this, we can minimize the water and irrigation problems.

Ways to eliminate the water shortages

1. To educate to change consumption and lifestyles
2. To recycle wastewater
3. To improve irrigation and agricultural practices
4. To recharge of the ground water from rainfall
5. To develop efficient desalination vegetation to control the over chemical usages
6. To develop the traditional agricultural practices
7. To make the proper irrigation system
8. To improve the better sanitation facilities
9. To improve mangrove replantation and conservation
10. To develop the drainage and water supply

Control the water pollution

1. Legislations

2. Awareness programs

6. CONCLUSION

Ground water is the most precious resource for human beings all over the world. The water level fluctuates in every areas of Sri Lanka. This is depending on the bedrock and soil.

The selected 70 wells in Porativupattu were the most suitable, that was selected in different locations and the each wells contained different water level. The seasonal changes of ground water level were analyzed by using chart 1.1. The ground water level is very high level in the rainy season as well November, December and January but it is also a little high in October and February but, in other season, the water shortage occurred in the study area.

The past 146 years' rainfall showed, the dry and wet season through the chart 1.2, 1.3 and, 5, 11 years moving average and standard deviation for it are more helpful to experience the rainfall fluctuation. According to 11 years standard deviation, the people experienced of 8 dry seasons and 8 wet seasons. Therefore, the people in every period experienced the different season in their life.

Thus, the human activities are mostly affected the ground water, uses of the agricultural chemicals, collapsing the soil formats, deforestation especially mangrove diminishing are caused to the water problems. Therefore, to increase the water level, every people should take the responsibility to save the wastewater and reduce the useless wastages, should do the awareness programme to each level as students, societies, clubs and the proper management activities for water conservation will reduce the water shortage in the study area.

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