



Resolved Mystery of Groundwater Basics through Biotechnology: A Gateway for the Management of Global Hydrological Extremes and Related Climate Change

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Abstract

Groundwater is vital to many nations. Worldwide some 2 billion people, innumerable farmers and many industrial premises depend on it for their water supply. Facing global environmental change including climate change, it is essential to assess the impact of all those on groundwater recharge and resources. Quantifying impacts of climate change on groundwater is difficult and is subject to uncertainties in future climate projections. Current understanding of climate change impacts is poor.

Hence, the pre-proposed Second water cycle with its conceptual scientific basics using the Pit Test, Tub Test, Brick Test and Field test were compared with the two different pre-applied ancient technologies used by two different persons in India in two different places.

The reported results directly support the pre-proposed concept of Basic Groundwater Hydrology and its underground physical process which stays invisible to our eyes thus acting as the solid proof for the large scale application and the pre-proposed concept.

Accordingly, in this article, all the basic technical details related to groundwater is compiled and addressed more clearly and specifically. The relationship between the groundwater and climate change is elaborated with the man made mistakes to both the water cycles and the rectification method is listed out with the call for Groundwater Revolution to make the future better for the next generation.

With this elaborated rectification method we can make a permanent solution to mitigate both the Hydrological Extremes – Flood and Drought and bring the water issues under control.

The Policy makers can consider the importance of the Groundwater whichever is mentioned in this article and rework on the sustainable water resources development and management strategies without neglecting them. Because this article will be the supporting material on the basics of Groundwater as the blueprint for action.

Keywords

Biotechnological principles; Water formation; Earth's complete water cycle; Surface visible water cycle; Underground invisible water cycle; Groundwater revolution; Water network; Groundwater operation

Introduction

Groundwater is vital to many nations. Worldwide some 2 billion people, innumerable farmers and many industrial premises depend on it for their water supply [1]. Groundwater is usually defined as water contained in an aquifer matrix located beneath the surface in the saturated zone. For many important agricultural production areas, groundwater will remain the ultimate source of freshwater when surface water sources have been depleted. The aquifers that host groundwater are the primary buffers against drought for both human requirements, and crop production [2].

Time series of groundwater levels and spring flows are assumed to contain valuable proxy information on past changes in recharge and their interaction with anthropogenic activity, land use and meteorological conditions. Analyzing those data can help to identify processes which will affect groundwater resources in the future and are worth to be considered in impact studies [3].

Changes in the distribution and the amount of precipitation, increasing temperatures, increasing demand and continued sealing of surfaces can easily increase the pressure on groundwater. Although the focus of climate change impact studies in the past has been mainly on surface water, more attention has been paid to groundwater related questions recently [4]. Surface water and groundwater are, in many cases, hydraulically connected. Yet this crucial fact has been all too often ignored in water management considerations and policies [5].

Quantifying impacts of climate change on groundwater is difficult and is subject to uncertainties in future climate projections. Natural climate variability is also often ignored with the focus typically being on anthropogenic climate change impacts only. Current understanding of climate change impacts is poor. Whilst knowledge of climate change impacts for groundwater is advancing, there does not appear to be any coordinated approach for developing responses [6].

To address the uncertainties and knowledge gap in the Groundwater, the basics were restudied on the basis of few conceptual experiments conducted for conforming the formation of groundwater, the direction in which the flow of groundwater takes place and the reasons behind the coastal saline aquifer, using Biotechnological backgrounds. The results obtained through the experiments made clear that, the process which takes place underground as per the understanding on comparison with the surface flow is not the real process which is actually happening beneath. A new model for understanding the basics of groundwater hydrology is presented with added technical information. With this, a modified water cycle has been proposed in this paper. This paper brings out the second part of the invisible water cycle on the basis of the real science and technology happening in the Earth's natural geological process and provides a way for the future water management as per the natural process [7].

The pre-proposed Second water cycle and its basics were compared with two different pre-applied ancient technologies used by two different persons in India in two different places. The results of the applied technologies directly matched with the expected results of the proposed concepts, science and technology for Groundwater on the basis of Biotechnology. These two solid case studies and its

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data provides the valid information for the Groundwater and its underground process which stays invisible to our eyes and stay as the solid proof for the proposed concept and the Second Water Cycle. Hence the plan of taking forward this research to apply the proposed concepts, science and technology in large scale field study in order to prove the concept got dropped to save the time and energy.

Since the invisible data is made visible in this article, the next step of the study is to clear the way for proper application of the technology. Accordingly, all the basic technical details related to groundwater is compiled and addressed more clearly and specifically in this article. The relationship between the groundwater and climate change is elaborated with the man made mistakes to both the water cycles and the rectification method is listed out with the call for Groundwater Revolution to make the future better for the next generation.

With this elaborated rectification method we can make a permanent solution to mitigate both the Hydrological Extremes – Flood and Drought and bring the water issues under control

Groundwater and biotechnology-The interdisciplinary interaction

In recent decades it has become evident in many countries of the world that groundwater is one of the most important natural resources. As a source of water supply groundwater has a number of essential advantages when compared with surface water: as a rule it is of higher quality, better protected from possible pollution including infection, less subject to seasonal and perennial fluctuations, and much more uniformly spread over large regions than surface water. Very often groundwater is available in places where there is no surface water [8].

How is it possible?? For this question, Biotechnological principles, Chemistry and Chemical Engineering Technologies combine together with the Earth Science and Geochemistry to bring out the possible science and technology behind Groundwater. Accordingly, in this paper, we will go back to the evolutionary period and come back with the solution and control measures for the Groundwater related problems and climate change.

Groundwater – The evolution and history

Where groundwater came from???? Where water came from???:

For this question, if we are going to give the Religious and Spiritual answer-It is created by “GOD”, then there is No second question as the answer is highly religious and subjected to Faith, Belief and GOD Himself. Because we have lot of different religious believers and faith throughout the globe from one place to the other, though the total Globe is controlled by a single Power named GOD which no one had seen yet. Hence, there is no need to do research with GOD or the power of GOD.

Whereas, if we look at the scientific answer it is based on Big Bang Theory. As this article is subjected to topic limitations, the details of the Big Bang Theory can be referred online.

Whether it is spiritual answer or scientific answer, the brain storming begins here...

- Earth's Total Land Mass-29.1% and Earth's Total Water is 70.9%.
- Layers of atmosphere have variable temperature noted at different levels of height.

- The Molecular weight of Oxygen and Hydrogen-Molecular Weight of Oxygen – 31.998% and Molecular Weight of Hydrogen-2.016%.
- The Total Area and depth of the Oceans.
- Height of mountains.

We have all the details; still, one more question comes next-Which state of water was first formed?? 1. Liquid 2. Vapour 3. Clouds 4. Rain and 5. Ice

Whether it is creation or Evolution, 24h is the important story here for water as mentioned by [7], which is more important, where we can accept the creation as well as the evolution. One day creation is also acceptable and the billions of years Evolution is also acceptable with the below mentioned technical points. This Groundwater story gives the outline for both the creation and the evolution.

The below mentioned technologies were considered for ruling out the basics of Groundwater in 2004.

Surface water possibilities were sorted out after working with the principles of Concentration, Evaporation, Distillation and Condensation as a part of Industrial Biotechnology in the stages of Fermentation Downstream process, Product Purification and Solvent recovery.

