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Jalasamvad

A Dialogue on Water

Editors: Dr. Datta Deshkar, Shri Satish Khade

Cover Story:
A Spring in the City

Struggle to save a tiny spring is a touchstone of our priorities

Changes in Rainfall Pattern :

- Till now there was definite system in the rainfall pattern. God Mansoon used to bless us every year on 7th of June. There was a spread of rains from June to September. In the month of September rains used to take some rest. That was benefitting the farmers as they could get some time to harvest the Kharip crop and prepare land for the Rabbi crop.
- Then again rains would continue up to November-December giving benefit to the Rabbi crop. You would appreciate if I say that Karip and Rabbi seasons were not man made. They were made by the Nature and then we started calling them by these names. This system continued for generations and the farmers tried to adjust their time table suitable to this pattern.
- But now, this pattern has substantially changed. Now a days, Junes are more or less dry. Farmers get their land ready well in advance and look at the sky with great hope that it would rain. But the Rain God disappoints them. There is an inordinate delay and rains start in the month of July. Previously, it used to rain for nearly 70 to 80 days in the rainy season. But now it rains hardly for 35 to 40 days. This decrease in the number of rainy days is a matter of great concern to the farmers.
- But every year the average rainfall remains the same with some minor variations. This naturally means that the force of rainfall has increased sizably. (Same quantity in less number of days) As a result of this heavy down pore , the run off increases giving rise to floods. You would observe that the frequency of floods in recent years has gone up substantially. Another impact of this is that the rate of percolation in the soil has gone down. If the flow of water is slow percolation is more. Naturally, as a result of this, the ground water level is dropping very fast. Late start and early end has become the new characteristic of the rainfall pattern.
- Due to this new rainfall pattern, the farmers are seen confused. When the Kharip harvesting starts, rains disturb that activity and quality of food grains is affected. And for Rabbi crops, sufficient humidity is not there in the soil when the crops grow. This affects the average yield per acre. Thus, both the seasons are affected due to untimely and inadequate rainfall. As a result, economic stability of the farming activity is totally lost.
- Most of the industries depend upon the agricultural raw material. When that yield is unstable, that instability affects the industrial activity also. Thus, this leaves its impact on the entire economy.
- With the climate change, the position has worsened still further. Rains have become more erratic and unreliable. This year, floods have played havoc in European countries causing heavy loss to life and property. Worst sufferer is the cultivator who has to depend on the vagaries of Nature.

Jalsamvad

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Editorial .....

Vastly increasing use of bottled water

Contamination of potable water and consumption of bottled drinking water has become a feature of the current century. As a school going children, whenever we went for a walk in the mountains, we used to enjoy drinking the water oozing out of the springs directly by mouth lying flat on slopes without touching the water by hands. Many times, we used to get up in the morning and walk through Daulatabad hills to a temple of Goddess situated in the hills to have a holy darshan. We often felt thirsty while walking such a long distance. At such times, everyone would bend down and drink the water of the springs without doubting the quality of water in mind. But, today, we have become so much vulnerable to pure water that we don't go out without taking a bottle of water with us. Bottled drinking water is now widely available not only in cities but also in rural areas as well.

Despite the fact that bottled water is harmful to health and also to the environment, its vastly increasing use is incomprehensible. We cannot deny that handling of water in this way is more convenient. Whereas in the past, copper flask was carried along, while in the journey. It was a bit difficult to handle the copper flask along with the other heavy luggage in the journey. Now, the journey has become smooth and comfortable. If you get thirsty during the journey, throw away 15 rupees and get a bottle of water for drinking. Although, this is a short-term benefit, are we going to consider the long-term consequences of it? Two consequences of this seem important. One is the adverse effect on the human body and the other is the adverse effect on the environment. Our strong belief is that the bottled water is always pure. However, it is being consumed today without any thought as to who made it, how and when it was made, how pure it is ? etc.

Numerous companies are working in this field today. We don't even bother to check their credibility. We consume water and throw the empty bottles away anywhere. Many of such thrown away bottles of reputed companies are collected back again and refilled with unprocessed ordinary water for reuse and are sold in the market. Unknowing the facts, we are happy from within that the water we are drinking is pure bottled water.

As the water in the bottle remains in the contact with its plastic for a long time, the toxins in it are released into it. and further when you drink such water, it enters into your body. From there it gets entry into your bloodstream, thereby affecting your liver and kidneys. This happens so slowly that we don't sense the bad effects immediately. However, after a certain period, they pose a serious health issues while it is already too late. This toxin accumulates slowly in the body and as it reaches a certain limit, it starts showing its true colours and invites a variety of cancers. This list of possible disorders is too long to be listed here.

