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WATER ISN'T JUST ABOUT WATER



Water is scarce because we are careless, casual, and callous with the way we treat everything related to water. Let me give you three examples.

With every road layering or repairing exercise, the level goes up a few millimeters and after some years the little drain holes that had been carefully constructed on the sides of the pavements get covered. Thicker isn't better in this case...in fact, the thicker the road layer gets, the manholes and pavement drain-holes get covered until they finally disappear. The tragedy gets compounded when officials discover that manhole-laying plans and pavement side drain-holes maps are not traceable. The result is severe waterlogging even after a weak bout of rainfall.

The rainwater drains by the side of roads are next in my list because these are places where debris and malba gets piled up all along the road the year-long. The only reason this happens is because this is easiest for workers who may not want to tow everything all the way to the nearest dhalao.

The third instance of societal attitude is home garbage that either adds to the blocking of roadside rainwater drains or is simply flung wildly into the nearest stream or river.

There are umpteen other examples where it is we human residents of a city, town, or village who conveniently forget our irresponsible actions and get flustered and ready to protest when water-supply gets scarce or drainage issues result in diseases, deaths, and delays.

Increased human demand, climate change and altered weather patterns, increased pollution... these are all causes of water shortages. Pause for a moment and think about these issues and you'll know that behind every

cause is the way humans have interacted with nature, technology, and legislations. There will always be one or more from elemental issues like poverty, education, social justice, economic development, gender equality, food security, and health. Water issues cannot be solved if we continue to focus only on areas that are directly connected to water. I mean, a clean river needs the assistance of technology but will also need awareness and responsible behaviour of citizen. Behaviour is connected in many ways to the ability to think and thinking gets a boost when one reads... and reading is all about the spread of education.

Take a simple act like washing hands to prevent infection during a pandemic like the one that the world is now going through. When 1.3 billion people have to wash their hands even thrice a day in a country where only 42 percent of the population have access to healthcare facilities, you will know what water scarcity really means. By the way, reports point out that in sub-Saharan Africa only four out of ten wash their hands at home. Washing hands too at first glance may need only an adequate supply of water but on deeper analysis we will find that our interaction with nature, economic development, and even social justice would be involved.

What is clear is that the problem of water scarcity or water shortages isn't just about water. It is only a wider cover of development that has the power to solve our water woes.

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Prof. Shailendra Singh
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WATER CRISIS IN INDIA WAY FORWARD

Water is an essential prerequisite for life and livelihood. We are not having any scarcity of water; it is the fresh water fit for drinking, irrigation, industrial and other usage that we are concerned with. According an estimate, of the total 1.38 bn cubic km water on the planet, 97 percent is salty and undrinkable, only 3 percent is fresh water. Further only 1% of all the world's water is potable while

rest 2% is not accessible. Worldwide freshwater usage annually may be about 3600 cubic km broadly categorised into irrigation 70 %, industrial use 20%, and household usage as 10%. Of the household use, on average 66 % goes into the bathroom. According to a McKinsey estimate, by 2030 the available fresh water supply will be able to meet the requirements of 60 % population globally and less than half for developing countries where water supply is already under duress.

Water crisis is a global phenomenon and India is no exception. Our water scarcity can be assessed by the fact that we house around 17 % of the world population but possess only 4% of the world's freshwater resources. Further, whatever fresh-water is available in India, we are not able access the same fully. According to an estimate of Water Mission NAPCC, our major water sources are annual precipitation including snow fall amounting to 4000 cubic kilometres(cbkm), run-off coming from neighbouring countries is 500 cbkm, and average annual natural flow in rivers and aquifers is 2301 cbkm. Out of these, only 1123 cbkm or billion cubic meters is utilizable water consisting of 690 cbkm as surface water and 433cbkm ground water. Why are we not able to utilize precipitation water fully? There may be several reasons. Primarily because maximum precipitation happens in monsoon season during June to October every year and it is unevenly distributed throughout the country creating a situation of flood and drought in various parts of the country. Further, the water-bodies and river basins are not able to retain rainwater coming suddenly in spells of brief periods and due to limited carrying capacity, soil erosion, breach of embankment, land slide, silting, pollution contamination, evaporation etc happens.

According to *Jal-Shakti* Ministry, Government of India, the total demand of water in 2010 was 813 BCM, which is expected to rise to 1093 BCM by 2025 and 1447 BCM by 2050. With increasing population and urbanization and more demand from agriculture, the demand for fresh-water will exceed our capacity to replenish this supply annually, ie. 1123 BCM. The crisis is further highlighted by the estimates of Central Water Commission which states that per-capita annual availability of water in the country is continuously going south . It was 1816 cubic meters in 2001 and went down to 1545 cubic meters in 2011. It is likely to decrease further

According to *Jal-Shakti* Ministry, Government of India, the total demand of water in 2010 was 813 BCM, which is expected to rise to 1093 BCM by 2025 and 1447 BCM by 2050.

to 1421 by 2021 and 1174 by 2051. According to the *Falkenmark Index*, one of the most popular index of water scarcity, if the per capita water availability goes below 1700cbm per year, the situation is labelled as water stress. If it further deteriorates and goes under 1000 cbm annually, the situation is called water scarcity. Thus, we are already living under what is called a water stress condition.

The preceding pointers provide a clear message to maintain water security, we need to develop strategies of efficient and effective use of available water resources and devise more creative plans to conserve, recycle and reuse water resources. To fulfil the need of water resources we need to ensure either increased supply of water or reduce the demand or do both. As accessible water sources are almost constant, conserving water and arresting misuse and overuse and putting a reasonable user charge may be the answer. Some of the initiatives for water resource management are listed here:

As per the National Water Policy, water is required for domestic, agricultural, hydropower, thermal power, navigation, recreation, etc. Among these, safe drinking water and sanitation should be considered most important followed by other household needs including needs of animals, food security, sustenance of agriculture, and minimum ecological needs. Available water after meeting these needs, should be allocated in a way to support its conservation and efficient use.

What needs to be done for *drinking water*? According to an estimate India uses 56 BCM for household purposes which may increase to 73

BCM in 2025 and 102 by 2050. The major part of this comes from groundwater. It is suggested that 85% of India's rural population and 50% of urban population depend on ground water for their personal needs. Providing safe drinking water to all is still a challenge. Our PM has recently set a target on 2024 to meet this goal. More investment and collective will for efficient use of resources may help. Roof-top water harvesting, recharging and maintenance of lakes, tanks, wells and other water bodies and other means of preserving rainwater will also go a long way in meeting the demand of drinking water in dry areas.

Water conservation may serve as a critical source to produce additional water for future usage. In simpler terms, water conservation implies improving the availability of quality water through enhancing the capacity of storage of water in surface reservoirs, lake, tanks, ponds, community supported water bodies, soil, groundwater etc. It highlights the need to modify the area and time availability of water to meet demands. This concept works on the principle, 'save today for better tomorrow' and emphasises the need for sensible use of water.

Irrigation techniques

Old-style irrigation techniques create significant water wastage due to evaporation, drainage, percolation, leakage, and excessive groundwater use. Farmers may be educated on best practices, like drip and sprinkler irrigation. India is in a better position than Israel in terms of water resources, but they have better water conservation and management practices, and thus do not experience water shortage related issues. It is suggested that water saving irrigation techniques can generate additional redeemable water which can meet a 50% increase in demand for water by 2025.

Aquifer recharge

We have forgotten our traditional water bodies that served as a medium for groundwater recharge. We need to revive our knowledge and go to our roots to revive our water bodies and ponds to conserve water. Governments and NGOs can take steps to recharge aquifers by inserting treated surface water into the underground aquifers. This means restoring watersheds and wetlands initiatives

Trained water resource management professionals, good governance practices in water sector and participatory management by stakeholders, the concept of community-based water resource management will go a long way in helping mitigate water crisis.

aimed creating and supporting green infrastructure and improvement of depleted ground water.

User Charges

People are using unlimited water without paying any user charges for various reasons. Such proportion of water in India has been estimated at almost 32%. By implementing proper metering, the efficiency of typical Indian municipal water utility can improve significantly.

Water reuse

Water reuse may also help tackle water scarcity. For example, IIM Ranchi's new campus project plans to reuse non-potable water (graywater) produced from recycled water for landscape irrigation and toilet flushing.

Desalination of seawater

or brackish groundwater may be considered to augment water resources if the cost of energy is low. Such experiments have been done in Gujrat coastal areas where a reverse osmosis machine is operated through a solar plant. Otherwise the high cost of operations and maintenance may make wide-scale use of desalination technology unfeasible.

Inter-Basin Transfer

Linking river projects will facilitate inter-basin transfer of water to recharge depleted ground water. Sardar Sarovar project on Narmada river is aimed at recharging the depleted aquifer of north Gujrat and Kutch. The same is the rationale for interlinking of Himalayan rivers with southern peninsular rivers to mitigate the ground water depletion of western and southern India. However, such projects may be

fraught with controversy and criticism regarding costs of various kinds.

Virtual Water

Virtual water refers to the water footprint embedded in a product. It means the amount of water consumed during its process of production. Interestingly, the concept emerged in the 1990s and received a good amount of attention from people concerned with water management and with water related to food production. By implication water intensive crops like, wheat, sugarcane, and paddy contain greater virtual water. According to one estimate, these three crops account for 50% of irrigation water demand. *When we export rice or sugar, we in a way export virtual water. As per NABARD assessment if we export 10 million tons of rice, we export 40 billion cubic meters of water. Thus, by this logic, we should produce less water intensive crop in traditionally dry areas to reduce water demand.*

Climate Change

Since climate is changing rapidly creating high risk to crop production. In order to deal with the problem, we should use climate resistant agriculture including indigenous varieties.

Mitigating Water Pollution

Water pollution is a big problem and needs to be arrested on priority. Source of contamination are pesticides, chemicals, excessive use insecticides. Untreated sewage, industrial effluents are also responsible for contaminating water. Legal framework, and awareness may help solve the problem.

Trained water resource management professionals, good governance practices in water sector and participatory management by stakeholders, the concept of community-based water resource management will go a long way in helping mitigate water crisis. Problems are many and so are the solutions. We need to work collectively to find the workable solutions keeping National Water Policy framework in mind which is quite comprehensive and provides reasonable direction on way forward. 

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NUDGING STRATEGY FOR WATER MANAGEMENT

*'In a gentle way, you can
shake the world.'*
Mahatma Gandhi

The magnitude of water crisis

Water is essential for survival of homo sapiens, and its scarcity is a big crisis that we are going to face, if we do not take effective steps to prevent it. Unfortunately, many of us are not even aware of its magnitude and severity.

