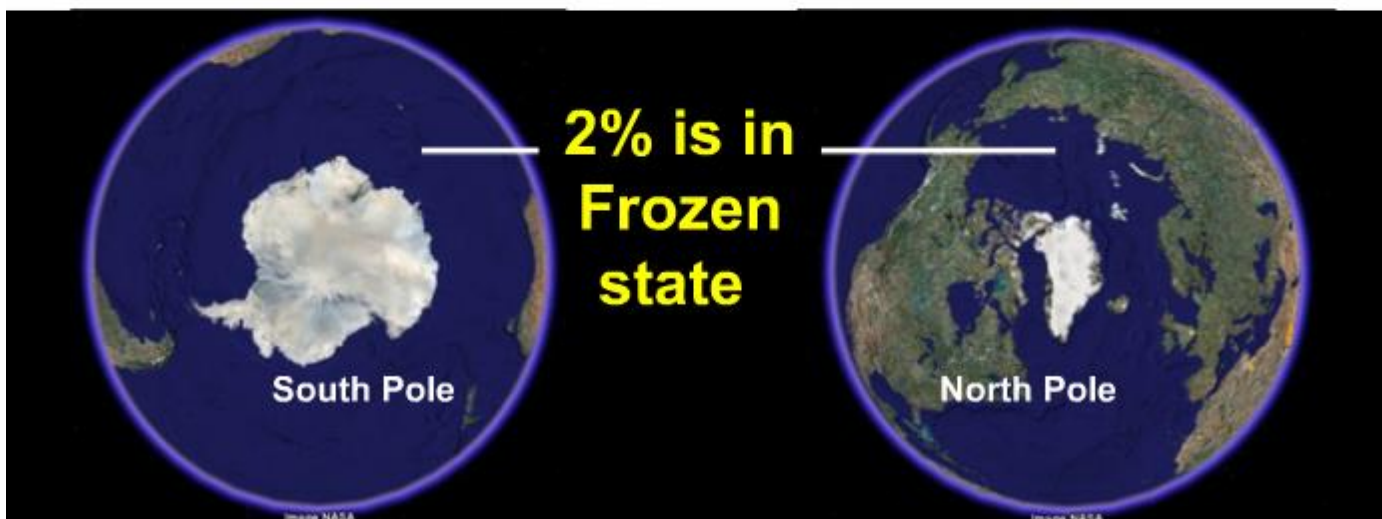


## North Chennai Worst Affected by Seawater Intrusion making Groundwater unfit for human consumption: Saline water Intrusion up to 14 km from the coast towards Inland

The Earth is a watery place with 70-75% of the Earth's surface covered with water. But ironically 97% of all Earth's water is in the oceans which is saline in nature and not suitable for human consumption leaving us in a freshwater deficit situation. It reminds us of what ancient mariner Marco Polo once said: "Water, water everywhere not a single drop to drink!" A breakup of the total water availability shows that we have 97% salty water and only 3% freshwater. Out of this 3% freshwater the Earth has, 2% remains in a frozen state in glaciers and icecaps of the polar region and Greenland.

