



## In depth analysis of groundwater quality and use of *Moringa oleifera* leaf powder treatment to improve physico-chemical properties and drinkability of contaminated groundwater



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### ABSTRACT

Groundwater is the major source for domestic, and other uses in the Jaffna Peninsula, Sri Lanka. This study assessed the spatial and seasonal variation of physical and chemical parameters of water collected from domestic wells in Chunnakam and Vadamaradchi aquifers. The measured physicochemical parameters were compared with the drinking water standards established by Sri Lanka Standards Institution.

Significant spatial variations in the water quality parameters were identified in both areas. Significantly elevated levels of nitrate and oil & grease were identified in Chunnakam, whereas significantly elevated levels of DO and pH were recorded in Vadamaradchi. Nitrate concentration of the wells ranged between 0.021–40.1 mg/L. Oil & grease of these wells ranged from 0.011 to 0.373 mg/L. In Chunnakam, 60% of sampled wells had nitrate level above the permitted nitrate standard level, and all the wells had elevated oil and grease concentration above the permitted standard limit. Filtration of water through *Moringa oleifera* leaf powder could significantly reduce the nitrate and oil and grease concentrations, thereby improving the quality of water.

### 1. Introduction

In Sri Lanka, the groundwater resources are considered to be lesser in extent than surface water resources. However, the available groundwater resources are widely concentrated in the Jaffna peninsula, which is located in the northernmost region of the country. The Jaffna Peninsula has four main types of aquifer systems, namely Chunnakam (Valikamam area), Thenmaradchi, Vadamaradchi and Kayts (Puvanewaran, 1986). These groundwater aquifers are very important in providing domestic, irrigation, industrial water supplies.

Although all the human settlements in other parts of the country were near to rivers and wetlands for easy access to water, the shallow aquifers and easy access to groundwater favored the human settlements in the Jaffna Peninsula. The extent of the Jaffna Peninsula is 1025 km<sup>2</sup> and is considered as one of the most densely populated districts in Sri Lanka (Department of census and statistics 2015). In the past decade, intensive rehabilitation and development activities were conducted in Jaffna and agricultural activities are expanding throughout the peninsula.

The excessive usage of ground water resources have caused many water scarcity problems in this area. The groundwater resources are recharged by the rainwater and the seasonality and uncertainty of

rainfall greatly affects the quantity and quality of groundwater (Vigneswaran et al., 2015). Also the non-sustainable ground water extraction methods and contamination due to non point source pollution have severely degraded the ground water quality in the aquifers of Jaffna Peninsula (Arumugam, 1970; Nandakumar, 1983). However, recent studies have not been conducted to assess the quality of the groundwater resources in this part of the country. Therefore, the present study as aimed at in depth analysis of physical and chemical parameters in the well water collected from two major aquifer systems, namely, Chunnakam and Vadamaradchi in Jaffna peninsula.

Plant based water treatment procedures for treatment of contaminated water is widely practiced in many parts of the world. These water treatment methods include treatment of contaminated water with extracts and powdered material of seeds, leaves and roots of different species of plants. Among the plant material tested, the seeds of *Moringa oleifera* is considered as one of the most effective primary coagulant for water treatment and its coagulant ability is considered to be similar to the most widely used conventional chemical coagulant, alum (Amagloh and Benang, 2009). Also, The *Moringa oleifera* leaf extract have effectively reduced water hardness, total dissolved solids, sulphate and nitrate concentration in the water (Jahn, 1989). *Moringa oleifera* is recommended as a suitable green water treatment source to be used in

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