The 2018 edition of the UN World Water Development report stated that nearly 6 billion peoples will suffer from clean water scarcity by 2050. This is the result of increasing demand for water, reduction

driven by dramatic population and economic growth. It is suggested that this number may be an underestimation, and scarcity of clean water by 2050 may be worse as the effects of the three drivers of water scarcity, as well as of unequal growth, accessibility and needs, are underrated (Boretti and Rosa, 2019). Globally, 844 million people lack access to clean water. Without clean, easily accessible water, families and communities are locked in poverty for generations. Children drop out of school and parents struggle to make a living (WorldVision, 2020).

The limitations of making big changes

Change need not to be always very big and painful. It can start small and can lead to big outcomes. Many change strategies fail because they do not take into account the behavioral aspects. One of the persisting problems in strategy is the huge failure rates of productive thought. As shown by McKinsey research in 'The Strategy Beyond Hockey Stick', 9 out of 10 strategies fail. Research in habits also lead to big failures of trying to make big changes in behaviors. What works is making small changes in habits.

Concept of nudging

Nobel Prize winner Richard H. Thaler and Harvard Law School professor Cass R. Sunstein show that no choice is ever presented to us in a neutral way, and that we are all susceptible to biases that can lead us to make bad decisions. But by knowing how people think, we can use sensible "choice architecture" to nudge people toward the best decisions for ourselves, our families, and our society, without restricting our freedom of choice.

See Less

Nobel Prize winner Richard H. Thaler and

Harvard Law School professor Cass R. Sunstein show that no choice is ever presented to us in a neutral way, and that we are all susceptible to biases that can lead us to make bad decisions. But by knowing how people think, we can use sensible "choice architecture" to nudge people toward the best decisions for ourselves, our families, and our society, without restricting our freedom of choice.

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Nobel Prize winner Richard H. Thaler and Harvard Law School professor Cass R. Sunstein



gave the concept of Nudge Theory. Nudge theory is based upon the idea that by shaping the environment, also known as the choice architecture, one can influence the likelihood that one option is chosen over another by individuals.

Common 'nudges':

The design of menus gets you to eat (and spend) more. For example, lining up all prices on either side of the menu leads many consumers to simply pick the cheapest item. On the other

hand, discretely listing prices at the end of food descriptions lets people read about the appetizing options first and then see prices.

'Flies' in urinals improve, well, aim. When Amsterdam's Schiphol Airport was faced with the not uncommon issue of dirty urinals, they chose a unique solution by painting flies in the (center of) commodes and men obligingly aimed at the insects, reducing spillage by 80 percent (Thaler&Sunstein, 2009). The ideas from Nudge theory are applied by many governments.

Nudging strategy for water management

There can be various strategies at various levels for water management. In this article we want to focus on nudging strategy as it really works. Governments, businesses and civil society should go with nudging strategy, creating choice architecture and focusing on making small positive change in habits of citizens, for example, research can be carried out for optimal amount of water requirements for various activities in various walks of life such as government organisations, business organisations, civil society, households, farming, schools and public places etc. Based on this, the Government can create a choice architecture that needs to be used by companies supplying water equipments. That is, if research shows one bucket of water is sufficient for one bath, than the shower stops automatically for a minute as this is the time for filling a bucket of water. If research shows one minute of running tap-water is enough for hand-washing, than the tap in wash basin stops automatically after a minute of running. If three hours of water supply is enough for irrigating a farm, then the water supply in that farm automatically stops after three hours. Equipment manufacturers need to do a bit of innovation to create such choice architecture giving the user a change in settings options depending on the requirements of the user. This might look like a minor change, but when put together and executed judiciously, it can lead to a lot of water conservation in various walks of life.

All organisations and people need to be sensitised with the concept of nudging for water

If three hours of water supply is enough for irrigating a farm, then the water supply in that farm automatically stops after three hours. Equipment manufacturers need to do a bit of innovation to create such choice architecture giving the user a change in settings options depending on the requirements of the user.

and best possible choice architecture shall be created by them for saving water wastage.

Conclusion

Water crisis is a big crisis that needs to be recognized and overcome. There can be various strategies for it. Nudging can be a good strategy to make a big change in a small way by creating choice architectures that leads to water conservation in various walks of life. 

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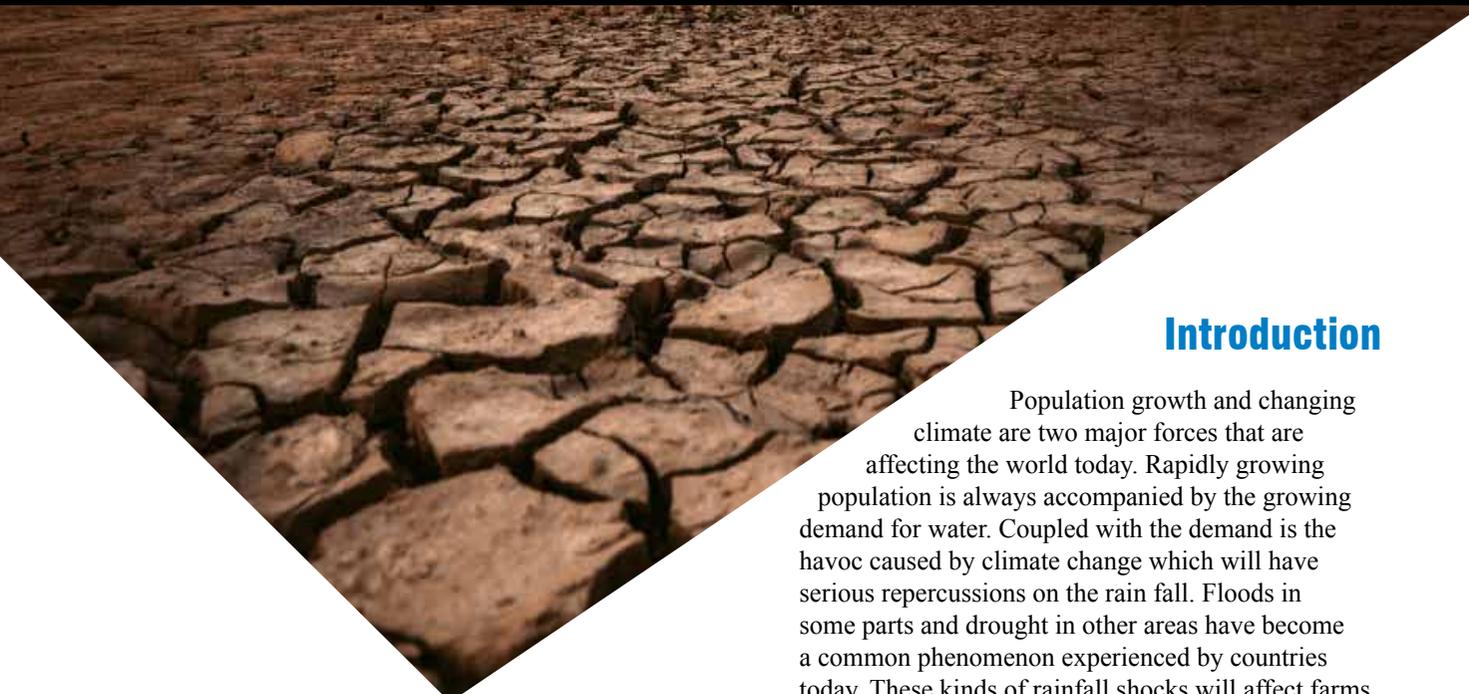
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LOOMING WATER CRISIS IN INDIA

LESSONS FROM ISRAEL



Introduction

Population growth and changing climate are two major forces that are affecting the world today. Rapidly growing population is always accompanied by the growing demand for water. Coupled with the demand is the havoc caused by climate change which will have serious repercussions on the rain fall. Floods in some parts and drought in other areas have become a common phenomenon experienced by countries today. These kinds of rainfall shocks will affect farms, firms and families. Farms are the largest consumer of water in the world. Due to climate change we

are experiencing declining yields in agriculture. The next major consumers are the firms. Textiles, meat production, beverages, and automotive manufacturing are some of the high water-consuming industries. Apart from this are hotels and restaurants... and they cannot function without water. If water is scarce their sales, revenues, and profits get a hit. At the centre of such scarcities are the families, who feel the impact of this uncertainty on their incomes, jobs, and long-term health and welfare. Availability of piped water to households is used as a measure of development of a country.

Water scarcity in India

In India, more than 600 million people are facing an acute water shortage. About three-quarter households do not have clean drinking water facility. Currently, India ranks 120th among 122 countries in the water-quality index. By 2030, India's water demand

ISRAEL AND INDIA ARE SEMI-ARID COUNTRIES WITH LIMITED WATER RESOURCES. HOWEVER, ISRAEL IS SELF-SUFFICIENT IN WATER WHILE INDIA IS YET TO PROVIDE PIPED WATER TO NEARLY 80% OF THE HOUSEHOLDS.

is expected to be double to that of supply that implies not only water scarcity for numerous people but also a loss of around 6 percent to the GDP. This makes it imperative for India to embark on effective water management systems.

Several large cities of India are prone to water shortages, with Chennai being the most prominent in 2019. The shortage of water affected the entire city of 9 million people and resulted in the closure of several



hotels, restaurants and businesses. According to a report by the National Institution for Transforming India (NITI Aayog), at least 21 major Indian cities will run out of water soon. The report also noted that approximately 200,000 people die in India each year due to the lack of access to safe drinking water.

Agriculture alone is responsible for 80% of the country's water usage. The scarcity of water has rendered a lot of valuable farmland in India completely useless and much of the farming industry in these regions has ceased to operate. Water shortage hurts the rural economy so badly that it results in severe unemployment which in turn leads to urban migration. India has a cycle of droughts and floods that have left large tracts of land barren.

Water scarcity also threatens even the lives of wild animals across India. We often read of wild animals encroaching the farmland and human settlements in search of potable water. Drought in the forest land is the reason for wild animals like elephants, tigers, and spotted deer sneaking into the cities. Some of these animals pose a threat to humans, as they can attack them. Some animals like spotted deer get physically attacked by dogs in the process, or they wind-up injured or dead in accidents. Elephants getting run-over by trains or being electrocuted by electric fences set-up by farmers are common news these days.

Innovations in water-management by Israel

Israel and India are semi-arid countries with limited water resources. However, Israel is self-sufficient in water while India is yet to provide piped water to nearly 80% of the households.