Moreover, the plastic material of the bottles does not decompose in the nature. 90% of bottles don't get recycled. They are thrown away in the garbage trash, thereby raising environmental issues. Recently, data of number of bottles that are used per hour has been released. This figure is unbelievably large. 10 million bottles are used every hour. In the United States, each person consumes 50 bottles on an average, each year. Where do these bottles go? So they are thrown away anywhere in the city. Eventually,

contd : page no 9

A Spring in a City: Struggle to save a tiny spring is a touchstone of our priorities

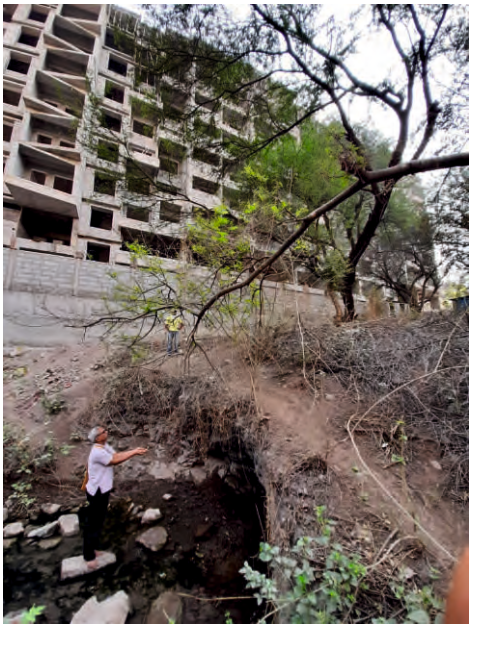
Parineeta Dandekar

Shailendra Patel, diminutive and fast-paced, was leading me through a maze of barbed wires, construction debris and iron fences. Pigs and dogs looked up at us with surprise. This was a treasure hunt. With us was Tushar Sarode from Jeevit Nadi. After sliding down a precarious mound of construction debris, the treasure shimmered before us. In the middle of a chaotic Pune suburb, surrounded by a garbage dump, an urban drain and mountains of concrete emerged a sparkling, babbling little spring. It was this spring that Shailendra Patel has been protecting for the past 5 years. If it were not for him, this pool with darting fish and water sliders would be buried under a luxury apartment or a road.

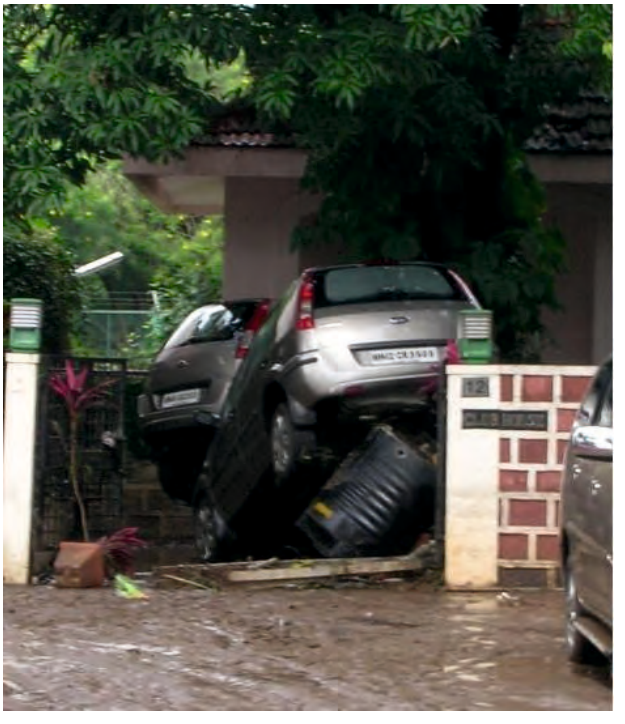
Pool formed by Bavdhan Spring Photo: Parineeta Dandekar

Once we reached the spring and its sandy pool, Shailendra Bhai took off his shoes. He didn't ask me to, which made me do so right away. He stood facing the small cave from where water bubbled and offered a silent prayer. It was dystopian to see this man clutching at his khadi bag, surrounded by towering apartments on one side and garbage dump on the other, worshipping a spring. This dystopia is typical to urban Indian waterbodies.

Shailendra Bhai calls this place Jal Devta Mandir. In the past five years, he corresponded, cajoled, requested, and made sure that several authorities, officials, ecologists, geologists, historians visited this place and put together a knowledge base which could help protect it from destruction. Shailendra Bhai's perseverance has yielded results. Several agencies have given clear recommendations to protect the Bavdhan Spring.



Bavdhan is one more bustling unplanned suburb of Pune, a metro in Maharashtra with a population of 3.1 million. It is said that Bavdhan was, as the name suggests, "Rich with Wells" at one time. Even now, a scraggly line of ancient Ficus trees and lianas stands testimony to streams, springs and wells which once populated the suburb. Pune is a city of hills and Bavdhan is a dense watershed mostly flowing into Ram Nadi, which joins Mula River, a tributary of Bhima and further away, the mighty Krishna. Ram Nadi is heavily polluted and encroached, with most of its feeder streams and springs built over. But water has a long memory, and the region floods unerringly each monsoon: water which once flowed through streams lined with ferns and ficus trees now floods homes and roads. It washes away cars and claims lives.



Amid this chaos, lies the perennial Bavdhan Spring in a mere acre of land. 20 years back, residents of Bavdhan village collected drinking water from this spring. Even now, when electricity fails as it often does, women trudge down to the spring and collect water for household use. If conserved and set up with a small treatment plant, the spring can provide a minimum of 30,000 litres water a day to the community. Pune is not new to dismal water scarcity and such a spring offering up its gift is to be nurtured and celebrated.