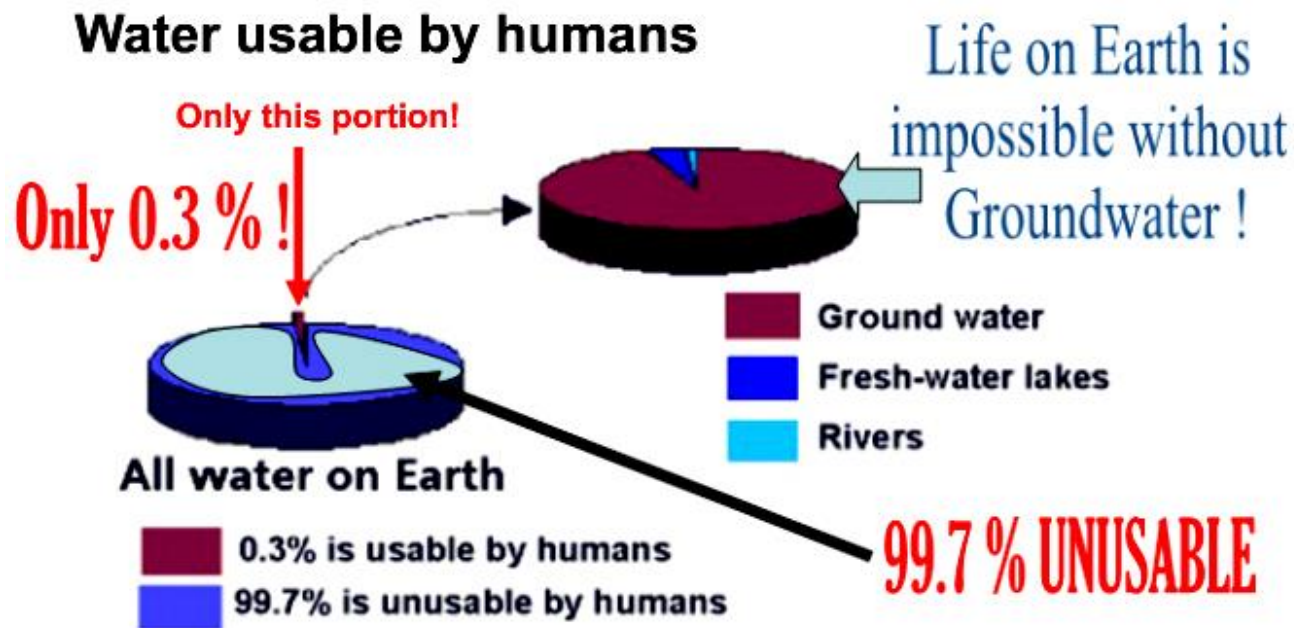
We have 97% Salty Water  
only 3% Freshwater

Out of the 3% of the fresh water that the Earth has, 2% remains in a frozen state in glaciers and icecaps of the polar region and Greenland



Infographic: SB, VP (Image Source: NASA)

But a further breakup reveals that we don't even have 1% of the freshwater usable to us. **In reality only 0.3% of the Earth's total freshwater is usable by humans. Where do we get this 0.3% of freshwater? The water on which our lives thrive are the 'freshwater' provided by' groundwater (0.3% of the total World Water) which is so negligible in quantity and which we don't see!**



Notice of the world's total water supply of about 1,386 million cubic kilometers, over 96 percent is saline.

Infographic: [SB, VP](#)

These water under the ground are the groundwater. **97% of the liquid freshwater is stored underground in aquifers within a few kilometers (mostly up to the depth of 2.4 km) of the Earth's surface almost everywhere, beneath hills, mountains, plains and deserts and of course the coastal areas.**

Pumped groundwater from the aquifer is the major source of freshwater supply through pipes delivered to cities, houses in the country or to irrigate crops. During the recent times, due to various human activities there is a crunch in the groundwater availability due to aquifer over pumping resulting in falling water table. As the Earth is overpopulating, to meet the need of freshwater, more water needs to be pumped from the aquifers and when the groundwater is completely exhausted, there are some places where people have to shift from their original places to other locations in search of freshwater. These people uprooted from their original place can be termed as 'water refugees'.