India's Average annual rainfall is 300–650 millimetres (11.8–25.6 in) but is very unreliable; as in much of the rest of India, the south-west monsoon

Water scarcity also threatens even the lives of wild animals across India. We often read of wild animals encroaching the farmland and human settlements in search of potable water.

accounts for most precipitation. The rainfall in Israel is unevenly distributed, significantly lower in the south of the country. In the extreme south, rainfall averages near 30 mm (1.18 in) annually; in the north, average annual rainfall exceeds 900 mm (35.4 in). The climate of Israel is characterized by a hot and dry summer and a cool rainy winter. Despite being one of the most water scarce countries in the world, Israel has achieved water security and full cost recovery through tariffs through a series of ambitious reforms. India has a lot to learn from Israel.

This involved nine key innovations, namely (1) putting in place a national water conveyance system to connect all water infrastructure, (2) reuse of treated wastewater for irrigation, (3) large-scale desalination PPP for potable water independence, (4) using aquifers as reservoirs, (5) interception of surface water run-off, (6) promoting crop selectivity and importation of virtual water, (7) efficient irrigation technologies, (8) demand management and public communication, and (9) creating a supporting environment for innovation.

National water system to connect all water infrastructure

Israel implemented early-on an innovative system of storing and conveying water from its wetter north to the drier centre and south—the main agricultural areas. A giant pipeline was developed and has operated since 1964 to transport water from the Sea of Galilee to the main population areas in the centre and the Negev Desert in the south. Israel established a national bulk-water transmission system that conveys 95 percent of Israel's potable water resources (surface water, groundwater, desalinated water) to the regional providers that supply end-users (domestic, industrial, agriculture). The pipeline is operated by Mekorot, a regulated public utility owned by the state and operating as a monopoly in a strategic water sector. It has been running profitably.

Reuse of treated waste-water

Israel created an extensive network of treatment plants and started using treated water for irrigation. The scarce fresh water was released for domestic and industrial uses and to safeguard the environment. More than 87 percent of treated waste-water effluents are reused for agriculture, representing approximately half of all irrigation water nationwide.

Large-scale desalination of seawater

They set up a large desalination plants to treat sea-water and brackish water to supply potable water that municipal and regional utilities distribute in the country. Five mega seawater reverse osmosis (SWRO) desalination plants supply 85 percent of domestic urban water needs. A national bulk-water conveyance system that allows to optimize the distribution of water across the country from various sources depending on demand. It conveys 95 percent of Israel's potable water resources (surface water, groundwater, desalinated water) to the regional providers that supply end-users.

Use of aquifers as reservoirs

With recharge of aquifers with treated waste-water during low-demand months, and capture of occasional flash floods Israel was able to recharge the ground water. They put in place various systems for a comprehensive monitoring and control of aquifers' levels and abstraction.

Major legal and institutional reforms

Israel implemented over the course of the last 15 years a number of major legal and institutional reforms. Their regulations and pricing policies helped them attain sustainability of the water supply. This included changing the pricing principles of water from a public and social good to a commodity, institutional reforms with corporatization of service providers and the establishment of a strong national regulator.

Despite a situation of acute water scarcity, implementation of this policy for sustainable water management has allowed Israel to achieve water

Five mega seawater reverse osmosis (SWRO) desalination plants supply 85 percent of domestic urban water needs.

security while at the same time drastically reducing over-exploitation of aquifers. This has been achieved through a massive increase in the production of non-conventional waters – waste-water reuse (since 1998) and seawater desalination (since 2006) – together with a legal framework that makes metering compulsory and asserts a strong government's control over water resources.

A landmark of the reform was the establishment in 2007 of the Israel Water Authority (IWA) as an autonomous government agency combining planning and regulatory responsibilities for all the elements of the water chain (potable water and sanitation, irrigation, water resources management). This allowed Israel to draw a line between the political level, which is responsible for policy setting, and the professional level, which manages the water sector. All the various regulatory bodies in the water and sewage sectors became gradually transferred to the IWA within a few years.

Implementation of these ambitious reforms over the last decade has put the Israeli water sector on a course toward financial viability, based on the principles of full cost recovery through tariffs. A new financial framework was put in place gradually, under the direct control of IWA which as national water regulator sets tariffs for all water users. The national bulk water operator Mekorot (in charge of all potable water production and the national water conveyor) was corporatized and transformed into a regulated public company.

Municipal water and sanitation services have been gradually transformed into corporatized regional utilities. Water tariffs for all users were gradually increased to approach full cost recovery for the overall

water chain (although there are also significant cross-subsidies between water uses), while the regulator set performance targets for improved efficiency.

After many years of reforms and massive investment, the Israeli water sector has now achieved almost full financial autonomy—with the exception of wastewater reuse (still relying on investment subsidies)—together with water security. Almost all the costs of investing and operating the water infrastructure are now paid by users through tariffs. Furthermore, the country is in a position to meet all future demand from multiple users.

Promoting crop selectivity and importation of virtual water

Israel is traditionally known for its collective farming, called kibbutz model. However, they experienced water shortage of fresh water for food crops as early as 1960. This forced the policy makers to think on a trade-off between food scarcity and water scarcity. They worked out models on what food crops should be produced domestically and what other food items should be imported.

As Israel started diversifying its economy, it was in a position to import more food items from cheaper sources. They looked at countries with abundant water and lower labour costs for import of foods, such as oranges, cotton etc. They started producing counter-seasonal vegetables in Israel for export to developed markets at higher prices. These crops are cultivated in greenhouses under controlled environment. As they use drip irrigation and precision farming, the water consumption is kept to the minimum.

Efficient irrigation technologies

The widespread development of efficient irrigation technologies, together with growing access to treated waste-water, have made it possible for the agricultural sector to continue to irrigate despite a sharp reduction in the amount of available fresh water. The efficiency of irrigation systems has been a major factor making possible the reduction in average water supply to agricultural land, down from 7,000 m³/ha in 1990 to 5,000 m³/ha in 2000.

Even in the early 1950s Israel started the manufacture of low-volume irrigation technologies such as drip irrigation and mini sprinklers. Now the technologies have become sophisticated that include

Israel is traditionally known for its collective farming, called kibbutz model. However, they experienced water shortage of fresh water for food crops as early as 1960. This forced the policy makers to think on a trade-off between food scarcity and water scarcity.

moisture-sensitive automated drips, automatic valves and sprinklers, low discharge sprayers, mini-sprinklers and compensated drippers that are computer-controlled. The successful development of low-consumption irrigation technologies has allowed the development of a thriving irrigation industry in Israel. Approximately 80 percent of the irrigation equipment made in the country is exported.

Promoting demand management and public awareness

The price of water for irrigation in Israel is higher than in most other countries played. This created a sense of urgency in the farmers to improve farm productivity. For the domestic consumers, Israel follows a two-tier pricing system for potable water and sanitation water. This encouraged people to conserve water.

The Government also ran several water conservation campaigns. It promoted the installation of water-saving devices (bathrooms, toilets, kitchens), reaching 55 percent of all households and all public buildings and government offices. A media awareness campaign was implemented over an 18-month period from 2008 to 2010 to educate consumers about water-use. The campaign was structured around a combination of education and media activities, carefully targeted to the various segments of the population.

These steps, together with the near doubling of water tariffs that also took place in 2008–10, proved effective. Thus, Israel reduced urban water consumption per capita by 24 percent, to stand now at less than 100 liters per capita for domestic customers. It is estimated that 8 percent of this reduction was due to educational activities and 16 percent to higher water tariffs and installation of water-saving devices.

Creating a supporting environment for water innovation

Like electricity, water is a public entity in most of the countries. Since these are managed by public sector or the government sector, innovation is rare in these areas. Israel made water a commodity and encouraged private entrepreneurs to come forward with their innovations. Water utilities companies work with the private entrepreneurs to try out new ideas. Israeli government too incentivised these innovations.

What started off with simple innovations, such as drip irrigation, has grown in sophistication with the advent of information and communications technologies, many high-technology concepts have penetrated the water sector, such as algorithm-based leak detection and cloud-based fixed leak detection. These technologies germinate in academia, private companies, or individual entrepreneurs. The success of Israel in irrigation innovation is due to the ability of the government to nurture such ecosystems.

Lessons for India

India can learn several lessons from Israel:

Strong control and enforcement of water allocations: This is crucial for mitigating extreme water scarcity. Pricing incentives are not sufficient. The Water Law of 1959 brought water under state control in Israel and gave state organizations the authority to regulate and allocate consumption for alternative uses. Control of consumption has been successful because of strong enforcement with sanctions – it has not relied exclusively on incentives. States in India keep fighting on sharing of river water. There is no clear policy on allocation of water between irrigation, industry and domestic use.

Nine lessons for India

1. Strong control and enforcement of water allocations
2. Collection of comprehensive and timely data
3. Build a national conveyance water system
4. Invest on Financially sustainable projects
5. Introduce BOT and PPP models
6. Reuse water
7. Create Public Awareness
8. Put in sound regulation and Enforcement Team
9. Develop an integrated water management framework

Collection of comprehensive and timely data: These are crucial for efficient integrated management of water. The Israel Water Authority (IWA) relies on its Hydrological Services Unit to collect, analyze, and model water data and factors in the effects of global warming on Israel's natural water resources. This allows IWA to allocate and manage all water resources on a real-time basis.

Build a national conveyance water system: This can help optimize water management under conditions of scarcity, allocating supplies and uses of water across the country. Israel's small size and the institutional reforms made it possible to create a national integrated water infrastructure that is economically efficient and well managed. It proved essential to bringing efficiency, promoting alternative water resources, and being able to mitigate adverse hydrological variations. We have been talking about linking of rivers since independence. It is never too late to start linking rivers.

Invest on financially sustainable projects: Investing massively in new water infrastructure is not enough; this needs to be done in a financially sustainable manner through appropriate institutional reforms. This includes putting in place a clear separation of roles between policy setting, regulation and planning, and operation of infrastructure. In the specific case of Israel, the vesting of all planning and regulatory powers of the water sector (water supply and wastewater, irrigation, water resources management) under a single autonomous agency (IWA) proved a beneficial decision, since it is managed professionally and largely insulated from political influence. India has to go a long way in building autonomous institutions that cannot be influenced by politics. This is going to be a real challenge for India. We need to make water a national

resource and build an autonomous water authority to manage water. This should be filled with water experts, policy makers, and stakeholders.