A distinct community resource, the latest Development Plan of Pune Municipal Corporation shows this as "Yellow Zone" or residential zone. The land belongs to a developer who randomly cordons off the region when agitation to protect it gets louder. Pune Municipal Corporation, which should have played lead role in protecting this resource, is busy protecting builders, building roads inside rivers, concertizing river channels in the name of river-front development and putting in a metro-lines inside the river beds. When a Municipal Corporation deals in thousands of crores, perhaps it does not see value in a life giving resource.

Toposheet overlaid with location of Bavdhan Spring

According to the esteemed Deccan College Post graduate and Research Institute, "This is a contact spring formed between two hard rock flows of upper vesicular (porous) and lower compact Basalt (non-porous). Occurrence of water-yielding contact spring in deccan traps is a rare phenomenon. This is an endangered natural feature in Pune city. The spring currently yields water enough to run a 5 hp motor continuously. This can be an important drinking water source for the community and reduce burden on the Pune municipal Corporation. Bavdhan spring must be protected and conserved. Water can be stored in a storage tank and supplied for drinking."[i]

A report from Central Groundwater Board CGWB official Dr. Upendra Dhonde states: "The yield of Bavdhan Spring monitored during May

2017 was 90 lpm i.e. more than 1 lakh liters per day but shows declining trend due to land use change and excessive pumping. The region needs urgent protection." The conclusion of the study is to make community members groundwater literate and share knowledge with other local institutions who can take up monitoring and management of spring.

Ecological Society, a Pune based ecological restoration NGO created a detailed inventory of the flora and fauna of the spring region as well as a restoration plan, "Small patches of wild areas like this become important in supporting urban wilderness. These areas can act as stepping-stones for connecting fragmented urban wilderness. Bavdhan Spring needs to be conserved and restored urgently."

Maharashtra Groundwater (Development and Management) Act (2009) and making institutions work

What is significant with Shailendra Bhai's struggle is that he has made several agencies engage with Bavdhan Spring and take action. He has made governance sit up and work on what is important. Without aiming to do so, Shailendra Bhai made the Maharashtra Water Resources Regulatory Authority (MWRRA) act. Under the Groundwater Act (2009), MWRRA is the Groundwater Authority of Maharashtra, but has hardly worked on the issue on ground. Operationalizing the Act is a novel exercise for all concerned including district officials who are supposed to act at District Groundwater Authorities under the Act, but never had to function in that role earlier.

In December 2018, Secretary of MWRRA visited Bavdhan Spring at the request of Shailendra Bhai. He was deeply affected by what he saw and immediately directed the Subdivisional Officer (Revenue) as the District Authority under the Groundwater Act 2009, to notify spring as a Public Drinking Water Source. Section 20 of Groundwater Act (2009) states: Power to notify public drinking water source: "The District Authority Shall, by order notify a public drinking water source."

Once a source is notified as Public Drinking Water Source, the District Authority is bound to protect its quality and integrity under Section 21 of the Act.

Pune Municipal Corporation loves developers, not waterbodies

The letter also directed the District Authority to give necessary orders to Commissioner, Pune Municipal Corporation (PMC) as the local self-governing body to protect Bavdhan Spring. In July 2019, the Subdivisional Officer of Maval-Mulshi Tehsil simply pushed the letter on to Commissioner Pune Municipal Corporation, requesting it to notify and protect the source as it falls under the Municipal Corporation Limits.

Since 2017, Shailendra Bhai has sent more than 150 letters to Pune Municipal Corporation to protect Bavdhan Spring. He has received no answer. He has filed several RTIs, sent multiple copies of MWRRA order to the PMC to no avail. Once, as he returned from the PMC after serving them one more copy of the SDO's letter about protecting the spring he found that the private developer had put up a tin fence in record time to keep away anyone wanting to visit or study the spring. It appears that PMC is efficient towards protecting the interests of only some real estate developers.

Confluence of Bavdhan Spring with Poluted NDA Stream. See the difference! Photo: Parineeta Dandekar

In Dec 2020, again after dogged follow up from Shailendra Bahi, MWRRA convened a special video conferencing meeting with all members, SDO, GSDA Officials and Commissioner, PMC. In the

meeting, PMC was asked repeatedly why it has not taken any steps to protect the spring and was directed not to allow any construction in the vicinity of the spring. Even after this meeting, absolutely no action has been taken by the PMC.

In informal conversations, PMC officials tell Shailendra Bhai that acquiring one acre of land will cost tens of crores, to which he says if the Corporation can spend thousands of crores on roads and flyovers, is it a prohibitive price for protecting a living spring?