Groundwater possibilities are sorted with the Biotechnological principles of Filtration, Absorption, Layer separation, Colour Removal, and Chromatography techniques from the ocean bed and accordingly experiments were set to study the process.

After 12 years working with the Fermentation, Bioprocess Industrial Background and directly involved in handling the relevant analytical technologies up to High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC) to detect the molecules, the above mentioned technologies were confirmed to set the basics of Groundwater with the help of the Experiments conducted and the data's collected.

Now we will go in depth to find out what is the actual truth

Technical possibilities

- Volcanoes confirm that our earth is having a hot burning mantle inside. Here we can accept the Big Bang Theory. If this is the case, then what might have happened next? Accordingly, we can list the next possibilities.
- When the molten earth started cooling, the surface of the earth should have gone for drying.
- As the atmosphere is filled with variable range of temperatures, at the initial stage of cooling on the earth's surface, the total Hydrogen and Oxygen molecules should have combined together and gone for Freezing based on the Earth's Vacuum, Temperature and Pressure where the First Ice Formation should have started.
- As a result, the earth's surface should have got covered with thick, dense snow and ice.
- Years later, the ice should have got fractured and started melting due to the temperature and pressure variations on the earth's surface.
- Thus, the first splitting of hydrogen from oxygen should have started which should have resulted in the First Water Vapour Formation.

- The melted water should have started to move down from higher surface to lower surface thus forming the first surface flow which should have resulted in the First Surface Run-Off.
- The first runoff from the melting ice should have reached the lowest level of the earth surface and should have started collecting there hour by hour and day by day, which should be our First Lakes and Ponds on the surface of the earth. This should be our Sea/Ocean bed today – The deepest bed.
- Due to the earth's varying temperature and pressure, continuous breakdown of hydrogen and oxygen molecules should have taken place from the melting ice, surface water flow and from the lowest level of our earth, where the runoff ended and the first accumulation of liquid water started. First Evaporation and Absorption of our planet should have started there.
- Based on the molecular weight, the low molecular weight hydrogen molecules should have started to move higher and higher and form a white mass called the cloud which should be our First Clouds.
- Single small clouds should have started to move in the direction of the wind, mix with the other clouds and formed cloud mass.
- Sudden variations in the atmospheric pressure, vacuum and temperature should have collected the scattered clouds together along with the wind. Due to this sudden change, a molecular bombardment should have taken place, resulting in the earth's First Thunder and Lightning along with the First Storm/Cyclone.
- During favourable conditions, (atmospheric vacuum, pressure and temperature) the bonding of hydrogen and oxygen molecules should have reverted back and after complete saturation, it should have come down to earth in the form of rain which should be The Planet's First Rain.
- The first rain should have given birth to the first fresh water run-off among the ice covered surface in the paths of the first water flow started by the initial melting of ice which might have resulted in the formation of the First Streams and Rivers.
- Day by day, once the water level starts increasing in the lowest level of the surface of the planet, the same water should have got absorbed along the side ways of the low level throughout the surface of the planet as per the experiments carried out by [7].

This continuous accumulation process should have resulted in the formation of Our Planet's First Sea and Ocean after several million years.

- The entire continuous process, should have resulted in the formation of two water cycles:
 - Surface Visible Water Cycle and
 - Underground Invisible Water Cycle

Surface visible water cycle: We all are familiar with this cycle as it is what we all know, study, refer and visible to our naked eyes. The above mentioned possibilities directly match with the Surface Water Cycle.

The above mentioned 16 Technical possibilities support the Science and Technology of Water Formation in this planet as per the rules of Big Bang Theory.

Underground invisible water cycle: How to study the second water cycle and the age of water in this planet???

If the above mentioned 16 technical possibilities support the Big Bang Theory, The below mentioned Experimental answers strongly support that the Earth and the water formation might have happened even in a single day and might have resulted in the formation of the ground water. Also these experiments clear out the formation of groundwater on the basis of Big Bang Theory too.

Whatever is the case, the below mentioned experiments and its results support both the Science and Technology of Evolution and the Spiritual Belief of one day creation.

Based on these data, we have to start a new Mission in the water management policies and programs which alone will save the future generations from the Hydrological Extremes especially the Flood and Drought along with the related climate changes.

24 Hours – The history and mystery

Experiments extracted from the study of [7].

1. Pit test
2. Tub test
3. Field test
4. Brick test
5. Bottle test

How to calculate the age of water??

- Pit Test and Field Test gives the information about the absorption spectrum of the land.
- Based on the soil nature, time lines may get varied.
- Approximately, 18 h is needed for the first absorption and then it is getting extended and extended.

Based on today's sea level:

- Total water on Earth (Today's Total sea water+Total Groundwater+Total Fresh water+Total Living beings on land and water+Total water vapours+Total Clouds) \times (18+18 hours) on sides, depth and height – {Impossible to calculate accurately since we don't have the accurate values for the clouds and vapours}
- Rate of absorption on soil: 14 L/18 h=0.78 L/h and 0.81 h/cm
- On total, $L \times B \times H$ on cm scale=0.6318 L/0.81 h/cm
- (Value and Time are variable according to the nature of the soil)
- Rate of evaporation – varies with the atmospheric pressure and temperature on 24×7 basis which is a continuous process.
- Similarly, more amount of water is also available on the land mass along the sides of the seas and oceans as like their width up to sea level.
- So only, even during the volcano eruption, the molten lava comes out in liquid form.
- Above the sea level, the amount of water will be less. Because the movement is against the gravitational force, otherwise the capillary force, which is too slow than the gravitational force. Still, the availability is based upon the pressure of the

water from the Sea/Ocean and type of soil. Weaker and high pressure areas produce Natural Springs in the cracks and hinges of the rocks/Soil. This was confirmed by the Brick test.

- Tub test represented the table top physical visual model of the Pit Test and Field test for easy understanding. This will be useful in demonstration and teaching the groundwater basics in school level and in workshops.
- Brick test acts as the example for the capillary movement of water absorption. The time taken by the water to reach the top most regions was the same 13 h as like the absorption seen in pit test and field test. After 24 hours the brick was found fully saturated.
- In the Bottle test, Color removal was studied from a mixed solution using sand column replicating the Filtration and Column chromatography method.

The important notable observation from the sand column test was, when the sand column was first filled with water and left undisturbed. The filtration was uniform up to 5 top-ups. The column was slightly disturbed by tapping on the sides to tighten the soil layer. Water was added. This time, there was no output for a long time and then the output was too slow when compared with the previous fillings.

This gives the information that, if the land surface is disturbed by blasting or through earthquakes, it will affect the water movement and decrease the flow – An important and serious point to note.

The decreased water table surrounding the Mines areas is the fine example for this observation. Being from the Mines affected areas where artesian springs were reported before starting the mines, today after almost 5-6 decades of continuous pumping of groundwater and daily blasting, the water table had gone down to a depth of almost 200 feet (Figure 1).

Where Groundwater Came from?

- When rainfall occurs, percolation starts immediately on the surface and results in the surface run-off from high level to low levels.
- In such a case, we need 18 h – 24 h for complete absorption into the land.