Introduce BOT and PPP models: The relatively low price obtained for desalinated water through Build-operate-transfer (BOT) schemes for Israel's desalination plants was contingent on a careful design of the PPP contracts—with more government guarantees being provided to private investors than what is typical for such public-private partnerships (PPP) projects. This allowed Israel to get bid prices for desalinated water that are among the lowest in the world, in turn making large-scale access to desalination financially viable. India has a large sea coast. Entire south can meet its water requirement through desalination.

Reuse water: Waste-water reuse is beneficial when dealing with water scarcity, but is also costly and requires significant public subsidies – even in the case of Israel where farmers have achieved high levels of efficiency and are able to pay significant prices for reclaimed water. Subsidies are concentrated to the treatment of wastewater and storage of recycled water, while farmers do pay the incremental costs of conveying treated wastewater effluent to irrigated areas.

Create public awareness: It is important to build public awareness and demand management. Israel carried out on a massive scale public awareness campaign to emphasize the value of water in a country suffering from acute water scarcity. This must be accompanied by a move toward full cost recovery and pricing water at its actual cost, as a strong signal to users that water is a precious resource not to be wasted.

Put in sound regulations and an enforcement team. Corporatization and aggregation of water and sanitation services is along process, that requires sound regulation and efficient supervision to be

Immediate steps should be taken to improve agriculture that consumes 80% of water resources.

Waste-water reuse is beneficial when dealing with water scarcity, but is also costly and requires significant public subsidies – even in the case of Israel where farmers have achieved high levels of efficiency and are able to pay significant prices for reclaimed water.

sanctions for the worst performers. India is known for making high pitch slogans and nice policy frameworks. We may coin a slogan, like, Paanee Bachao – Bhaarat Bachao. But, if we fail to implement the policies, the slogans will not bear any fruit.

Develop an integrated water management framework: Immediate steps should be taken to improve agriculture that consumes 80% of water resources. Israel adopted drip irrigation and precision farming to increase yield for every litre of water used in agriculture. Crop mix for every region has to be looked in to carefully to optimize water utilization. Industries should be made to treat water and reuse them. Domestic consumption has to be regulated by metering water used by every household. Rain-water harvesting must be made compulsory in every building. India has enough water but it needs to be harvested, stored, processed, recycled and reused for avoiding shortages during droughts. Initiatives that started in 1959 has helped Israel attain self-sufficiency in water. We have a long way to go. It is high time that India gives enough importance to this critical area. 

successful. Israel Water Authority regulates all utility companies and keeps them in check through a mix of financial incentives. There are

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WATER

A Crisis, Challenge and Solutions

Water is a basic necessity for survival... one of the reasons why earth is the only planet in the solar system that supports life. Life cannot function without water which makes-up almost 70% of the planet. With this amount of water, it is inconceivable that there is a looming water crisis on earth. Let us first discuss the reasons for the crisis.

The Crisis

A major contributing factor to the water crisis in India is the fact that India has just 4% of the world's fresh-water resources whereas the population of India constitutes ~17% of the world's population. Water scarcity in India is expected to worsen as the overall population is expected to increase to 1.6 billion by year 2050.

World Resource Institute has concluded that India is facing the worst water crisis in its history. More than 600 million people are facing acute water shortages. Critical groundwater resources – which account for 40% of our water supply – are being depleted at unsustainable rates.

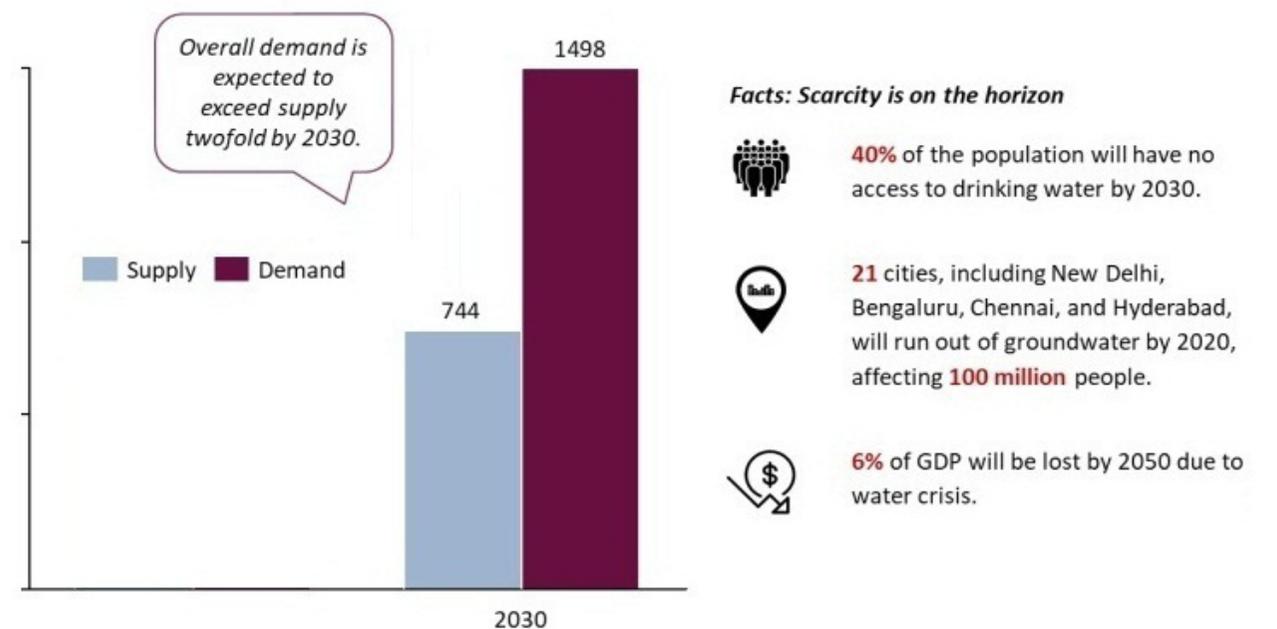
According to the Composite Water Management Index (CWMI) released by the NITI Aayog in 2018, 21 major cities (Delhi, Bengaluru, Chennai, Hyderabad and others) will reach zero groundwater levels by 2020, affecting access for 100 million people. The other implications of water scarcity are: 21% of country's diseases are water related and over 329, 000 children under five died

due to diarrhea in India in 2015. Further, the total area to be brought under the micro irrigation (drip and sprinkler) in India is 42.2 million hectares of land, however only 3.9 million hectares of land or 9.2% of the potential is currently under micro irrigation. Our farmers are highly dependent on rain (~53% of agriculture in India is rainfed). Since droughts are becoming more frequent, this creates stressful conditions for farmers. When water is available, it is likely to be contaminated (up to 70% of our water supply), resulting in nearly 200,000 deaths each year.

India is suffering from the worst water crisis in its history and millions of lives and livelihoods are under threat. The crisis is only going to get worse. By 2030, the country's water demand is projected to be twice the available supply, (shown in Fig.1) implying severe water scarcity for hundreds of millions of people and an eventual ~6% loss in the country's GDP.

As per the report of National Commission for Integrated Water Resource Development of MoWR, the water requirement by 2050 in high use

Demand and supply of water in India (forecast)
 In Billion Cubic Metres (BCM) (2030)



Source: Dalberg analysis; CWC Water & Related Statistics 2013; FAO & UNICEF, Water in India, 2013; Mckinsey & WRG, 'Charting our water future', 2009; World Bank

scenario is likely to be a milder 1,180 Billion Cubic Meters (BCM), whereas the present-day availability is 695 BCM. The total availability of water possible in country is still lower than this projected demand, at 1,137 BCM.

Challenges

Water conservation – We lose considerable amount of water due to wastage which happens when water is transmitted through pipes which leak due to wear and tear, non-maintenance of the water carrying pipes, rusted taps which again leak even when tap is closed etc.

Water Management – The most important constituents of water management are water conservation and efficiency. Hence it is of utmost importance to improve water infrastructure. Inadequate management of water resources for agriculture, industry or domestic use, leads to considerable water wastage. We need clean technology for water efficiency. Solar desalination (discussed later) and smart irrigation systems are great examples of clean technology for water efficiency. This holds true for the agriculture and farming sector - the largest consumer of water.

Pollution of water – Water gets polluted due to industrial discharge and also due to unsafe sanitation. Such water is the carrier of diseases and unsafe for human consumption. Hence, maintaining the quality of water by proper filtration and chemical processes is essential. This demands a continuous monitoring of the water quality. It is most important to improve the sewage system particularly in rural areas. Water Pollution degrades the water quality which contributes to water shortage. Pollution is the main threat to the availability and reuse of water. Fertilizers and pesticides, soil depletion and poor waste disposal conditions are detrimental to freshwater sources.

Climate Change – Climate change is causing the Glaciers to melt in some areas, affecting the freshwater supplies. Due to global warming, there are more and more droughts, floods and heat waves. Climate change is therefore worsening the water crisis, especially in regions that are already under water stress.

We need to improve water efficiency in the agricultural sector. We must increase the water efficiency of agriculture, to an economical system of moving towards organic farming.

Reclaimed water – We get reclaimed water from rainwater harvesting and recycled wastewater. The more we reclaim water from these sources, the greater the reduction in water scarcity. In new buildings, proof of rainwater harvesting is essential to get completion certificate. Rainwater allows to recharge the groundwater by moving water from surface water to groundwater which can be used only when necessary.

Education – People have to be made aware of the water crisis and to understand their responsibilities, they need to be educated. All forms of water consumption have to be reformed (discussed in the next section). This is as much true of individuals as it is true for large companies.

Groundwater resource – Groundwater supplies 90 percent of rural India's drinking water and 75 per cent of agriculture is groundwater based. In urban India, 50 percent of the water supply is groundwater based. Groundwater is a common pool resource; interestingly, this common pool resource is almost invisible. When we recharge, it is not the wells that get recharged but aquifers. An aquifer is a body of porous rock or sediment saturated with groundwater. Groundwater enters an aquifer as precipitation seeps through the soil. It can move through the aquifer and resurface through springs and wells. So it is not the wells that are the resource but the aquifers. The challenge is to identify an aquifer from where water can be extracted.

Solutions

We need to improve water efficiency in the agricultural sector. We must increase the water efficiency of agriculture, to an economical system of moving towards organic farming.

Next, we must reduce all kinds of food waste which represents around 30-40 % of all agricultural production. There is waste at all levels of consumption including during the production line, such as during the transportation of food products. In this waste cycle if we are able to reduce the water waste during the production line by 30-40 % then we avoid water wastage.