Shailendra Patel and volunteers who actively helped save the spring Photo: Tushar Sarode, JeevitNadi

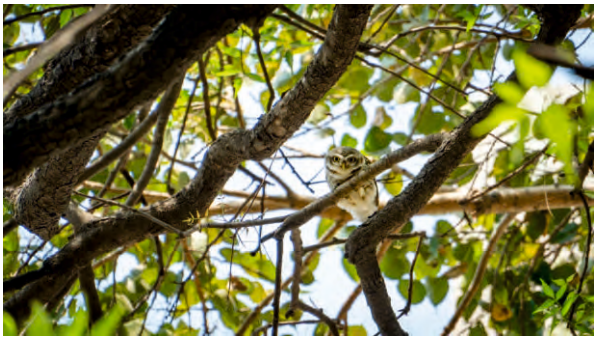
Living springs make living rivers, not concrete channels

Struggle goes on. Students, experts, curious residents keep visiting the debri-surrounded place of respite. As we walked along the spring bank, Shailendra bhai and Tushar Sarode from Jeevit Nadi casually took away debris and garbage. Under each mound glistened a small trickle and as we cleared this trickle, it became a steady flow. We unearthed more than 10 such living springs along the bank of Bavdhan Spring and NDA stream. In a place where tankers ferry for six months a year, this resource is nothing less than a treasure: a treasure buried under garbage.

What will happen to these living springs if NDA stream and Bavdhan Spring are channelized? The answer is simple. The life giving springs will be smothered. Riparian ecosystems around the spring will be destroyed. And yet all around Pune, Maharashtra and also India, channelizing streams and rivers is the first step in the name of river rejuvenation, river front development, beautification. As a matter of fact, channelization only opens up new land for real estate development. It is rejuvenation of land developers, not streams.

As we walked around the riparian area of Bavdhan Spring, we came across older men sitting leisurely under a Peepal-Neem-Banyan grove. This was once called the Odhyacha Paar, or Spring Grove. Curious spotted owlets peered at us as we talked. They told us of how they drank water from the spring, how they would love it if there is a water storage tank made here preserving the sanctity of the place. They are bewildered as to how a community resource can just be walled and made off limits for us and them, one fine day.

Discussion with the community which once used the Bavdhan Spring Photo: Tushar Sarode



Riprian Patches of Bavdhan Spring Photo: Tushar Sarode, Jeevit Nadi

Bavdhan Spring now flows over just an acre of land. We have buried and reclaimed most of the streams and springs of this region. Saving Bavdhan

Spring is not a small act. If a city cannot save one acre of land which gives crystal clear water thourghout the year, then it is matter of shame for all concerned.

Shailndra Bhai's struggle is not small, it is not symbolic. Saving a living water source is one of the most significant achievement in these times. He needs your support and encouragement. And more importantly, engagement.

On the occasion of World Water Day 2021, we urge the Pune Municipal Corporation, District Groundwater Authority, CGWB and the MWRRA, Maharashtra government, including Chief Minister and Environment Minister to:

Immediately protect Bavdhan Spring from any developmental pressures. Declare the small plot admeasuring roughly an acre as Biodiversity Park.
Remove all illegal construction debris dumped by developers into the spring and its banks.
Restore the spring using ecological techniques in its natural form.
Restore the NDA drain flowing adjacent to Bavdhan Spring.
Install a simple water purification plant and small storage tank to provide clean and affordable drinking water to the residents of the area.
Let the spring feed Ram Nadi.
Video on Bavdhan Spring visit made by Tushar Sarode, Jeevit Nadi. Thanks a lot Tushar!

Parineeta Dandekar, SANDRP
(parineeta.dandekar@gmail.com)

[I] Environmental and Archeological investigations of a natural spring in vicinity of Bavdhan Area, Dr. P. D. Sabale, Professor in Environmental Archeology Related

From Page N0 : 4.....

everything reaches the sea through the streams and rivers. As an effect of this, many islands of this plastic material are formed in the Atlantic Ocean. As for the city of Mumbai, when it rains heavily, water cannot be drained out because of the hurdle of empty water bottles those get stuck in the stream and cause stagnation of water, thereby affecting the city life badly.

Many of us might not know that it takes about 10 litters of water to make a plastic bottle. After having read this, the mind becomes dumb. The raw material used to make these bottles is the mineral oil. Today, the demand for mineral oil has tremendously increased for various purposes. So, it is unfortunate that the mineral oil has to be spent for such a work of producing plastic water bottles. This may preferably be used for other productive work.

The size and shape of these bottles is such that they cannot be easily cleaned. So, there are big chances of bacteria getting accumulated in it and if used without cleaning, it easily enters into stomach.

What is the solution for this issue? This question should be asked often now. The simplest solution is to avoid or reduce their use whenever is possible. The day when we realize this, will be a good day for all of us.

Dr.Datta Deshkar
Editor

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World Water Day-1995

Women and Water

Gajanan Deshpande, Pune - (M) : 9822754768

(A new series of articles has been launched from August 2021 to learn more about the importance of World Water Day and the various water awareness programs implemented every year.)

The main theme for World Water Day-1995 was "Women and Water". Various events and related activities were organized in that year for public awareness.

We all know that in Indian culture, women have an inseparable relationship with water. Even the main source of water like rivers and wells are known as feminine sense, as rivers are life-giving like a mother.

Our society, based on, water is facing a different problem today. Due to various reasons, especially due to population growth and increasing industrialization, water availability is becoming more and more difficult. Water resources are becoming increasingly polluted. There is a fear that the encroachment on resources will degrade our water culture and traditions. In such a situation, it is important to make sure that our water resources remain clean and drinkable. It is sure that the happy future of the country will depend on the proper use of water.