## What is Groundwater?



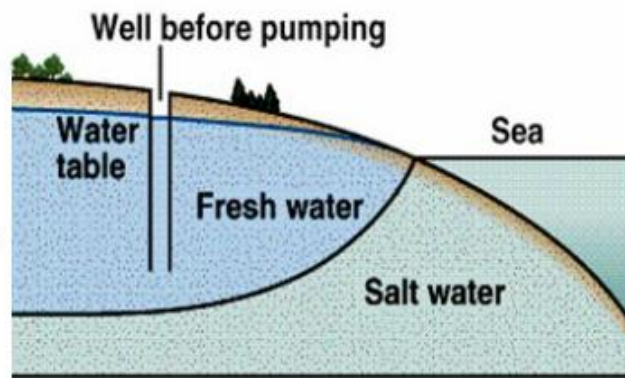
**97% of liquid freshwater is stored **underground** in **aquifers** within a few kilometers [mostly 2.4 kms] of the Earth's surface almost everywhere, beneath hills, mountains, plains, and deserts.**

Infographic: SB, VP

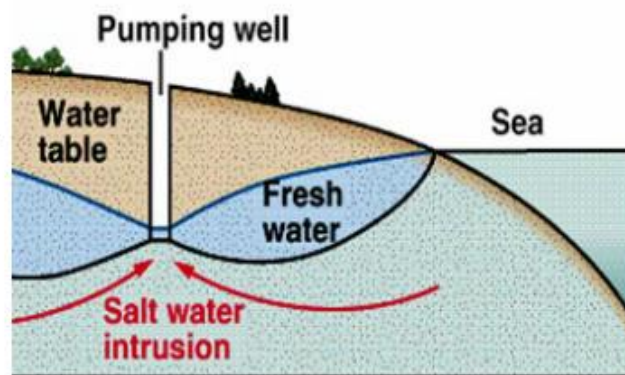
One of the major problems the world has been witnessing is the pollution of groundwater. Seawater intrusion in the coastal regions of India is one such major threat to the freshwater aquifers.

# Salt Water Intrusion

One consequence of overpumping in coastal regions is the encroachment of saline seawater into fresh aquifers.



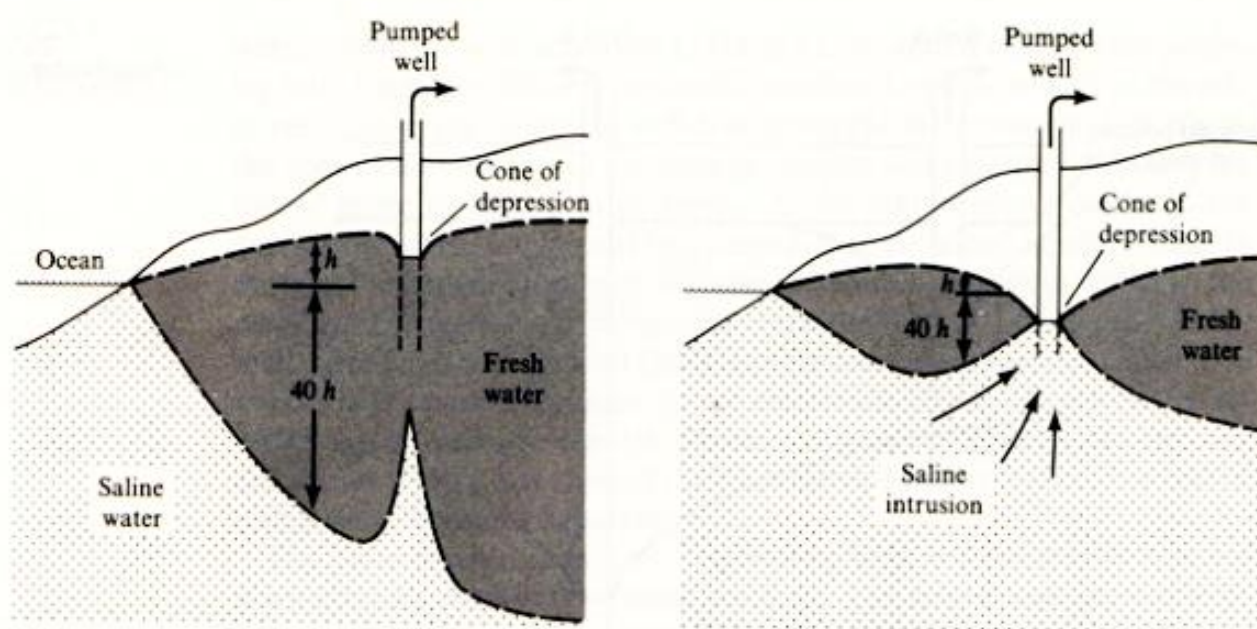
To combat this, many coastal communities re-inject wastewater into coastal aquifers.