- This is not possible immediately in the run-off and even in the accumulated lakes and ponds, thus leads to the formation of floods during heavy rains.
- This in turn reaches the oceans and seas through the rivers.
- In case of frequent light rain, based on the total water received, it is clear that, those drops are not sufficient to fill the total land mass based on the time line noted.
- Ground water should have come from the first drop of the water to the current oceans of water which had entered into the land surface by means of absorption which in turn had continued all these years of the formation or the evolution of the current earth as mentioned in the possibilities.
- Out of the above mentioned possibilities, Groundwater formation gets confirmed here with the help of the pit test and field test by manually poring the water by creating the pit and the absorption band noted.
- Thus the movement of Groundwater is from Seas/Oceans to Land and not from Land to Sea as mentioned in the literatures.
- Surface water and Groundwater are moving in the opposite directions. Not in parallel as per the above mentioned Experiment details by [7].

Thus, earth is covered by water on a 100% basis. 70% on seas and oceans, 30% on the land as groundwater, surface water, all living beings on land and water which are the carriers of water in their body cells, getting connected with both the water cycles and to the atmosphere too.

The mechanism of the flood formation is also cleared here. 18-24 h is most important during rain fall based on the absorption pattern studied. During heavy rains, Flood formation is based on the route of flow. If the surface is free flowing, then the water moves from high land to low land easily within the above mentioned time interval where the low land might be facing heavy flow which we name as flood. If the flow path is not free, then, accumulation will happen wherever the path is hindered and resulting in flood even in the higher land surface.

This we can see today in this modern world due to improper drainage and blocked surface, flooding occurs immediately even for a single day heavy rain and this flood water gets stagnant for days. Hence proper management is needed which is mentioned in the next section of this article (Figures 2 and 3).

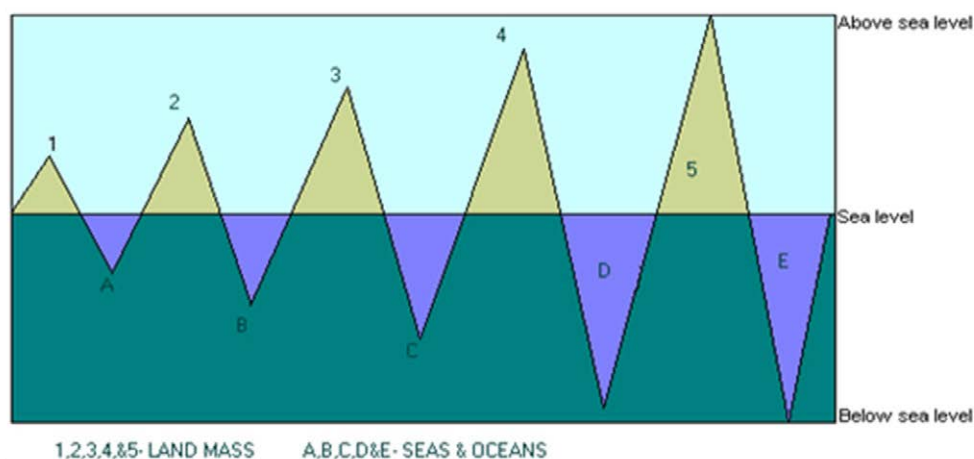


Figure 1: Surface picture of our planet Earth.

As per the above discussed points, by merging both the water cycles, our planet’s actual and complete water cycle is presented below (Figure 4).

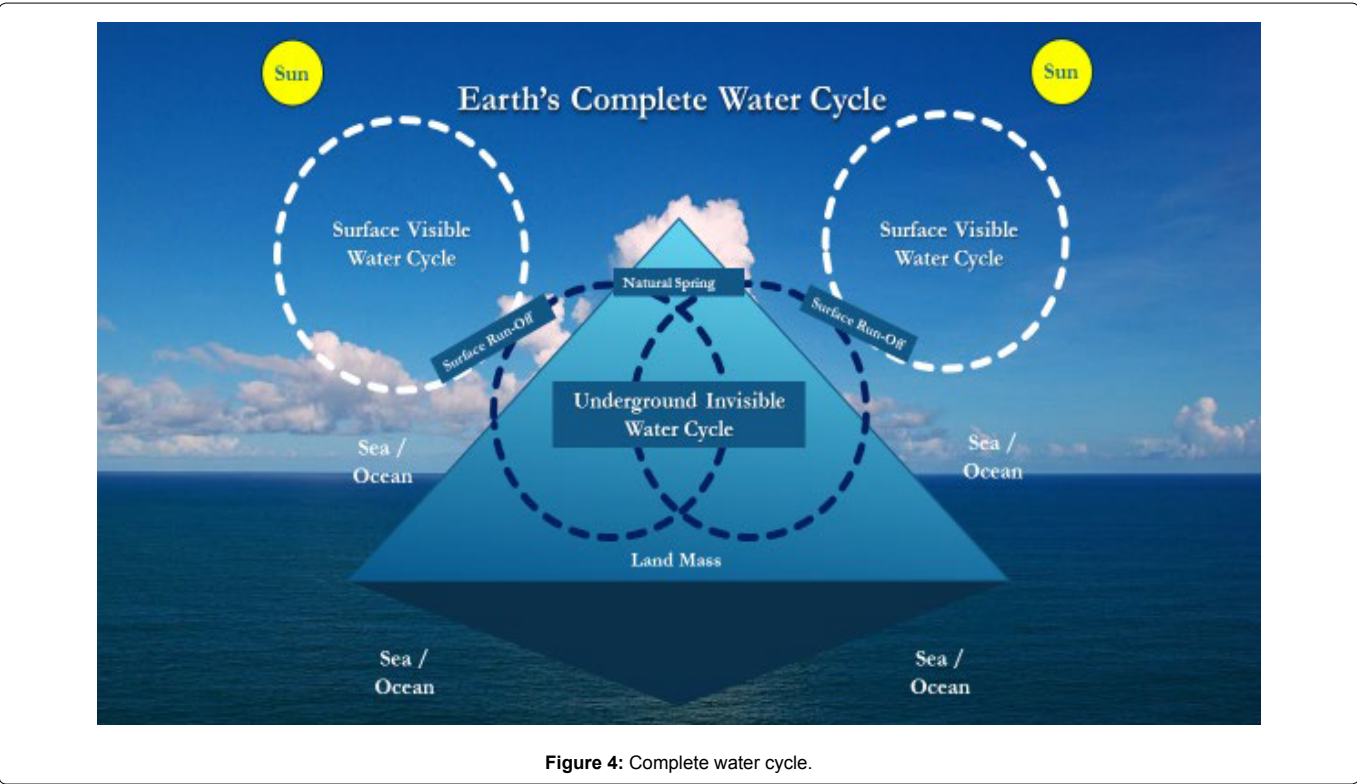
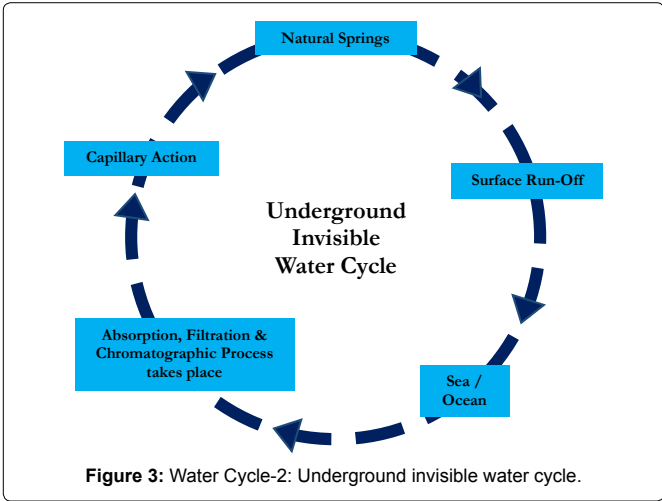
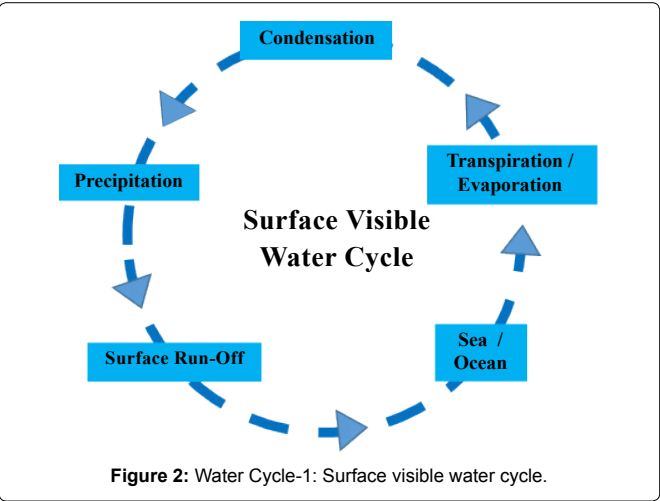
In spite of the fact that ground and surface water are separate components of total water cycle in the globe, they are, at the same time, closely connected. Therefore, when solving problems of groundwater use, this interconnection should be considered [9]. This is how the actual connection is working in the planet (Figure 5).