The status of women in water development:

It has been noticed that women can resolve water related problems more efficiently. At the International Water Council meeting held in Dublin in 1992, some basic principles regarding water were presented. It emphasized the role of women in water availability, water management and water conservation.

But, the true picture today is unfortunately very unfavorable. There is a complete difference between the principles and the actual practice. In our male-dominated culture, women have a very secondary place. If this situation is to improve, increasing women's participation in water use is a matter of time.

Women are considered to be the main custodians of water for the family. The housewife is very conscious about getting water for her family from the water available in her area, storing it properly, managing the water required for cooking, drinking, cleaning, washing utensils, washing clothes, gardening in the house. She plays a key role in this. The responsibility of irrigating the crops has traditionally fallen on the woman from the farming family. Women seem to be at the forefront of such agricultural work. As a result, water management skills are traditionally acquired by women.

We see that women are heavily involved in water use in both domestic and manufacturing

areas. Women's participation in household use is considered to be their primary duty; however, their participation in water use for production is considered secondary and ignored as well. This is a tragedy.

Despite such a dual form of active participation, they have no place in the decision-making process. They are not taken into account in any decision making in water management. Therefore, discrimination against women in equitable water sharing, social justice and necessary technical skills in water management must now be eliminated. Accordingly, their involvement in water management needs to be more proactive; so be it agriculture or domestic water use. There is an urgent need to include them in the decision-making process and give them special powers in it. Not only this, it will be in the interest of the society to build her reputation as the next chief manager in this field.

Women And Discretionary use of water :

▪ If women control the following things and control the wrong habits, they will be able to solve the water issues in the near future.

▪ Do not throw away previous day leftover water. The concept of leftover water, fresh water should be abandoned.

▪ Do not use treated water in the toilet or bathroom.

▪ When washing utensils, use water in the bucket; do not keep the tap running.

▪ Water the garden only as much as they need. Giving more water does not mean that the plants grow faster.

▪ In the kitchen, use washed water of dal-rice, vegetables for the plants. In this way water is reused and also saved.

▪ Use laundry water to clean bathroom-toilet-basin.

▪ Using unclean water for drinking causes many disorders. Diseases caused by contaminated water kill countless children every year. Hygiene should be inculcated in children to prevent these diseases. Women are better suited to do that. Women should take care that the water will be used only after purification. For this, use filtered water, boil it, stir alum and add medicines in it. Use a water purifier if possible.

Providing clean water to women near their homes can lighten the burden of their work and save time by contributing to the family's financial well-being. Also their daughters can be free to go to school.

Ultimately, since women's responsibility is paramount in family as well as for other water use, it is certain that skillful management and upliftment of human society's relationship with water can be done through women. This was the objective for 1995 world water day.

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Story of Water. Part 4 - India's Water Budget

Chetan Pandit

(M) : 9423174594

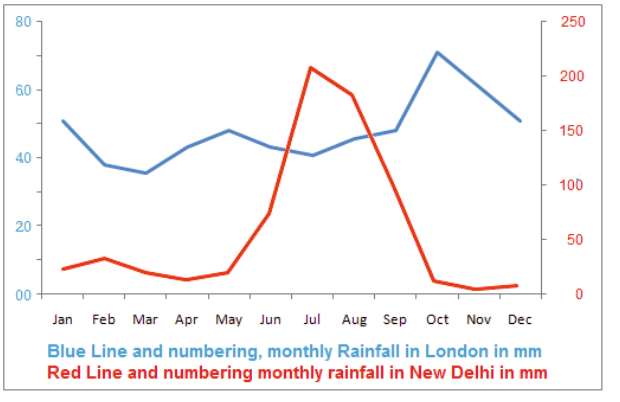
In part 2 I explained the hydrologic cycle which provides us a certain quantity of fresh water every year; and I also explained how the water moves in nature. In part 3 I explained how large quantities of water are measured. Now we are ready to examine India's water budget.

Catchment is the area from which all rainfall and snowmelt gathers in a river at a given location. viz. catchment of Ganga up to Rishikesh, up to Kanpur, up to Varanasi, and so on. The entire catchment of a river, up to either its outfall in to the sea, or its confluence with a larger river, is called a river basin. The Ganga basin means the entire catchment of Ganga up to the point where Ganga outfalls in to Bay-of-Bengal. However, sometimes these two terms are used synonymously.

You will recall that in the previous article I explained that the once a day measurement of flow rate in a river in cumec (cubic meters per second) multiplied by 3600 X 24 is the volume of water that flowed in the river in that day. And the sum of the volume for each day of the year, is the annual flow volume. This is also called the "yield" of a basin, or a part basin.

A year is 365 days, but the 365 days count can start from different dates. The calendar year is from 1st January to 31st December; the financial year in India is from 1st April to next 31st March; the schools and colleges have their own academic years. How about water ? Monsoon is reckoned to cover four months, June, July, August and September. In these 4 months, most of the rain occurs, rain water flows in rivers, is stored in dams, ponds, lakes, and aquifers are recharged. Towards the end of September the surface and ground water storages are at their maximum. Over the remaining 8 months of October to next May the stored water is used. As we approach May end the storages and also the ground water levels are at their lowest, waiting for the next monsoon to fill them again. Therefore we recon the hydrologic year from 1st June to next 31st May. All water budgeting is done for the hydrologic year.