Infographic: SB,VP

There are different methods of investigation through which researchers have reported the extent of salty seawater intrusion. **North of Chennai is reported to be facing the maximum extent of seawater intrusion in India (upto 14 km from coast).** It is estimated that around 7% of India's the total coastal area is affected by seawater intrusion, where groundwater is below mean sea level. **Around 57% of the coastal area of India has groundwater level in the range from 0 to 10m below msl (Mean Sea Level).**

## Fresh Groundwater contaminated by Saline water near coastal region



(a)

(b)

- (b) Near the coast, groundwater occurs as a lens over saline water. The height of the lens above sea level is equal to one-fortieth of its depth below sea level
- (c) Heavy pumping of the groundwater generates a large cone of depression in both the upper and lower boundaries of the freshwater lens, and eventually allows saline water to enter the well

Researchers at [Anna University, Chennai](#), conducted a study through many peer-reviewed articles on the effects and extent of seawater intrusion in the Indian coastal region which is published in the journal of **Environmental Science and Pollution Research**. The study was funded by the [National Centre for Earth Sciences Studies](#), Thiruvananthapuram, Kerala and Earth System Science Organization (ESSO), Ministry of Earth Sciences (MoES), New Delhi.

The studies employed Various methods were employed during the study to identify seawater intrusion, namely - Groundwater Level Method, Geophysical Method, Geochemical method, Isotopic Signatures, Chemical Indices and Groundwater modelling.

The researchers from Anna University also collected data on groundwater levels of 991 wells for over a period of 10 year starting from 2007 to 2017 obtained through [WRIS-WebGIS](#), which is a ingeniously developed Web enabled Water Resources Information System.

The combination and comparison of data thus enabled the researchers to provide a thorough understanding of the problem of seawater intrusion. **It was found that few coastal regions of Gujarat, Tamil Nadu and Andhra Pradesh are greatly affected by seawater intrusion because of the depletion of groundwater level below the mean seawater level. However, the extent of seawater intrusion along the west coast was found to be lower than the east coast as the west coast is at a higher altitude.**

The total area affected by seawater intrusion is approximately **2600 sq km** which was an increase of approximately **500sq km** between 2007 and 2017. **Chennai was found to be the worst affected city with observed seawater intrusion of about 14 km.**

[Dr. L. Elango, Professor and Head](#), M. Sc (Applied Geology), M.E (Hydrology & Water Resources Engineering) Anna University, who took a lead in the research expressed his worries that if the current trend continues, with other deleterious contributing factors like climate change and sea-level rise will make the groundwater unusable due to even more increase in seawater intrusion. "Overuse of groundwater from the coastal region will increase the extent of seawater intrusion and the groundwater will no longer be usable due to an increase in salinity," he adds.



Dr. L. Elango, Professor & Head, M.Sc (Applied Geology),M.E (Hydrology & Water Resources Engineering)

The researchers suggested controlling of the unchecked pumping of groundwater near the coastline and **moving of the pumping wells deeper to the inland from the seaside. Another mitigation process they suggested is to pump the salt water contaminated groundwater from coastal aquifers and replenish the saline groundwater with freshwater.**

Among all the tested mitigation efforts by various researchers, the most efficient method, as per the researchers of the current study, is to allow for increasing groundwater recharge, via **permeable pavements** and **percolation ponds**. These structures store rainwater and recharge the subsurface water.

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