Scale-up model, data and living example for the proposed theory and concepts

The pre-proposed Conceptual Science and Technology is compared with two different ancient technologies used by two

different persons in India in two different places (Table 1). As Ground water was a topic of assumptions and uncertainties, the conceptual experiments were planned to apply in a large scale level to conform the pre proposed Groundwater science. During this stage, the supporting application oriented data obtained for the above mentioned concept in which the results had attracted the global community and the media is presented below. Thus the proposed concept is confirmed true with these two case studies.

Case study – 1: On March 20, Singh was awarded the 2015 Stockholm Water Prize, sometimes described as the Nobel Prize for water. “Rajendra Singh did not insist with the clinics,” the Stockholm International Water Institute, which awards the prize, said in a statement. “Instead, and with the help of the villagers, he set out to build *johads*, or traditional earthen dams”.



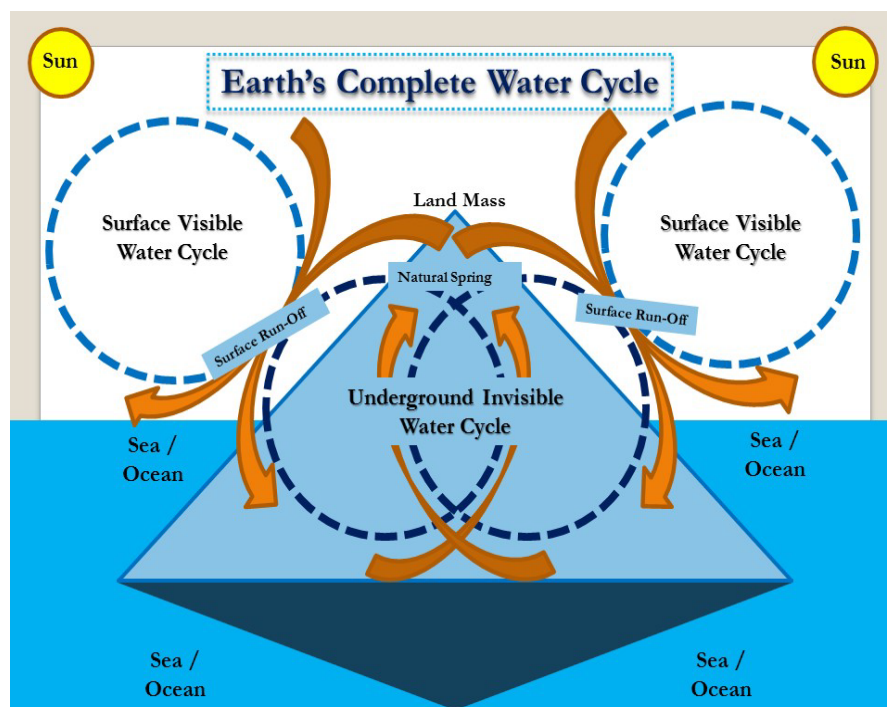


Figure 5: Both the water cycles circulate in opposite direction.

"OUR PLANET EARTH ITSELF IS A HUGE WATER TREATMENT PLANT, WITH A FINE AUTOMATED DISTILLATION, CONDENSATION, FILTRATION AND CHROMATOGRAPHIC UNITS" [7].

These ancient structures—evidence of reservoirs to collect rainwater date back to 1500 BC—were designed not only to hold runoff from monsoon rains, but also help this water percolate into the ground and help improve the water table. But these large earthen structures require substantial manpower and are typically community projects.

Between 1985 and 2007, "Two decades after Rajendra Singh arrived in Rajasthan, 8,600 *johads* and other structures to collect water had been built, in over 1,068 villages across 6,500 square kilometres" it observed. "Water had been brought back to a 1,000 villages across the state". The impact of these *johads* was spectacular. The water table—the depth underground from where water may be extracted—rose from about 100 metres to between about 13 metres and 3 metres. The area under single cropping increased from 11% to 70%, and the area under double cropping went from 3% to 50%. Forest cover expanded from 7% to 40%.

The Stockholm International Water Institute, which presented the prize, said his lessons were essential as climate change alters weather patterns round the world. Its director, Torgny Holmgren, said: "In a world where demand for freshwater is booming, we will face a severe water crisis within decades if we do not learn how to better take care of our water. Mr Singh is a beacon of hope". In its citation, the judges say: "Today's water problems cannot be solved by science or technology alone. They are human problems of governance, policy, leadership, and social resilience [10,11].

Case study – 2: Ancient Mauryan engineering has brought water back to the undulating and rocky terrain of Magadh, the grain bowl of Bihar that had turned almost entirely arid because of abortive modern irrigation policies.

Gaya itself was a modern nightmare as most of its ponds overflowed with garbage. The water table had dipped below 200 feet, and taps and tube wells had gone dry. The water crisis was so acute that people sold their houses in posh localities at throwaway prices. The government promised to build a 100 km canal from the Ganga, but the project failed.

The crisis looked irreversible but Rabindra Pathak, who taught Pali and Sanskrit at a college in Arwal, was certain that the answer lay in the long-forgotten and crumbling aqueducts and water reservoirs that irrigated the fields and fed ancient India's most glorious empire. He pored through old books and scriptures, and found that reviving the dilapidated network of pynes and ahars was the lone solution. Pynes are channels carrying water from rivers. Ahars are low-lying fields with embankments that act as water reservoirs. This combined irrigation and water conservation system dates back to the Mauryan era that flourished in Magadh 2,000 years ago.

They revived the 125-km Jamune Dasain pyne and 159-km Barki pyne. These two complex channels, rebuilt with help from social worker Chandra Bhushan, brought water from Falgu, a tributary of the Ganga. The impact was instantaneous and miraculous. About 150 villages along the Jamune-Dasain pyne and around 250 villages along the Barki canal have been able to irrigate their fields for the kharif and rabi (monsoon and winter) crops, and grow vegetables, pulses and oilseeds as well.