Certain places in the world have rainfall well distributed throughout the year. Such climates are called temperate climates. Europe is an area of temperate climate. The graph shows the average



monthly rainfall in London and in New Delhi in the same frame. The blue line is the rainfall in London and the red line is the rainfall in Delhi. You will notice Delhi has much more rainfall than London has. But there is another important difference. The rainfall in London is distributed throughout the year. There is no "dry" season, and no "wet" season. In contrast to this, in Delhi most of the rainfall occurs in just four months of June, July, August, and September. Such climate is called tropical climate. India's climate is tropical and this has a profound impact on our water management

paradigm, which we will examine in detail.

The rainfall differs from year to year. When something varies with time, we use the average over a number of years to get an idea of the typical magnitude. But rainfall not only varies from year to year, but the average of the rainfall is also not constant and can change over a number of years. Therefore meteorologists take average of last 30 years, and this is called "normal" rainfall. In 1970, the normal will be the average of 30 years 1940 to 1969; in 1971, it will be average of 30 years 1941 to 1970; and so on.

Hydrologists also use the average, but more often they use another measure called "dependable flows". A project is designed to use a certain quantity of water. The years when the project receives the planned quantity of water, and serves its intended purpose, are called success years. River valley projects cost a lot of money. And the expenditure is justified only if the project has some minimum success rate. Different types of projects need different success rates. Supply of water for domestic use must have a 100% success rate. People must get water every year. However, to design a project for 100% success means reducing the number of beneficiaries. Do you see how ?

Flow in a river at a certain location ranges from a minimum, to a maximum. If we plan the irrigation project to irrigate only as much area as can be irrigated using the minimum flows, then the success rate will be 100% but only a small area will get irrigated. Conversely, if we plan to irrigate as much area as can be irrigated using the maximum flows, then a very large area can be irrigated, but in most years the flow will be less than maximum and the success rate will be very low. So we have to strike a balance between extending the benefits to more farmers, versus increasing the success rate. Irrigation projects are typically planned to use the flow that will be available in 75% of the years, i.e. in 3 years out of 4. This is called "75% dependable flow". Hydro-power projects are planned to use 90% dependable flow, i.e. the flow that will be available in 9 years out of 10.

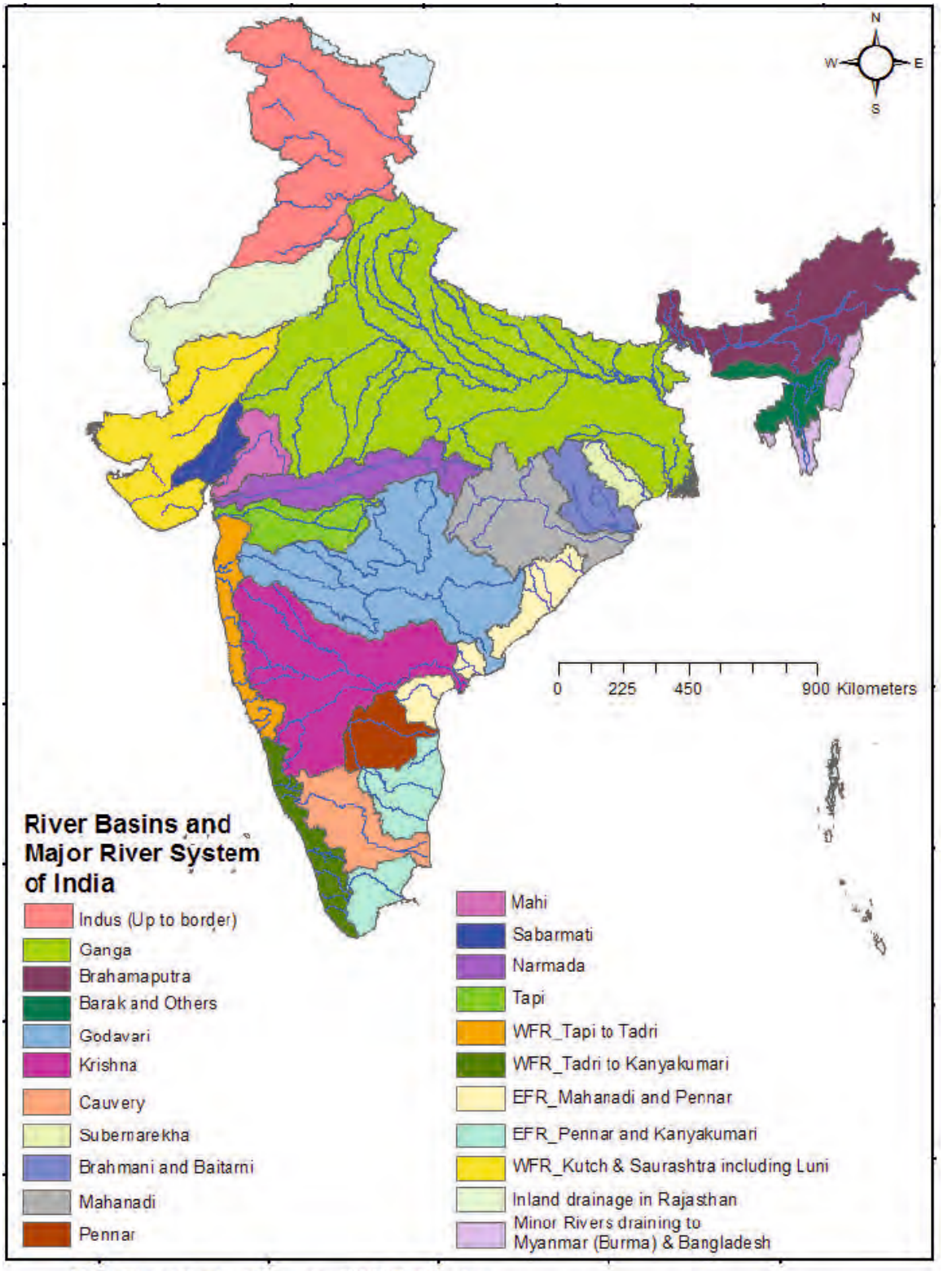
How do we estimate the 75% dependable flow? There are two reasons why I will not go in to explaining that. First, understanding the explanation requires a background in statistics and probability theory, and is beyond the scope of this article. Second, I earn my living from doing such computations and if I explain it and you all learn it then I will have competition. Briefly, this is in the domain of hydrology, which is a specialized branch of civil engineering and deals with computations pertaining to journey of rainwater back to the ocean. Typically, a hydrologist answers question such as :