Another solution is to change our consumption of meat which should be reduced. All kinds of agricultural products including meat which need a lot of water need to be reduced. We will have to find substitutes for animal protein.

Industries that are water intensive need to be looked at in terms of their water usage. One piece of paper takes about 100 litres of water to produce while one litre of milk takes about 1,000 litres of water. One cup of coffee takes 150 litres of water – just one cup of coffee – that's because there is not only the water you are drinking but the water needed to prepare the coffee beans and the water used in the materials of just one cup of coffee.

According to Solar Impulse Foundation, several solutions to water scarcity are as under:

Artificial Intelligence (AI) to reduce water losses – 'Big Data' and Artificial Intelligence (AI) is combined to improve profitability, sustainability and efficiency in Water Distribution Networks and ultimately change the way networks are designed and managed. AI aims to address this global problem with a scalable and affordable solution for water utilities that can reduce and prevent water loss. Its technology is positioned at the intersection between the Smart Water Management market (SWM) and the Big Data Analytics market. SWM includes devices,

technologies and services to procure a smarter and more efficient water management.

Nozzle Pro - Dual flow atomizer – Nozzle Pro atomizes the flow of water in a water faucet. Only 2% of the regular flow of water is used which can be used to wash hands, do dishes, wash greens, etc.

Two modes are available: spray and mist mode. Spray mode is used when we require higher flow of water i.e. filling a glass of water. However, this mode still saves 85% of water. Nozzle Pro is unique in this aspect, being the only nozzle in the market with a dual mode and small enough to fit into bathroom faucets. The nozzle can be easily installed in the majority of existing faucets. The installation is simple and takes 60 seconds to install. This leads to an awesome 98% savings in water flow.

Enreau - A stand alone renewable based energy – This solution is a stand alone renewable energy unit with or without water purification installed.

The system consists of 40 feet container sized modules, mobile and easily deploy-able anywhere in the world. For its energy production it has about 96m² of Photovoltaic (solar) panels and 6 vertical wind turbines. A battery storage is also installed for backup power and optimized regulation of energy consumption with production. When equipped with desalination unit it delivers about 30 000L of drinking water each day in tropical areas from salt water.

Wave-powered desalination buoys – Wave-powered desalination buoys allows a sustainable, economical, scalable and eco-friendly supply of drinking water.

It is a solution that combines the resource (sea water) and the source of energy (waves) in the same system to make drinking water. The choice of wave energy to produce drinking water is based on the principle that it uses a very dense energy (waves) to transform the resource (seawater) which is the same element thus enabling a very simple technology to do so. The up and down wave movement on the buoys is used to draw water from the sea and pump it through reverse osmosis membranes, the osmosis process extract fresh and clean drinking water from the sea water. A small portion of the buoy's pumping energy is used to pump water to the shore via an underwater pipe. The water is then redistributed locally by the user. 



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WATER

A CRISIS, CHALLENGE, AND SOLUTIONS

More than two thirds of earth's surface is covered with water, but not all of this is usable. Oceans alone hold 96.5% water on earth. Only 3% of the global water resources is fresh-water and two-thirds of this is trapped in the form of ice-caps and frozen glaciers. The rain cycle, rivers, lakes and ground water are lifelines for humanity's water requirements in a closely-knit ecosystem of industry, agriculture and household sectors. The global resources of usable water are on the decline. A huge crisis is impending as the population grows unabatedly driving development needs and thence putting pressure on the already worsening water crisis.

India has 17.7% of global population residing in just 2.2% of land area. With about 14 million people getting added annually, she will surpass China's population by 2027. However, India has just 4% of the world's fresh-water sources, 80% of which is used in agriculture to feed the 1.38 billion people. Though India receives an average of 4,000 billion cubic meters of rain-water every year, only about half of it is added to India's surface and groundwater bodies. The situation is further exacerbated by indiscriminate and unsustainable use leading to a huge pressure on scarce water resources. Besides this, even people are not aware that indiscriminate use of drinking water will lead to less of it available for future generations.

Water scarcity in India is an omnipresent crisis. According to the 2018 Niti Ayog's Composite Water Management Index (CWMI) report, 21 large cities of India including the metropolises viz., Delhi, Bengaluru, Chennai, Hyderabad etc. are hurtling towards zero groundwater levels within the next five years thereby affecting access to clean water for over 100 million people. The continually reducing groundwater table in the rural areas is already impacting agriculture.

The CWMI report further projects that by 2030, India's water demand is estimated to be twice the available supply. The resultant severity will also impact the GDP & disposable incomes. Food & economic security will drive development agenda. The scale of water crisis in India is thus slated to be so large that

economists and political scientists warn of inter-nation, inter-state & inter-community conflicts driven by concerns around water management and sharing, are issues that India must avoid at all costs.

Decoding the Indian water crisis

The simplest way to understand water crisis is when the supply of unpolluted water in a geographical or use-concentrated region is less than the demand for the same. India is a large country with enormous variability in distribution of population, natural resources, infrastructure development and thence economic opportunities for living. We have simultaneous occurrence of floods and drought in different parts of India. Monsoon rains are a major source of water for irrigation, water bodies & underground water levels. In the recent memory, just two consecutive weak monsoons & the resultant drought adversely impacted about a quarter of India's population. It is estimated that over 100 million homes in India already lack access to safe potable water. Women & children in the rural side often have to bear the burden of walking kilometres every day to fetch water. Eventually vast sections of communities are already staring at a bleak future for their future generations.

With about half the Indian population being dependent on agricultural economy including animal husbandry, the country also has the largest population of cattle in the world. The food, fodder and drinking water requirements of the agriculture economy is highly dependent on water. An allied problem arising out of improper planning of water resources is poor sanitation, consumption of polluted water & related problems. With 21% of the sickness being water-related leading to unwarranted deaths of people and animals, it is evident that the issue of managing the water crisis was never more important than today.





brought in by melting glaciers and rains mostly flows into the ocean. The local water bodies as well as the flow area have been encroached upon over the years. The rainiest places including Cherrapunji in Meghalaya also face scarcity of water because appropriate water harnessing has not been done over the decades. So, despite mountains, glaciers, and perennial rivers, the basins are thirsty.

The underlying factors that are causing the water crisis include:

Climate change, extreme weather events, erratic monsoon patterns. While monsoon rains account for 70% of India's annual rainfall, the southwest monsoon irrigates over 50% of India's agricultural farmlands during the sowing & growing seasons which determines the yield of major food crops including rice, wheat, sugarcane and oilseeds. Monsoons also provide enough water for city water consumption by filling-up the reservoirs. Climate change inflicted cyclones and erratic monsoons often lead to droughts, floods and drinking water scarcity.

Pressures of the agriculture economy. India has a large agricultural economy and together with allied sectors, it accounts for about 80% of freshwater consumption. Poor irrigation facilities, low average land holding, dependence on monsoon, vagaries of weather and poor awareness combine to lead to poor land productivity, crop wastages and over-usage of water. The underground water table in most parts of rural India have already reached alarming levels.

Pressures of the industry led development. India needs industries & jobs for economic development. Industries account for 13% of all freshwater sources. The developing economy will need more industries & thence a larger need for water in future. Poor recycling and industrial contamination impacts the water bodies, underground water quality & thence livelihoods of millions.

Poor conservation & storage mechanisms. Water

Contamination of water. Unabated discharge of industrially polluted water into water bodies without treatment or polluted water seeping under surface leads to contamination of over as well as underground water. Such contamination is being caused by human waste as well. Poor & ineffective implementation of policies & regulation holds the key there.

Inadequate water cycle planning. Drinking water planning & recycling of used water is majorly an urban phenomenon. With the plans not being able to keep pace with unabated urbanization, overstretching of existing municipal water solutions is omnipresent. Those who cannot get enough water resort to unabated drilling of wells to access groundwater sources, which is commonly seen in urban outskirts and rural areas that are largely left out of the public water supply plans.

Over-use and wastage of water. There is a popular belief that the cost of water availability is zero or negligible. Municipal water prices may be zero or low in most cities. Private wells keep getting exploited after the one-time digging investment. It is also estimated that 80% of household use goes into the drains as waste. The over-use & the waste water is not adequately recycled leading to reducing levels of clean water resources.

The way out

The solutions for the worsening water availability crisis in India lie in active governance, proactive water management measures, use of technology, community involvement, awareness and user behaviour changes.

The possible solutions include the following:

Improving irrigation and agricultural practices

A sustained focus here addresses usage of 80% of India's freshwater resources. Awareness needs to be built to give up old practices and adopt modern agricultural practices like precision farming, farm mechanization, drip irrigation & judicious use of cropping, fertilizer and pesticides. Governments & local communities have a major role to play here given the predominance of subsistence farming among small & marginal farmers who constitute 80% of the farmers.

Education & awareness

Education leads to awareness around sustainable water usage that impacts behaviors & patterns of water use. People need to be aware that their today's actions are impacting the life of their future generations. However, change in behaviours which is a nuanced and complex matter and hence is difficult to bring about positive change. It is a long drawn process and the children & youth will have to be drivers of this change.

Water harvesting, catchment & storage

The pressures of development needs drives a greater interest in laying large networks like river grids, constructing huge storage dams, or building canals to fetch water from hundreds of kilometres. However, in the process, there is an evident neglect of the role of local communities and local water bodies. Local ponds, check dams, clearing obstructions in the catchment area, ensuring depth of reservoirs are extremely important. The efforts of the waterman of India, Mr. Rajendra Singh (Ramon Magsaysay Award, 2001; Stockholm Water Prize, 2015) around water awareness & building thousands of johads (small earthen check dams) led to improvement in underground water levels up to 6 metres and a 33% increase in forest cover.

Cleaning & recycling wastewater

A good part of the water used can be treated chemically, biologically or through natural means

to make it fit for reuse. Appropriate policies that incentivize reuse & recycle needs to be in place.

Technology can play a big role here and countries like Singapore lead the way in which they have developed and are using advanced water treatment technology that makes wastewater fit for multiple uses, including drinking. Industrial water usage that accounts for consuming 13% of freshwater in India can reduce its water footprint by treatment, recycling & reuse.

Dynamism in policies and regulations around water

Water being a natural resources, governments have a big role to play. To ensure better management of scarce water resources, governments need to redefine their role to become more active in those dealing with policy formulation & implementation, regulation, appropriate pricing, research & review of policies with new data, pollution monitoring, building awareness, developing community consensus & more.

