

RESEARCH ARTICLE

Status of the saltwater intrusion in Jaffna, Sri Lanka

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Abstract: The objective of this study is to assess the present status of saltwater intrusion in the proximity of lagoons (Vadamarachchi and Uppuuru) in Jaffna, Sri Lanka. Ten villages along the periphery of the said lagoons were selected for a questionnaire survey (n=150) and groundwater quality analysis. The results revealed that the villages; Thondaimanaru, Atchuveli, Ariyalai, Kaithady and Karanavai are less affected (<33%) whilst Chemmani, Madduvil, Navatkuli, Irupalai and Neerveli are highly affected (>60%) in terms of intolerable level of salt content in the sandy aquifer. In Irupalai alone, more than 80% of the wells are highly affected where more than 80% of the wells monitored are exceeded the tolerable limits of EC (>2.5 S/cm) and salinity (>900 ppm), thus unsuitable for human consumption. The field mapping of water quality parameters (EC and salinity) revealed that the villages influenced by Vadamarachchi lagoon was lesser affected (<33%) than the villages influenced by Uppuuru lagoon. There is a trend of decreasing salinity from boarder of the lagoons to inland. As an initiative, water quality monitoring, establishing monitoring wells, and educating the people about adverse effects of over pumping of water are essential to reduce the saltwater intrusion in the area. Renovation of existing saltwater barrages would be an appropriate solution to enhance the groundwater quality in future.

Keywords: saltwater intrusion, barrage, lagoon, groundwater quality.

INTRODUCTION


The Jaffna Peninsula, lies in the longitude and latitude 79° 45' N – 90° 30' E and 80° 20' N – 90° 50' E and covers the extent of 1000 km² forms the northern edge of Sri Lanka. Groundwater is the prime source of water for the people in Jaffna peninsula as the surface water resources are lacking due to karstic nature of the limestone, unpredictable rainfall leaving no rainfall harvesting and flat terrain (Kumara *et al.*, 2013; Hidayathulla and Karunaratna, 2013; Wijesekera *et al.*, 2012). Salt water intrusion is a serious issue in the coastal zone wells of Jaffna, since the wells are now producing low quality groundwater unsuitable for drinking and agricultural purposes (Rink *et al.*, 2016). This eventually left hundreds of acres of arable lands abandoned and caused hundreds of wells with brackish water in the coastal zone (Kumara *et al.*, 2013; Sivakumar, 2013).

The Jaffna peninsula falls within dry zone of Sri Lanka and underlain by Miocene limestone. There are two major types of aquifers in Jaffna Peninsula - limestone and sand dune aquifer (Vigneswaran *et al.*, 2017). The peninsula has four main aquifers namely Chunnakam (Valikamam), Thenmaratchi, Vadamaratchi and Kayts (Mikunthan *et al.*, 2013). The geology of the western side of the peninsula is limestone, and the eastern part is sandy with limestone base. The limestone aquifer together with thin sand layer provides a source of drinking water for the peninsula. The caverns and crevices exist in the limestone facilitates the movement of groundwater through the limestone aquifer (Sivakumar, 2013; Mikunthan *et al.*, 2013). Rainfall is the only source that replenishes the limestone aquifer (Mikunthan *et al.*, 2013).

The freshwater is less dense than the saltwater thus it floats on the top of salt water. The rainwater percolates through limestone and floats as lens-shaped bodies over the denser sea water. The thickness of the freshwater lens is highest in the middle of the peninsula, whilst the thickness is lesser in the coast (Mikunthan *et al.*, 2013). According to Krupavathi and Movva (2016), the saltwater intrusion is usually caused by two mechanisms - one is lateral encroachment and the second is upward movement. Lateral encroachment occurs from the ocean due to over extraction of groundwater from wells located in coastal zone. Upward movement generally happens from deeper coastal zone due to pumping wells. Sivakumar (1993) and Kumara *et al.* (2013) reported that the over extraction of water in Jaffna from a sandy/limestone aquifer pulls the underlying saltwater upward, forms up coning effect along the interface, and mix up with the fresh water above and deteriorate the water quality. According to past research studies, digging of deep wells and over extraction of groundwater for extensive agricultural activities are the major causes for salt water intrusion into the groundwater (Rink *et al.*, 2016; Janen and Sivakumar, 2014). This happens especially in dry season as the thickness of freshwater lens is less when compared to the thickness in wet season (Mikunthan *et al.*, 2013).

Groundwater naturally flows from higher hydraulic head to lower. This natural movement of fresh groundwater from inland to sea prevents sea water entering into sandy

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