• What is the annual yield of a basin at 75%, or some other dependability;

• What is the magnitude of the flood of a specified probability, at a given location of a river;

• Given the rainfall that has taken place in the past day or two in the catchment of a river, what will be the flow in the next day or two;

Hydrologic observations and yield assessment all over India are done by a technical department called Central Water Commission, (CWC). For the purpose of estimating surface water availability, CWC has identified 15 main river basins and some smaller catchments between two major basins. The main basins are Indus, Ganga, Brahmaputra, Barak and others, Godavari, Krishna, Cauveri, Suwarnarekha, Brahmani and Baitarani, Mahanadi, Pennar, Mahi, Sabarmati, Narmada, and Tapi. And there are many smaller catchments like several West flowing rivers of the Western Ghats, some east flowing rivers between two main rivers such as rivers between Mahanadi and Pennar; rivers between Pennar and Kanyakumari; and rivers of Kutch and Saurashtra, etc. These are shown in the basin map of India. The table shows the catchment area, average rainfall, and average water availability, in each basin.



Main River Basins. Source : CWC Publication
"Reassessment of Water Availability in India using Space Inputs, November 2018"

Water Resources of India					
Basin	Catchment Area SqKm	Av. Water Availability BCM	Availability MCM / SqKm	Are as % of Total	Av. Water Availability as % of Total
Indus (within India)	3,17,708	45.53	0.143	9.7	2.3
Ganga	8,38,803	509.52	0.607	25.6	25.5
Brahmaputra	1,93,252	527.28	2.728	5.9	26.4
Barak & others	86,335	86.67	1.004	2.6	4.3
Godavari	3,12,150	117.74	0.377	9.5	5.9
Krishna	2,59,439	89.04	0.343	7.9	4.5
Cauvery	85,167	27.67	0.325	2.6	1.4
Subarnarekha	26,804	15.05	0.561	0.8	0.8
Brahmani-Baitarani	53,902	35.65	0.661	1.6	1.8
Mahanadi	1,44,905	73	0.504	4.4	3.7
Pennar	54,905	11.02	0.201	1.7	0.6
Mahi	39,566	14.96	0.378	1.2	0.7
Sabarmati	31,901	12.96	0.406	1	0.6
Narmada	96,660	58.21	0.602	3	2.9
Tapi	65,806	26.24	0.399	2	1.3
WFR Tapi to Tadri	58,360	118.35	2.028	1.8	5.9
WFR Tadri to Kanyakumari	54,231	119.06	2.195	1.7	6
EFR Mahanadi to Pennar	82,073	26.41	0.322	2.5	1.3
EFR Pennar to Kanyakumari	1,01,657	26.74	0.263	3.1	1.3
WFR of Kutch & Saurashtra including Luni	1,92,112	26.93	0.140	5.9	1.3
Area of inland drainage in Rajasthan Desert	1,44,836	0	0.000	4.4	0
Minor rivers draining into Myanmar and Bangladesh	31,382	31.17	0.993	1	1.6
Total	32,71,953	1999.2			

Notes : Catchment Area, and Average Water Availability data from CWC Publication "Reassessment of Water Availability in India Using Space Inputs, November 2018".
Av. = Average; WFR=West Flowing Rivers; EFR = East Flowing Rivers;

There are several interesting things in this table.
The average annual water availability is 1999.2 BCM. You may have read about a water stress index called

"Falken Mark" that says if the annual water availability is less than 1700 m^3 per person then the country is said to be water stressed; and if it is less than 1000 m^3 per person then the country is said to be suffering from water scarcity. If you divide 1999.2 BCM by our current population taken as 138 crores, the annual water per person comes to 1449 m^3. That puts us in water stressed category, but it is only a little less than 1700 m^3/person and we seem to be not too bad off.