Strengthening rural infrastructure & local governance

Poor rural physical & health infrastructure is often connected with greater prevalence of water-borne diseases in the more vulnerable population. Covid-19 has further stressed the need for investing on these. On the governance front, local communities are best judges to the problems & constraints they face. Technology and modern knowledge has to be encouraged to be blended with traditional knowledge. More autonomy & effective governance at the grassroots-level also builds capacities of local communities to manage their own water resources well.

Integrating water economy with other elements of local economy & infrastructure

The complete value chain of water can integrate source management, recycling, sewage treatment, generation of bio-waste fertiliser and biogas, reuse. Further integration is also possible with agriculture and animal husbandry to lead to a holistic ecosystem that draws from and manages local resources. This would also strengthen local economy & create job opportunities for the teeming millions.

International Cooperation- Role of UN, Institutions and technologies

The United Nations has included water in its Millennium Development Goals. By the nature of its origin and the future potential to bring conflicts, water crisis is a global problem and thence a joint responsibility of the nations. India should exhort UN to drive international cooperation through appropriate frameworks and institutions. Technology can play a big role here irrespective of its place of origin. International sharing of technologies of energy efficient desalination plants can bring down costs as well as energy intensity of the process. Further, climate change issues are almost co-existent with water scarcity. Traditional thermal power plants which spew a lot of greenhouse gases, also need a lot of water for production whereas renewable energy hardly uses a fraction of it. This factor needs to be appropriately accounted for when considering the returns from support to renewable energy projects.

What lies in the future

The Government of India and various states have been active in addressing issues around water scarcity. The Federal Government at the centre has established the National Water Mission under the National Action Plan on Climate Change with an objective to conserve water, minimize water wastage and ensure more equitable distribution both across and within States through integrated water resources development and management. **The five goals of NWM include:**

- ◆ Comprehensive water data base in public domain and assessment of the impact of climate change on water resource;
- ◆ Promotion of citizen and state actions for water conservation, augmentation and preservation;
- ◆ Focused attention to vulnerable areas including over-exploited areas;
- ◆ Increasing water use efficiency by 20%; and
- ◆ Promotion of basin level integrated water resources management

Further measures across various levels of governments focus on agriculture development initiatives including promotion of insurance

schemes, irrigation schemes, micro and drip irrigation measures; development schemes for small and marginal farmers; timely availability of accurate weather forecasts; promotion of weather-resistant short cycle crop varieties in most food crops; and development of integrated rural economy around agriculture, animal husbandry, fisheries, apiculture among others.

The Ganga rejuvenation plan is under implementation for a decade. The ambitious project of interlinking of rivers for efficient water management has also been initiated with the Godavari and Krishna Rivers in South India. The challenges are huge and the government has set a tough target at a time when hundreds of millions don't have access to clean water. The vagaries of weather coupled with poor community management of scarce water resources also results into poor environment justice to a large cross section of Indians who would wish to raise their children with dignity. The future beckons us with a responsibility to ensure a water-crisis free world for our grandchildren. 

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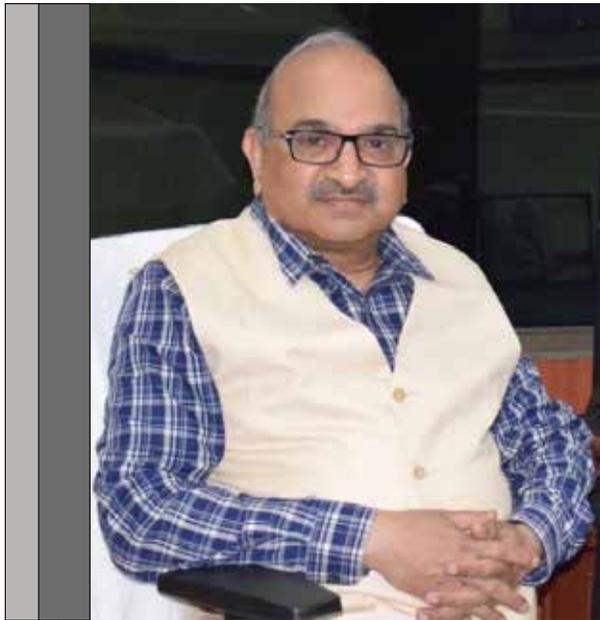
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PARADOX OF VALUE

DIAMOND VS WATER

Adam Smith, a Scottish economist, popularly known as the Father of economics explained economics as a 'science of wealth'. He deliberated over the concept that, though water is the primary reason for life on earth, it is still less 'valuable' than diamonds. However, we can live without diamonds but we cannot live without water. This concept was known as the Diamond Water Paradox. If today, Adam Smith would have been alive; would he redefine this paradox of value? One may wonder why water, which is a necessity for life is valued less than a shiny piece of an element known as diamonds.

Different economists have explained the reasons for this paradox in different ways. Some gave the concept of scarcity, some talked about marginal utility and some enumerated the concept of demand and supply. The truth, however, remains that until today we have to pay a huge amount for diamonds as compared to what we pay for water. The concept is explained by economists through the law of diminishing marginal utility, they argue that in the eyes of the

consumers, diamonds are more valuable than redoubtable water. It is evident that if anyone is given an option to have a diamond against water, the outcome is obvious. The utility of water is temporary in comparison to diamonds for most of us. We hardly have any realization when we see water literally spiraling down the storm drain. We may not have a penchant for diamonds but still, enormous water flows down our sluices through our washbasin each time we enter the bathroom, and if the sluice over-spills then it is considered of no value. No wonder water has less stature among some economists by appendage, average consumers. The concept of water and diamond was proposed in 1700; from then till 2020 the demand and supply of both the commodities have changed alarmingly. Today 66% of the water is consumed for irrigation, arid regions use around 90% of the water, domestic households and industries consume 34% and 20% of water respectively. Change in lifestyle, increase in population has increased the demand for water. In contrast, the wastage of water, global warming, and improper use of water have depleted our water resources. With an increase in demand for water and its supply reaching a critical level, the paradox of value may reverse.

Value of use & value in exchange

Water has a higher value of use but is exchanged for low value and on the other hand diamond has very little value of use but is exchanged at a very high price. It happens because of the difference in their marginal utility. The marginal utility of a commodity means the satisfaction derived after consuming an additional utility of a commodity. It is also stated that marginal utility decreases as we consume the same commodity without any interval and the satisfaction derived from the additional utility will fall. (Law of diminishing utility). The same law follows when a person consumes a diamond or water. But it is interesting to note that the first glass of water consumed gives more satisfaction as compared to the first unit of diamond bought. Water has a greater marginal utility at the initial level as compared to diamonds. This is the case when a person is thirsty but water is not available at that time. In this situation, water will be having greater value than diamond. If water is easily available, then the consumer will not be interested in consuming water till they need it. And once the need is met, his marginal utility becomes zero which means he is no longer interested to buy water. This is explicitly different for diamonds. Diamonds are projected to be scarce and are well marketed to create demand. It results in the higher marginal utility of diamonds and thus get

exorbitantly priced as compared to water. Adam Smith wrote in his book Wealth of nations: 'Nothing is more useful than water, but it will purchase scarce anything.'

Demand for water

Water only triggers one aspect of its usage and that is for domestic purposes. Water has a variety of uses and it has increased multifold since 1950. According to an estimate, the consumption of water is increasing at double the rate of increase in population. During 1950 the annual water consumption was 1.22 trillion cubic meters, it reached four trillion during 2014 and since then is continuously increasing. At this rate, it is forecasted by the Organization for Economic Co-operation and Development that global water consumption will increase to almost six trillion cubic meters in 2050. This increase is expected due to the increase in population and industry demand. It is not only an increase in population that will make the demand for water rise but it is expected that the demand for water by industries will increase in the future to a great extent. At present industrialized countries demand 19 percent of all water. In the coming years as the present economic situation projects, many countries will be enhancing industrialization resulting in a huge demand for water.

Another factor that will increase the dependency of industries on water is the consumer buying pattern. Industrialization will lead to urbanization which, in turn, will enhance the per-capita income. An increase in per-capita income will increase the purchasing power of the people. Higher purchasing power will shift the demand of people to a nutritious diet like a diet rich in proteins rather than a grain-based diet. The production of high protein foods requires more water thus leading to a high demand for water. Across the globe, maximum consumption (around 69%) of water used takes place in the agricultural sector. Agriculture is followed by Industries, which accounts for 19% of the water used, the remaining 12% of water is used domestically. Ironically, the use of water is increasing at a fast rate, from 1960 till 2019 demand for water by household has increased by more than 600%. As the population increases so does the demand for water. As the economic activity of the world increases, demand for water will also increase since for many industries, water is an important raw material. The industries refer to the water they use for the processes as embedded water or virtual water. A large amount of food products are being exchanged globally, each time the exchange takes place inadvertently, countries partake in water trading.

Supply of water

Pacific Institute compiled data from direct and indirect resources that total renewable freshwater supply in the world is 53674.44 km³/yr. The primary sources of water which bring continuity in the water supply are groundwater, rainwater, and glaciers. Groundwater counts for food security and livelihood. In the last fifty years, the rate of abstraction of groundwater has increased to a great extent and is an important source of consumption, contributing 50% of the world's drinking water. Over the years over-utilization of groundwater has created a sign of worry. The speed with which it is used is greater than with which it is replenished. Global warming has made glaciers shrink and it may seem that the level of the stream has increased but in the long run, the glaciers will disappear leaving the streams dry. It will result in a considerable fall in the water supply. Polluting water worldwide has reduced the supply of clean water which is fit for a variety of uses. The earth hydrologic cycle furnishes the water on earth, rain is an important component of the cycle as it increases the supply of water to earth. Sadly, most of the water falling as rain is not collected, thus not making a great significance to total supply.

Paradox of value redefined

Due to climate change and drought-like situations, coupled with unbounded groundwater draw-out, the aperture between demand and supply of water is prone to be broadened. Though nature has its unique way of distributing and maintaining water resources, humans are unable to manage, maintain, and relinquish it. The

REGION	Annual Renewable Water Resources (km ³ /yr)
Africa	5560.3
North & central America	7222.82
South America	17131.7
Asia	19138.05
Europe	3005.97
Oceania	1615.6
Total	53674.44
<i>OCEANIA - Australia, Fiji, New Zealand, Papua New Guinea, Solomon Islands, Timor-Leste</i>	

Source: <https://www.worldwater.org/water-data/>

present condition projects that the supply of water after thirty years will be at a critical stage. The paradox of value had held true when Adam Smith was alive. After four centuries, the paradox of value has now over-turned. In order to have a sustainable level of water, consumption of water should be lesser than the replenishment of water. In the present scenario, the gap between demand and supply of water is widening. Failure to conserve the existing water and unable to curtail the wastage, humans are trying their level best to defy the paradox of value. It is predicted that after thirty years demand for water will be too high as compared to the supply of water. Water being a necessity commodity, its demand is inelastic. The scarcity and inelasticity of demand will collaborate to increase the price of water. The situation will further be aggravated with a reduced supply of water. The prices of water will surpass that of the diamonds. After a few years don't be surprised if your wife or friend demands a bottle of water instead of a diamond ring. 