"Recurring protests over water crises are now a thing of past in the district. Hand pumps and wells that were abandoned are now working," said Rajesh Kshitij, a lawyer in Gaya [12].

These two examples directly prove the proposed concept and the Science behind Groundwater.

Water Cycle and Climate Change – Interconnected

Climate change is “an altered state of the climate that can be identified by change in the mean and/or variability of its properties and that persists for an extended period, typically decades or longer”. It may be due to “natural internal processes or external forcing’s, or to persistent anthropogenic changes in the composition of the atmosphere or in land use”. Over the past 150 years global mean temperatures have increased with the rate of warming, accelerating in the past 25 to 50 years. This process will continue in the future [13]. Climate also varies in response to natural phenomena, on seasonal, inter-annual, and interdecadal scales such as the El Nino Southern Oscillation. The presence of, and degree of influence from, these natural phenomena will vary between countries and even watersheds [14].

Groundwater level decline caused by reduction of infiltration recharge and evaporation from its surface, recharge process extension in time, smoothing of seasonal and perennial level fluctuation amplitudes can result in pits and springs drying out, reducing the efficiency of overland ecosystems (parks and forests drying out), changes in vegetation species composition,

Over drying of swamps and resulting soil and peat depletion, and the ignition of peat. There is also the possibility of increased seismic activity with water pumping. Flooding is the most characteristic disturbance of the natural environment, connected with groundwater level rise. Municipal and agricultural flooding is followed by numerous negative Consequences [15].

Deforestation

This is the major mistake done by the human community which had affected the Surface Visible Water Cycle a Lot.

When Human population was less and forest areas were more, the climatic pattern showed some uniformity. Due to the advancement of the science and technology, and increased population, forest area had become shrunken and most of the trees were removed from this planet. Now we are facing all the problems. Rain fall is not uniform in the season and some times more and sometimes less rainfall we are observing everywhere.

The main reason should be the Trees and the Forests. The breathing nature of the trees is that they take in carbon dioxide and

give out Oxygen in the Transpiration Process during day time and vice versa in the night time is the botanical science.

As mentioned in the possibilities of the formation of the water and rain, Oxygen plays a vital role in binding with the hydrogen molecules to form water in the form of rain, snow and ice.

Trees – The natural oxygen factories

One part of the Oxygen is produced by the trees and plants in the land mass and from the surface water bodies through evaporation. The other part of the Oxygen is produced from the oceans during evaporation.Both these oxygen mix together and form a uniform dispersion in the wind and had maintained the climate and weather of this planet in a uniform seasonal pattern.

The second role of the trees in the planet was to absorb the water from the landmass and to give it to the atmosphere during summer season and to send the water to the depth of ground during rainy season through its root system. Thus they balance both the summer and rainy season. In the olden days, the pattern was uniform and so the climate and rainfall was uniform as per the circulation of the winds throughout the year.

Urbanization and modernization

Human civilization had started destroying the forests and building new structures for the housing and industrial development purpose. Today we can see lot of tall and short concrete structures throughout the land mass and what about the forest and trees? Our ancestors had grown trees along the roads. But our generation had cut down all the trees and expanded the roads as per the need and failed to grow the trees. As a result we can feel hot and burning heat during the summer while travelling in those roads during summer.

Will all our concrete buildings replace the trees?? Will they produce the required Oxygen to balance the atmosphere??

Instead of Oxygen, these structures are producing only carbon dioxide and other pollutants is the real truth and they get hot during the summer days and reflect the sun’s heat during the summer nights which each and every one can feel. For cooling we are adding the cooling systems esp Air conditioners and Air handling units which again release the heat and pollutants to the atmosphere.

Table 1: Summary of the Conceptual Study and the Ancient Practices Comparison Chart.

Observations	Comparative Case Study – 1	Comparative Case Study – 2	Conceptual Study
Technology Used	Ancient Technology	Mauryan Technology	Biotechnology
Scientific background	Ancient Practice	Ancient Practice	Filtration, Absorption, Chromatography, Capillary Action
Structures constructed	Johads	Pynes and Ahars	Pit Test, Field Test, Brick Test, Bottle Test
Structure description	Large Earthen Dams that acts as water reservoirs	Pynes are channels carrying water from rivers. Ahars are low-lying fields with embankments that act as water reservoirs.	New Model to study the Groundwater Formation, Flow and the Second Water Cycle – Underground Invisible Water Cycle
Technology live period	1500 BC	2000 years ago	2004-2018 studied and effective from 2018 onwards
Technology reused period	1985 – 2007	2006-2018	Conceptual Experiments compared with large scale applied ancient technologies in case study – 1 and 2 without the proposed Scientific basics.
Reused By	Mr. Rajendra Singh	Mr. Rabindra Pathak	Noted Results: Pit Test, Field Test and Brick Test results match the Water Table Output noted from the Case Study – 1 and 2 and confirm the proposed Science and Technology
No of structures constructed	8600 Johads	2 Pynes	
No of villages covered	1068 nos	150 nos and 250 nos	
Area covered	6500 sq.kilometers	125 and 159 kms	
Water table output	Water table rose from about 100 metres to between about 13 metres and 3 metres	Hand pumps and wells that were abandoned are now working.	

In addition, we had increased the transportation facilities and Industries which emit lot of pollution to the atmosphere. Each individual is in need of a two wheeler and most of the well settled and good earning individual opts for a four wheeler for the comfort and privacy in locomotion. This had increased the Carbon load to the atmosphere and had resulted in the increase in global temperature which we had named it as “Global Warming and Climate Change”. Both the conditions didn’t happen on its own. “WE”-The Humans had changed the things.

In the current days where the forest area had become too small, the oxygen produced from the oceans and seas remain the same. Little more might have got increased due to the global warming. But what about the one which was produced by the trees from the land?? Consumption of the Oxygen is more as the population had increased. What about the productivity to balance the atmosphere??

Instead of producing Oxygen from the land, by destroying the Natural Oxygen Factories, we are doing a high rated Carbon emission.

Due to this imbalance in the wind circulation, the season had failed or shifted or became improper is the actual truth.

And our human civilization had failed to manage the surface water bodies. All the waste has been transferred to the surface water (Both the Solid Waste and the Liquid Waste from house hold to Industrial wastes) and had spoiled the total surface water and this has been taken from one place to the other according to the flow pattern from high land to the low land and the total land mass had got contaminated and polluted.

We are telling “WE” – The humans are the supreme and advanced creature of this planet and this is what we had done to the planet.

When the season fails totally or comes back with a high monsoon, we don’t have the proper methodology to face and balance both.

During these conditions, we start blaming the God and Nature. For the mistakes made by us, are they responsible??? (Figure 6).

Wells, bore wells and mines

In earlier days people depended on the wells for the household water usage. After some days, we got the hand pumps. Then came the Bore wells. Now stories of drying away of the bore wells are more.

Simultaneously, Science had developed to extract the hidden underground minerals and fossil fuels through mining operation where large amount of groundwater is pumped out on daily basis.

“For safe mining operation, ground water is pumped out continuously round the clock through bore wells located at predetermined points” [16].

In and around the mining area, Groundwater is pumped out round the clock as mentioned without knowing from where it is coming and how it is going to affect the surrounding. On daily basis Mining authorities are pumping and pumping whereas the surrounding areas are drying and drying where the water table had gone down. No one is bothered about that.

Construction of the Mines for the minerals and Fossil Fuels, Wells and Deep Bore wells for Household, Industrial and Irrigation is the major mistake done by the human community which had affected the Underground Invisible Water Cycle a Lot.

When the Underground Invisible Water Cycle was not disturbed, we had lot of natural springs.

Initially wells supported the water need. When hand pump came, Wells started drying at a period of interval. Later, bore wells replaced hand pumps. This made the hand pumps and wells to dry completely. Later number of bore wells increased that each individual need an individual bore well and the depth increased from one bore well to the other. When the depth increased, the lesser got dried.

When the mining area came in the nearby location, even the deep bore wells dried. Now we are forced to drill beyond the depth of the mining area to get groundwater is the practical truth. Because of these manmade actions, the natural cycle has been bypassed all these days.

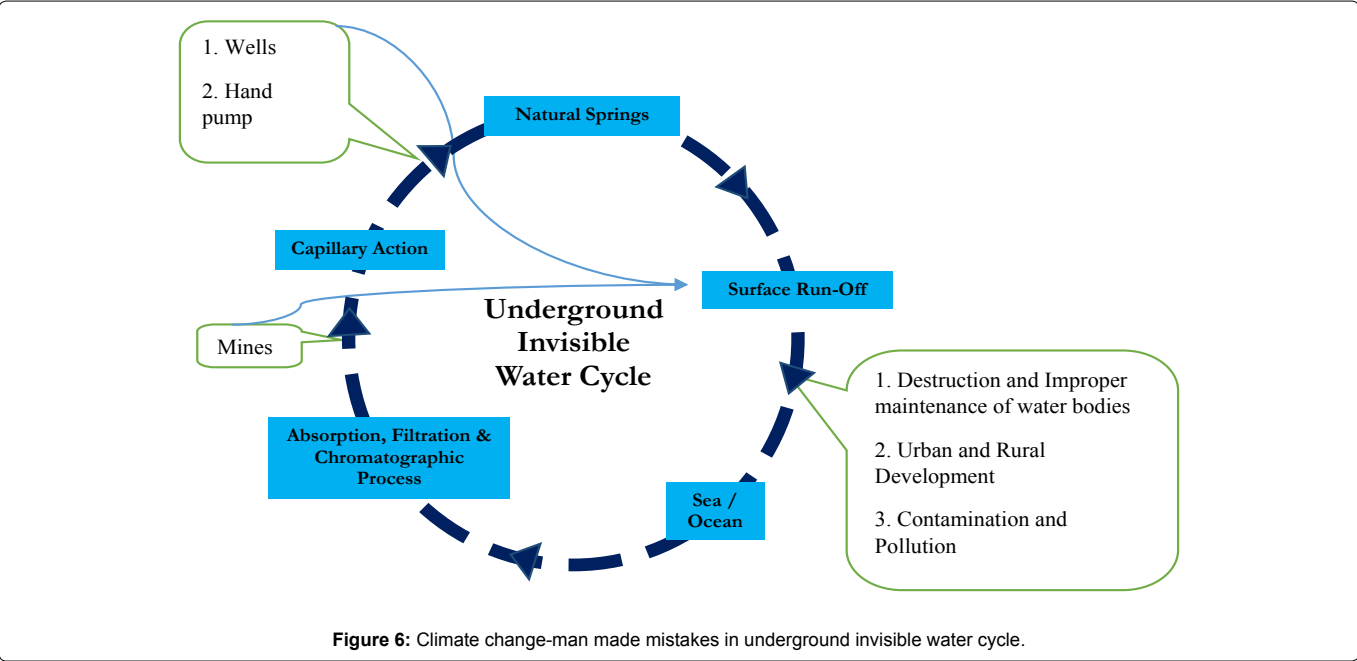


Figure 6: Climate change-man made mistakes in underground invisible water cycle.

The Underground Invisible Water Cycle is blocked and bypassed from the capillary action directly.

Because of these three pumping effects, the nearby natural springs had dried and lost their traces nowadays and stands as a question mark in this second cycle.

Wells and Deep Bore wells provide fresh groundwater which is consumed less and goes to the surface runoff in the name of waste. Similarly, The Mining areas pump out larger amount of groundwater and mix it in the surface runoff on daily basis for decades and more than a half century. These surface runoff again gets contaminated and polluted. The underground pumping had increased a lot and due to that, the water table had gone down.

Today, due to the construction of mines, wells and bore wells, we had lost the natural springs in many places. And because of that, natural rivers had dried. Today we are seeing the rivers with water only during the rainy season and floods during heavy rain fall.

We had spoiled the natural process and so today, Lot of bore wells and deep bore wells had dried and became useless. It means that, too much water has been pumped out and the underground was made empty.

Due to this, the surface of the land is getting hot easily during the summer and reflects the heat even at night since the cooling agent under the ground – The Groundwater is missing or the level had gone down.

Being from the lignite mines affected area, the observation noted is of high importance

It has been made clear that water table of the mines affected areas will go down due to the continuous pumping. While travelling to the home town on a winter night where the travel was chill and cold, a sudden temperature variation was felt. Cold and chillness disappeared when the bus entered into area 20-25 kms away from the Mining Zone. As night travel was preferred most of the time due to the heat, this observation was noted and felt several times in the same particular zone.

This clearly indicates that the heat absorbed from the sun by the fossil fuels in the day time gets emitted during the night and turn the night warm even in the winter season. Is climate changing or we had changed the climate??

When we need the Air conditioner and Air handling units to cool our self, Earth also need its cooler – The Groundwater which was lost because of our poor knowledge and over usage. Who will replace this groundwater and cool the Earth??? Do we have any methodologies or plans??

We had taken away a lot of the valuable natural resource knowingly and unknowingly. Due to our poor knowledge over these process and technical background over the Earth's Complete Water Cycle, we had missed to manage the resource properly. Because of that, even during heavy rainfall, we are unable to manage the resource and face flood and drought conditions.

How we are going to rectify these mistakes?? What we are going to leave for the next generation in this planet??? Are we going to leave any traces of groundwater for the next generation or going to clear everything and make this planet empty??? Is there any way to get back the resources?? Is there any way to replace the water which we had pumped all these years???

Yes. We can rectify and replace the groundwater effectively in its original place beyond our daily usage by applying the science and technology discussed in this paper.

Rectification of the man made mistakes

“Flood and drought management by making groundwater visible to all”.

Hydrological extremes, such as floods and droughts, have destructive impacts on economic development and human health [17-20]. Floods and droughts have been listed as two of the most devastating natural hazards in terms of economic losses exceeding \$1 billion [21,22]. Within the context of global warming, hydrological extremes are expected to increase in the frequency, duration and intensity at global and regional scales [23-27], thus posing larger risks to economic and human systems [17,28,29].

Understanding recent changes in regional vulnerability to floods and droughts is critical for developing foundational knowledge and strategies for reducing the risks and damages in the future [18,23,30]. Many studies have investigated the changing characteristics and the impacts of floods in terms of economic losses [31-35] and human casualties [36,37]. The changing patterns and impacts of droughts have also received lots of attention during the past decades [25,28,31,38-40].