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STOPPING COVID-19 IN ITS TRACKS

A THREE STEP APPROACH

The over hyped and over rated Covid-19 also known as SARS-COV-2 has made many of us highly anxious, despite the fact that the disease has only around 2% mortality rate and close to 60% recovery rate. The recovery rate in Delhi state is almost 90%. Recent research suggests that up to 95% of the corona virus positive but asymptomatic or mildly symptomatic patients do not require any hospitalization and recover on their own after an adequate period of home quarantine or isolation only.



Due to overreaction several such asymptomatic patients were put in hospital across India causing severe shortage of beds for the seriously ill patients who needed quick hospitalization and probably intensive care. Moreover, hospitals began avoiding women on maternity and patients with other serious illnesses due to perceived contagiousness of the disease and caused some serious collateral damage in return. Many died awaiting treatment.

What should we do now?

First, we must move from our over reactive state to a proactive state. Every action, needs to be a result of thorough analysis and research. Funding for research on contagious diseases should be increased manifold. Whenever there is an official press conference at the topmost level, the Health Minister or the officials must be accompanied by Director-AIIMS, Director-NCDC and DG- ICMR to send a message to all citizens that all our decisions are backed by experts. No need for countrywide lockdowns at all. On a hindsight, experts say only one lockdown of 21 days was enough as a warning. The successive lockdowns, proved to be a remedy worse than the disease, causing widespread pain, economic contraction, mass scale migration,

deaths on roads and railway tracks, and suicides due to depression. We should also ramp up dilapidated primary and secondary health care systems, across country, and ensure availability of tertiary care at all district headquarters.

Second, we must move from a pharmacokinetic focus to herd immunity-based approach. This virus like several others will decide its own timeline. Viruses often mutate, rendering vaccination and current pharmaceutical response less effective over time. The solution lies in opening up immediately. The countrywide un-lockdown is a step in the right direction and is helping us learning to live with the virus. Let the young and healthy confront the parasite and help us bring about a herd immunity across the nation. To do this, it is essential to open schools and colleges quickly. Research suggests, that lockdowns have brought with it, depression and amplification of existing mental illnesses in young as they were deprived of much needed physical social interactions. So, herd immunity will bring with itself both physical and mental wellness. Colleges and schools however must prepare their infrastructure and be ready for staggered classes, hybrid teaching- learning approaches, and sanitization of campuses on a regular basis. They must also provide masks, sanitizers, isolation rooms, Covid-19 help

desk, contactless temperature meters and a physician who is permanently available on the campus. Opening up of schools and colleges will help demystify the disease and reduce anxiety about it in general public. Educational institutions not only serve the purpose of knowledge creation but also help in bringing about behavioural changes in all aspects of life. Universities, Colleges and Schools shall work towards spreading awareness about the parasite, the disease in its pandemic form, and the precautions to be undertaken by hosts, in a manner similar to all other literacy programmes. Awareness about the disease would help us open up public transport across the country quickly with adequate precautions in place.

Covid-19 has magnified inequalities in our country. It has brought to focus economic inequalities, digital divide and unequal access to healthcare & education in both urban and rural India. The third and most important solution for stopping Covid-19, or for that matter any pandemic, in future, in its tracks, will be to immediately design and implement policies for not only a self-reliant India (Aatma-Nirbhar Bharat), but also an equal India (Samaanata-Poorna Bharat) with equal access to employment, healthcare and educational opportunities for all. This pandemic has proved that around the world it is the poor, unaware, and those without access to healthcare, who perished first, and in largest numbers. 

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In a career spanning close to 25 years he has served in senior academic & administrative positions in premier institutions in private sector and Government of India. These include Lal Bahadur Shastri Institute of Management (LBSIM) Delhi, Institute of Management Technology (IMT) Ghaziabad, National Institute of Financial Management (Ministry of Finance-Govt. of India) and Institute of Cost Accountants of India (Statutory Body under Ministry of Corporate Affairs-Govt. of India) where he served as Director of Advanced Studies.

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THE WATER CRISIS CHALLENGES & OPPORTUNITIES

The United Nations adopted seven development goals in the year 2000 for the Planet and its inhabitants. One of the Goals was to make safe drinking water available to people and reduce water scarcity for at least half the affected people by 2015. The goal was achieved due to concerted efforts and collaboration by members of UNO. In 2015, the UNO adopted 17 sustainable development goals and one of the key goals was to make safe drinking water available to all the people by 2030. Latest updates indicate that around 1.2

billion people around the world don't get access to clean drinking water even now.

The water scarcity is primarily driven by two converging phenomena: increasing demands for freshwater use and decreasing supply of clean water due to steady depletion of usable freshwater resources. There is a physical angle to water scarcity and an economic angle as well.

The quantity of water is limited physically. There is water scarcity in 'absolute' terms, due to non-availability of enough natural water resources to cater to the net demand. This is physical water scarcity. The economic water scarcity is a result of poor management of the available water resources, due to lack of awareness of consequences or lack of access to the right technology for managing the consequences. The attitude to waste water is driven by lack of information and community sensitization about how communities are interdependent in an aggregated way and could address as a collective only, the balancing of demand and supply of critical natural resources like clean water and clean air.

There is a developmental skew in the path of human civilisation over many centuries but the skew became extremely harmful in the last two centuries due to rampant exploitation of natural resources for the economic purposes of industrialisation. Earlier, the market used to be a subset of the society but after the industrial revolution and colonisation of Africa, Americas, Asia, Australia and Antarctica for feeding raw materials for the industries of the colonial powers, the Society turned into a subset of the Market. Even after the decolonisation, which started 100 years ago and which is almost non-existent in the political context today, the market has only grown more and more powerful and assertive.

Practically, the real masters of the society today are the power elite of the Market Economy. The World Bank, the Federal Reserve, the Dow Jones, and the other major stock exchanges of the World determine the fate of civilisation. The market determines how much water people and other livestock should drink and how much water the machines should guzzle! Thus, the solution to water crisis can be addressed much better by raising the awareness of the leaders of the Market Economy with a logic that would appeal to the market. They must see a better sense in correcting the skew of the water usage, for the prospects of better business in the market.

Rain water harvesting, afforestation and internal looping of river waters are already proven techniques for mitigating water crisis in every region.

The bottling industry has made trillions of dollars peddling doubts about contamination of ground water in populated habitats. First the industry contaminated the ground water and the rivers through polluted effluent discharge, and then they came out with industrial solutions to purify water, selling water purifiers in mass scale. The cycle of wrong and right shall continue unless the loop is broken with another strong logic, where the market can see more dollars in saving water from pollution.

In the context of India, the nature has endowed her with plenty of sunshine and rain, hills and plains, and a rich pastoral culture that worships nature in different forms across the diverse hills and plains of India. More rain water gets drained out to the ocean than what is necessary to provide clean drinking water to her 1.3 billion people. The distribution of water through a network of rivers, rivulets and canals have not progressed with speed and purpose. The major bottleneck has been the so-called reasons of 'economic viability'. After building a few irrigation dams, the perennial flood cycle could be broken in India, and the green (agriculture) revolution made India self-sufficient in food grains. The inertia of self-sufficiency did not allow to think beyond, and every proposal to connect the rivers of India through a network of canals were considered unviable. Had that been done, there would not be any physical wastage of water nor scarcity of drinking water, water for irrigation or industry either. Rain water harvesting, afforestation and internal looping of river waters are already proven techniques for mitigating water crisis in every region. The more we act the less we shall suffer, and we must join hands to bequest a better world for the future generations. We must eradicate the water crisis fully by 2030. **EP**



Prof. Devendra Pathak

WATER

A CRISIS, CHALLENGES AND SOLUTIONS



शं नो देवीरभिष्टय आपो भवन्तु पीतये। शं योरभि स्रवन्तु नः।

O Water, may the auspicious divinity which is wished for be present in you when we drink (water).

May the auspiciousness which supports you, flow to us.

Jalam Jeevanam- Water is life.

Significance of Water

Nature has been kind as earth is the only recognised planet having water and life till day. Water is an indispensable item like air for survival of not only human species but the entire living organism of this planet. Hindu scriptures are full of prayers beckoning the rain gods to give plenty of water. Water is the most indispensable element of life and is essential for existence. The significance of water

in our life is evident as it helps the body to carry out definite metabolic tasks and controls our body temperature; in addition, water carries nutrients to all cells in our body and oxygen to our brain. Water allows body to absorb minerals, vitamins, acids, glucose and other substances.

Water flushes out toxins and waste and helps to regulate our body temperature.

Water links and maintains all eco-systems on the planet. It is an important source for nutrients for people, plant, animal and planet earth as all need water for their survival. Had there been no water there would be no life on earth. The human body is more than three-fourths water as it helps breakdown food and keeps organisms cool. The physical performance will suffer if we are not hydrated enough. When the heat is high and we must undertake intensive exercises, it is even more important to drink plenty of water. It boosts energy levels and makes up for the water lost through perspiration. Even if we lose 2-3% of our water content in the body, we will be dehydrated. To regulate the body temperature, stay energized, improve motivations and do away with fatigue, we must drink plenty of water.

Water Crisis

Water scarcity is the lack of fresh water resources to meet the standard. Water scarcity can also be caused by droughts, lack of rainfall, or pollution. This was listed in 2019 by the World Economic Forum as one of the largest in terms of potential impact over the next decade. Two-thirds of the global population (4 billion people) live in conditions of severe water scarcity for at least a month of the year. Half a billion people in the world face severe water scarcity all year round. Half of the world's largest cities experience water scarcity.

A mere 0.014% of all water on Earth is both fresh and easily accessible. Of the remaining water, 97% is saline and a little less than 3% is difficult to access. Technically, there is a sufficient amount of



freshwater on a global scale; however, due to unequal distribution (exacerbated by climate change) resulting in some very wet and some very dry geographic locations, accentuated by a sharp rise in global freshwater demand in recent decades driven by industry, humanity is facing a water crisis. Demand is expected to outstrip supply by 40% in 2030, if current position

of availability of potable and other water usable for for other purposes continue at the present position.