Variation in the risk of floods and droughts is not only dependent on the hazard itself but also on the assets exposed in the hazard-prone areas, as well as the vulnerability to hazard [19, 41-44]. To date, understandings on hazards have been greatly improved in terms of the changing patterns of hydrological hazards. However, our understandings on the economic costs and regional vulnerability to floods and droughts and their spatial-temporal changing patterns are limited, due to lack of proper indicators, limitations of data availability and complex response mechanisms [19,43-46].

During a recent (2006 to 2009) drought in the California Central Valley, large-scale groundwater depletion occurred when the source of irrigation water shifted from surface water to predominantly ground water. Gravity Recovery and Climate Experiment (GRACE) satellite data and ground-based observations revealed that groundwater storage declined by between 24 and 31 km³, a volume that is equivalent to the storage capacity of Lake Mead, the largest surface reservoir in the United States [47,48]. Thus, the indirect effects of climate on ground water through changes in irrigation demand and sources can be greater than the direct impacts of climate on recharge [49].

In total, 136,920 records of flood and 50,967 records of drought in the United States during 1996–2016 and inter-compared the spatial-temporal patterns in occurrences and damages between floods and droughts at the country and state levels. For the past two decades, an average of 6520 floods and 2427 droughts have occurred annually in the country. Floods have caused an annual average of 3986 million dollars of economic damages, which are approximately 1.5 times larger than that by droughts. Hydrological extremes such as floods and droughts have devastating impacts on the economic and human systems. Examination of recent changes in economic damages by hydrological extremes would greatly benefit adaptation and mitigation strategies [50].

To overcome the Flood and Drought, the corrective action plan for the society is extracted from the study by [7] and produced here.

The corrective action plan

- Tamil Nadu's Drought in 2003-2004 is the root cause for this thought process.
- Recent drought and Flood in Tamil Nadu, other states and countries exhibits the need for the change in our current approach and practices regarding Water Management.
- Problems we had come across several times which we know very well. But the solutions are not satisfactory and often temporary.
- We need a permanent solution to balance both the conditions and to overcome the above said warnings.
- Climate change is related with Groundwater as discussed above.
- Inter-linking of rivers concept should be revised for a better water network and distribution.
- Today's Man made Mistakes should be rectified technically for a better tomorrow.
- **5R's – The Resolution for Groundwater Revolution: Rectify, Repair, Refill, Replace and Resume the Groundwater – Naturally.**

Thought Process for this Mission-Restructure

- Rectify
- Repair

Actions Expected out of this thought process – Water Network

- Refill
- Replace

Groundwater Assured through the Natural Route

- Resume
- Zero wastage of Water through water network should be the mission objective.

“Groundwater revolution” – The groundwater operation plan

- Groundwater recharge by Artificial Reservoirs.
- Formation of Groundwater network.
- Improving the Groundwater table and making it available to all throughout the year.
- Nullifying the Drought and Flood by water networks.
- Inducing the Natural process in its natural way – Artificially
- Recovery Time depends upon the nature of the soil, amount of groundwater lost in and around the area, amount of water used for recharge.
- Interested field experts are most welcome to fight against this social cause.
- Because, this is an operation – Ground Water Operation.
- One term investment Procedure without any returns, benefitted by providing groundwater to all in their own homes-Throughout the year.

- Agriculture should be made possible-Throughout the year.
- Each and every individual should be a part of this mission and so, the cost should be shared by each individual in several means according to their capacities other than Government and funding organizations.
- The Unity shown during natural disasters should be maintained throughout the mission from all until the goal is reached.
- Common people know where water is getting accumulated in their area more than the local area administrative officer because they are the one affected directly than the officer.
- Hence, each village, panchayat, municipality, city and Town should be the governing bodies for this water network.
- Total Surface Water bodies should be restructured using the field test as the model.
- Restructuring covers the total water bodies – each and every individual Rivers, Canals, Ponds and Lakes followed by interconnection without missing even a single area.
- As like Blood Transfusion and organ transplantation, this should be Water Transfusion Technology with Artificial Recharge Method.
- The amount of water pumped out all these days should be replaced in the same place beyond our daily usage.
- This we have to do for the betterment of our generation and the next, by considering our planets health.
- This is possible only through the formation of Water Network on the surface of the planet.

Water network through groundwater operation: The only solution for future Generations.

- Identify the low land surface which is often affected by the flood by coordinating with the local people.
- Calculate the amount/level of water accumulated in those low land areas during the flood.
- Segregate the waste water system from the fresh water system. Never allow waste water to mix in the fresh water to stop contamination and pollution which can be carried forward easily on the direction of the flow and spoil the total surface.
- Treat the waste water separately and take it for reuse.
- Deepen the rivers and canals from high land surface to the low land surface according to the level of water accumulated in the low lands.
- Deepen the Ponds and Lakes such that they will be the source of water for that particular area for a period of minimum 5 years without rain fall.
- Construct new ponds and lakes in-between each neighbour Village, Town and city with the same depth and capacity.
- Interconnect all the ponds and lakes through canals/Tunnels along with the river of minimum Ten feet depth such that water should flow on both the directions.

- During floods, the nearby canals should be opened and the water should be diverted to the other area and the interconnected ponds and lakes should be filled without any issues.
- Provide High efficiency Pumping facility from low land to high land areas and take the water to high land surfaces during floods.
- Each village, town and city should be the governing body of the lake, pond, river and canals of that particular area and they should maintain and manage.
- During flood water sharing, the route should be specified and followed under coordination between the corresponding managing bodies.
- No Life loss and Property loss should be noted in this distribution system.
- All advanced tracking technology can be utilized for this water distribution and management.
- Village to village, town to town, city to city, state to state and country to country the water network should be formed.
- Total man power should be utilized in all the possible ways to form this water network.
- Plant more trees throughout the water network and set a green and clean boundary.
- Make use of the fresh water available during the rainfall and fill the total water network.
- Until the total network is filled with water, never let a single drop of water to mix in the Seas/Oceans.
- No need to bother about stopping the freshwater mixing to the Oceans. Nothing will go wrong. Because, all these years, we had given a lot of freshwater to the sea in contaminated and polluted form taking away from the Groundwater. This is also a reason for the increased sea level.
- Now the Ground is empty and so our full focus should be on filling the ground only. So keep on diverting the rain water throughout the network and fill all the spots.
- After filling the total land, we can divert the fresh water to the Sea/Ocean if anything remains.
- Once these structures and the network is filled, then there won't be any difficulty in managing the drought conditions. Because the Flood water will move through the network and will topup the water bodies.
- Only after filling the complete water network, flood water can go into the Sea/Ocean.
- This we have to set and achieve in the next 10 years throughout the globe. The early start will start giving the result early. Still, we have to respect and give the nature its own time line.

If the ancient technologies on the surface can give the result in 10-20 years, then, this Nature's actual Physical Science and Technology will give the result in a shorter period if it is done effectively as this is going to be the Ground Operation. The difference in timeline will be noted only when the networking is proper as mentioned above by resaturating the landmass. This again depends upon the soil nature

and the time taken for absorption in and around the area, the amount of water supplied, Etc.

Conclusion

Today's water crisis is widespread, and continuing with current policies for managing water will only widen and deepen that crisis. During the 20th century the world population tripled—while water use for human purposes multiplied six fold. Providing six times more water now than a hundred years ago, an enormous task, has significant impacts on people and the environment [51].

According to Crosbie et al.[52] hydrological model uncertainty has a significant role in the uncertainty envelopes of future climate change impacts and should be routinely considered in assessments.

Consequently, at the end of the typical model chain approach used in climate change impact studies, multiple significant sources of uncertainty affect the results, making it very difficult to get reliable projections of future hydrological fluxes [53-58]. Argue that besides the magnitude and direction of the changes it is most important to understand and explain why certain changes are projected. Therefore, to improve climate change studies, dealing with the impact on groundwater resources, it would be of the utmost importance to identify dominant processes affecting groundwater dynamics.

So far, analyses of long-term and large-scale data sets with respect to the interaction with groundwater level time series across Canada and found an almost equal number of decreasing and increasing trends. [58] Examined the relationship between groundwater levels and climate variability across the south western United States and detected significant correlation between groundwater dynamics and large-scale climatic cycles like the Pacific Decadal Oscillation (PDO). The number of studies is larger if we also consider analyses for smaller regions and shorter time series.

For example Fiorillo and Guadagno [59] found not only correlations between groundwater levels in Californian aquifers and the PDO, but strong relationships to the El Nino-Southern Oscillation. Holman, et al. [60] focused on the connection between climate variability and groundwater levels around Winnipeg, Canada for a period of 35 years and found strong correlations between precipitation and groundwater dynamics. Similar results were found for a European study. Over a period of more than 70 years [61] found a strong relationship between a precipitation based drought index and the discharge of a karstic spring in southern Italy near Naples.

Also for Europe, teleconnection patterns and corresponding hydrogeological responses have been analysed [62]. Detected a relationship between the North Atlantic Oscillation and the dynamics of a chalk aquifer in the UK. Apart from the direct analysis of the relationship between groundwater dynamics and climate variability, long term groundwater data are used to calibrate the parameters of auto-regressive models which are afterwards applied to climate change scenarios [63]. Global abstraction of groundwater grew from a base level of 100–150 cubic kilometres in 1950 to 950–1,000 cubic kilometres in 2000. The bulk of this growth is concentrated in agriculture, particularly in Asia [64].

As far as this article is concerned, the entire basics of the water and the Groundwater are presented more clearly, scientifically and technically. The experimental part by Raj [7] is extracted here for providing the data and science for the Groundwater.

Thereby, the uncertainty and the knowledge which was invisible to the public and the policy makers are made visible in this article. Also, the points to set the water management for the future are listed out here.

On considering and applying the above mentioned science and technology in the water management system, then no need to bother about the Drought and Flood. Each and every individual can get their groundwater easily at their home whose wells and bore wells had dried now when the rectification is planned and executed in the above mentioned ways.

Plant much more trees along the road side and wherever possible to balance the oxygen production in this planet as they are the natural oxygen producing factories. Never blame any of the trees against drought or flood. Because, it's not because of them. It's because of the man made mistakes to the natural Eco-system.

The current understanding of the groundwater and its basic science is mentioned above as per the literatures that it is not clear and uncertain with knowledge gap is explained more clearly and particularly with the relevant Science and Technology using few simple experiments on comparing with the applied technologies.

The invisible is made visible in this article. The unknown is made known using Biotechnology. Thus the new science is now ready for application and implementation.

In this modern world, the below mentioned verdict by the High Court reveals the misunderstanding of the basic science and reality of the Groundwater with unknown facts makes us understand the importance of this study.

The poor understanding of groundwater and a court verdict on comparing with a tree

“Karuvamelam Trees (*Prosopis juliflora*) Eradication Verdict by TN High Court relating it with the loss of Groundwater and drought” (Dec-7, 2016 and Feb-27, 2017) is available in most of the media network from Tamil nadu, India.

“A Division Bench of Justices A. Selvam and P. Kalaiyaran passed the interim order on a public interest litigation petition filed by former Mayor M. Patturajan seeking a direction to the three officials to curb the growth of ‘karuvamelam’ trees across the city in order to save groundwater table depleting drastically due to deep penetration of their roots” [65].

It was only last December that the judges began hearing the long-pending PIL in earnest. Initially, they directed the Collectors and other Revenue department officials of 13 districts under the territorial jurisdiction of the Madurai Bench to uproot *seemai karuvamelam* trees completely from public as well as private lands, and report to the court. Cautioning government officials against a recalcitrant attitude, the Division Bench said, “The High Court will make surprise inspections and if any lapse is found, the same will be viewed seriously.” It also directed the government to sanction adequate funds periodically for uprooting these trees.

Defending Explanation was posted to the High court, TN Government and the corresponding departments on the topic: “Karuvamelam (*Prosopis juliflora*) and Trees – Groundwater – Drought – Ecosystem-The Actual Relationship with Scientific Explanation Reg” dated 10-05-2017. And the same has been received by all was confirmed by the tracking system.

Lessons from the nature

During April 2016, we were riding on the bike for distribution of marriage invitation. We have to go a long ride in the highways and local roads. When we were travelling in the areas surrounded by the trees, we faced a cool weather and when we were travelling in the areas where there was not even a single plant in the road side, we were facing the burning heat of the summer. What does this mean?? Most of the areas we travelled were covered by this “Karuvamelam (*Prosopis juliflora*) trees only. Where is the problem?? Is it with the trees or in our understanding?? Being directly involved in the study of Groundwater basics, these kind of mistakes can't be accepted technically.

Just one query here

It is mentioned in the verdict that “the roots of this tree go deeper than other trees, absorb groundwater and give it to the atmosphere which had become the reason for the drought in the areas”. If that is the case, what about the deep bore wells constructed by the humans which were operated by high power pumps. Comparing the trees and the bore well operation, which is taking more groundwater and giving to the surface?? If the trees should be eradicated for that reason, then what about the bore wells and the humans who do the same activity??

For most of the public, groundwater is out of sight and out of mind. Groundwater, and the boundaries that define it as a water management unit, are physically invisible to humans. This lack of physical visibility has contributed greatly to its lack of visibility in many discussions of water policy, governance and management [67].

Nature teaches the lesson which no one is ready to read it properly. Those who misunderstand the things use the media and the social networks spread the wrong information and it is getting viral. Most shocking thing noted in this case was a college professor sitting in the media and acknowledging the mistake as the right thing. According to him it is right because, that is the understanding over the Groundwater and its basics throughout the globe as it has been neglected and a subject of uncertainties with knowledge gap as mentioned by several authors. This is the reason for elaborating this article.

This is a fine example for our current understanding over the groundwater, the trees and the Ecosystem.

Instead of reporting that there is no data for understanding the groundwater basics, the same has been presented more clearly in this article for the welfare of the future generations. Hence, all those who bother about this valuable resource are expected to join together and start this Groundwater Revolution today and make a change for a peaceful generation tomorrow.

Worldwide sustainable water resources development and management is recognized as an ultimate goal of national water strategies. The sustainability of groundwater is closely linked with a range of micro and macro-policy issues influencing water and land use, and represents one of the major challenges in natural resource management. Investment in management and protection of the resource base has been seriously neglected. Practical advances are urgently needed; there is no simple blueprint for action, due to the inherent variability of groundwater systems and related socio-economic situations. Many developing nations need to appreciate their socioeconomic dependency on groundwater, and invest in strengthening institutional provisions and building institutional capacity for its improved management before it is too late [1].

As this article will be the supporting material on the basics of Groundwater as the blueprint for action, The Policy makers can consider the importance of the Groundwater basics whichever is mentioned in this article and rework on the sustainable water resources development and management strategies without neglecting them.

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