The essence of global water scarcity is the geographic and temporal mismatch between fresh water demand and availability. The increasing world population, improving living standards, changing consumption patterns and expansion of irrigated agriculture are the main driving forces for the rising global demand for water. Climate change, such as altered weather-patterns (including droughts or floods, deforestation, increased pollution, greenhouse gases emissions, and wasteful use of water can cause insufficient supply. At the global level and on an annual basis, enough freshwater is available to meet such demand, but spatial and temporal variations of water demand and availability are large, leading to (physical) water scarcity in several parts of the world during specific times of the year. Scarcity varies over time as a result of natural hydrological variability but varies even more so as a function of prevailing economic policy, planning and management approaches. Scarcity can be expected to intensify with most forms of economic development, but, if correctly identified, many of its causes can be predicted, avoided or mitigated.

According to world Economic Forum Report-2019, 844 million people lack basic drinking water access, more than 1 of every 10 people on the planet, women and girls spend an estimated 200 liters of water every day, the average woman in rural Africa walks 6 kilometres every day to haul 40 pounds of water, and more than 800 children under age 5 die from diarrhoea attributed to poor water and sanitation. By 2050, at least 1 in 4 people likely to live in a country affected by chronic or recurring fresh water shortages, 2.3 billion

people live without access to basic sanitation, and 892 million people practice open defecation. This report also points out that the UN 'Sustainable Development Goal' aims to provide universal access to clean water and sanitation as 90% of all-natural disasters are water-related.

Between 2000 and 2025 the global average annual per-capita availability of renewable water resources is projected to fall from 6600 cubic meters to 4800 cubic meters. Given the uneven distribution of water resources, however, it is much more informative that some 3 billion men and women will live in countries wholly or partly and or semi-arid zone that have less than 1700 cubic meters per capita, the quantity below which one suffers from water crises. The water gap scenario indicates that by 2025 about four million people – that is, half the world population will live in countries where more than 40% of renewable resources are diverted towards human usage. Projections under the business as usual scenario show diverging increases in water use—even without making sure all demands get satisfied—with the largest uncertainty being whether we keep expanding irrigation and other agro-based activities.

The statistics taken from UN World water Resources Report-2019 points to a dismal picture as is evident from the following Table:

The Challenges

The earth's water supply is never replenished from space as is the case with solar energy which we get from the sun. However, nature has developed mechanism to maintain the earth's water supply which is known as 'water-cycle'. Unfortunately, humans are inclined to disturb these water-cycles with huge distraction of ingenious regulation, pollution and water wastages for usage in industries, etc. A realistic view of the main challenges can be deduced from the following questions:

Will the rate of expansion of irrigated agriculture continue as in recent decades, or will it slow down, as appears to be indicated by reduced investments in the sector? Can improvement rates in water use efficiency or preferably, water productivity be increased drastically on short notice to ease the water crisis? How can technological and institutional innovation be stimulated to improve these rates? Can water productivity for rain fed

agriculture be accelerated? Will policies emphasise national food self-sufficiency or global food security (involving governance and trade issues)? What contribution will biotechnology make to increased water productivity? Will genetically modified crops gain public acceptance in Europe and developing countries? Will this call for capacity building for water storage? Can the recharge to aquifers used for irrigation be drastically increased to prevent a groundwater crisis—without major environmental impacts? Will there be increasing or decreasing public opposition to large dams in developing countries? Will the hydropower potential in Asia, Africa, and Latin America be developed at the rate of past decades to meet the rapidly increasing demand for electricity? How can affordable water storage be created with

			Expanding Irrigation	Stable Irrigation
USE	1950	1995	2025	2025
Agriculture				
-Withdrawal	1100	2500	3200	2300
-Consumption	700	1750	2250	1700
Industry				
-Withdrawal	200	750	1200	900
-Consumption)	20	80	170	120
Municipalities				
-Withdrawal	90	350	600	900
-Consumption	15	50	75	100
Reservoir (Evaporation)	10	200	270	200
Total				
-Withdrawal	1400	3800	5200	4300
-Consumption	750	2100	2800	2100

Source: World Water Report -2019

acceptable environmental and social impacts? Will reforming water resource management institutions be necessary? Will governments implement policies to charge the full cost of water services? Will current trends towards decentralisation and democratisation empower communities to select their own level of water services? Will the trend towards transferring management of water systems to water users continue, and will these users be assigned stable water use rights? Can governments and the private sector form effective public-private partnerships and develop a service-oriented approach to water management, accountable

to users? Will countries be prepared to adopt comprehensive approaches to land and water management? Will this lead to valuing ecosystem functions? Will wetlands continue to be claimed for agriculture and urban uses at current rates? Or can this trend be stopped or even reversed? Will wetlands receive enough water of good quality to maintain their biodiversity? Will environmental or dry sanitation make the expected breakthrough and become adopted on a wide scale? Will there be increased demand for investments in wastewater collection, treatment, and disposal in rapidly developing emerging economies? Will transition economies upgrade their systems? Will this lead to an increased co-operation in international basins? Will countries recognise the need to cooperate as scarcity in international basins increases? Will they make binding agreements on how to share the resources of rivers that cross national boundaries? Will the public sector increase research funds to foster innovation on public goods aspects of the water sector— such as ecosystem values and functions, food crop biotechnology, and water resource institutions? Can innovation be linked to effective capacity building, education, and awareness rising? Will science, with the help of information technology, develop innovative approaches to improve water resource data, real-time methods, seasonal drought forecasting, and longer-term cyclone and flood warnings?

Thus the three global scenarios known to us, are:

Business as usual – a continuation of current policies and extrapolation of trends.

Technology, economics, and private sector – private sector initiatives lead research and development, and globalisation drives economic growth, but the poorest countries are left behind.

Values and lifestyles – sustainable development, with an emphasis on research and development in the poorest countries.

Solutions

Develop and enact better policies and regulations

As water scarcity complicates food security and pollution, governments need to redefine

their role. The U.S. government is considering expanding the Clean Water Act. to ensure more protections. In Russia, meanwhile, Prime Minister Vladimir Putin has approved waste discharges in Lake Baikal, one of the world's largest bodies of freshwater. Regardless of what path Circle of Blue/ Globe Scan Water Views Survey indicates they are considering multiple approaches—the survey also found that most people say it is up to the government to ensure communities have access to clean water.

Holistically manage ecosystems

Simply put, holistic management applies to a practical, common-sense approach to overseeing natural resources that takes into account economic, cultural, and ecological goals. In essence, the whole is greater than the sum of its parts, and each facet is related to and influences the others. Good examples of holistic management are communities that operate sewage treatment plants while pursuing partnerships with clean energy producers to use wastewater to fertilize algae and other bio-fuel crops. The crops, in turn, soak up nutrients and purify wastewater, significantly reducing pumping and treatment costs.

Improve distribution infrastructure

A considerable amount of water overflows during floods in North India inundating States like Uttarakhand, UP, Haryana, Punjab, Bihar, Bengal, Assam, North East and other northern states while southern India do not face these problems as much. Linking north Indian rivers with Krishna, Kaveri, Godavari, etc in the south were suggested but so far nothing has been done.

Poor infrastructure is devastating to health and the economy. It wastes resources, adds costs, diminishes the quality of life, and allows preventable water-borne diseases to spread among the vulnerable population, especially children. The problem is not confined to the developing world. Pipes burst on a regular basis in the USA and as they do in India, causing wastage of water prompting alerts to authorities. Sewage treatment systems regularly overflow and malfunction

affecting the distribution and management.

Build international frameworks and institutional cooperation

Binding international accords for natural resource issues are hard to achieve. The 2009 United Nations Climate Change Conference in Copenhagen is evidence of this. This isn't because the freshwater crisis, arguably the most visible and dire of the climate change risks, was ignored. Regional agreements regarding trans-boundary or shared water-bodies such as the great lakes in the USA and the Nile River Basin agreement in Africa are just as difficult to ratify. But policymakers and advocates need to keep trying. Humanitarian-oriented treaties, such as the UN drinking-water Millennium Development Goals confirms that comprehensive global water strategies are possible.

Address pollution

Measuring and monitoring water quality is essential to human health and biodiversity. The unbridled increase in pollution level through allowing hazardous effluents and chemicals, wastages of the factories and industries in the river, lack of sewage plants allowing all filth and dirt to mingle in water through thousands of drains, throwing of flowers, wastes, burnt ashes and even dead corpses are the perennial sources of pollution distorting ecology and environment.

Public Common Resources

One of the key United Nations 'Millennium Development Goals' or MDGs is to ensure access to drinking water. While the steps to achieve this goal are debated, the thesis that water is a basic right comes into play. Chile's attempt to reform water rights is a pointer. U.S. politicians are considering how access rights translate into federal protection of Lake Michigan. We in India must also apply concerted efforts to build more reservoirs for water and aim for its conservation through mandatory rain-water harvesting for every infrastructure project as this will increase ground-water availability.

R&D/ Innovation

Access to water in a water-scarce world will

become a much high priority in business decisions. Communities are likely to pursue public-private partnerships that draw on the innovative capacities of companies. For instance, cities that operate sewage treatment plants are likely to pursue partnerships with clean energy producers to fertilize other biofuel crops with waste-water.

Water projects in developing countries/ transfer of technology

Climate change and water scarcity are producing the most dramatic consequences in developing regions such as northwest India and sub-Saharan Africa. One proposed solution is to transfer water conservation technologies to these dry areas. Doing so is tricky because economies are weak and there are gaps in skills that often compel government and business authorities to impose these changes on locals.

Climate change mitigation

Climate change and water scarcity go hand-in-hand to cause some of the biggest contemporary challenges to the human race. These issues have a reciprocal relationship, identified by the inter-governmental panel on Climate Change (IPCC), in which, "water management policies and measures can have an influence on greenhouse gas (GHG) emissions." As renewable energy options are pursued, the water consumption of these mitigation tactics must be considered in producing alternatives ranging from bio-energy crops to hydropower and solar power plants".

Population growth control

Due to the accelerating growth in global population many parts of the world could see a supply-demand mismatched up to 65% in water resources by 2030. Currently, more than one billion people don't have access to clean water. With seventy percent of the world's freshwater used for agriculture, water's critical role in food production must be considered. 

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