However, that is a misleading picture. The distribution of rainfall and therefore water availability is not uniform all over India. Our census is carried out state wise, and we do not have basin wise population figures. But we can make an assessment of the uneven distribution, called skew, from the availability per unit area. In the three basins, Brahmaputra, WFR Tapi to Tadri, and WFR Tadri to Kanyakumari, the availability is more than 2 MCM/SqKm, while in all other basins except the Barak, it is 0.66 MCM/SqKm or less, i.e. less than one-third. But these three basins are also the ones that are sparsely populated. Which means fewer people have lot of water and lot of people have less water.

The % share of the area of four basins of Ganga, Bramhaputra, and West Flowing River from Tapi to Tadri and Tadri to Kanyakumri is 25.6 + 5.9 + 1.8 + 1.7 = 35% of total, but their % share in water resources is 25.5 + 26.4 + 5.9 + 6.0 = 63.8% of total. Meaning, 35% of area has 63.8% of all water, and remaining 65% of area has only remaining 36.2% of water. The 65% of the area, comprising peninsular basins of Narmada, Krishna, Godavari, Cauvery, Mahanadi etc. is already "water scarcity" category.
You may ask "can't we bring some water from the water rich areas to the water stressed areas? Yes, and No. Technically it is certainly feasible, and the Govt. of India has already formulated a scheme called "Inter Basin Water Transfer", popularly known by an incorrect name "River Linking". The Hon'ble Supreme Court has given instructions that this scheme be implemented expeditiously. However, there is a lobby of activists working against it 24X7. And unfortunately they seem to be succeeding in preventing this scheme from implementation, just as they also seem to be succeeding in preventing many other development projects. All this is done in the name of environment and rights and unfortunately our laws and the legal system enables them to stop infrastructure development. This is a very important issue and I will devote an entire article, probably No. 10, to analyzing this.

Further, the basin wise availability you see is the average flow in the rivers. But all of it can not be put to use. I have already explained that almost 90% of the flow occurs in 4 months of monsoon. And if not stored, it will flow away to oceans. How much of it can be stored is constrained by the topography for construction of large dams, and now it is also constrained by environmental considerations. It is estimated that the total water available for use is approximately 1123 BCM, 690 BCM from rivers, which we call surface water, and 433 BCM from ground water.

Artificial recharge of ground water can increase the annual usable ground water by about

36 BCM, i.e. take the total to 690 + 433 + 36 = 1159 BCM. The estimate of these figures keeps changing and also different people make slightly estimates. So don't be surprised if you come across a different estimate in some other paper. But generally, the availability is around 1159 BCM.

And how much water do we need? The water requirement has been estimated by different scholars between 1000 BCM to 1400 BCM. Which means we either have just enough water, or are a little short, depending on which estimate you accept. However, do remember what I said a little earlier. The availability is not uniform all over India. About 35% area has 63.8% of water, and remaining 65% of area has only remaining 36.2% of water. As if these problems were not enough, the rainfall pattern is expected to change due to global warming and climate change but we are not yet in a position to predict exactly how it will change.

Global warming and climate change will not only change the rainfall pattern, but it will also have two other profound impacts.

1: As the climate gets hotter, the quantity of water required to grow a crop will increase.

2: The rainfall may shift toward winter. i.e. the onset of monsoons may be delayed. Which means there will be a time-mismatch between water requirement and water availability.

And the population and with it the demand continues to increase. What all this means is, water scarcity is not something that may happen in future. It is already there. And unless we take some hard decisions, India may revert back to the era of food shortages and famines.

That completes the story of India's water budget. In the next, that is 5th article, we will learn about different hydraulics structures – dams, barrages, regulators, aqueducts, canals, etc. Till then take care, follow Covid appropriate behaviour, and stay safe.

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Organization - Central Water Commission (CWC)

Shri Vinod Hande - (M) : 9423677795

' Central water Commission' is a technical organization in the field of Water Resource. It is working under Government of India the Ministry of Water Resources, River Development & Ganga Rejuvenation. The Organization is serving the nation since 1945. Responsibility of organization is research, river management, water project planning. The Commission is assigned with responsibility of initiating, coordinating with the State Government concerned for control, conservation and utilization of water resources throughout the country for purpose of flood control, irrigation, navigation, drinking water supply and water for development. The commission also undertakes the investigations, construction and execution of any schemes as per requirement. CWC is headed by a Chairman, with the status of Secretary to the Govt. of India. The work of commission is divided among three wings namely, Designs and Research wing (D&R), River Management Wing (RM), Water Planning and projects Wing(WP&P). Each wing is placed under the charge of Full time Member with the status of Additional Secretary. Chief Engineer, Director, Deputy Director, Asstt. Director, Engineers and other supporting staff assist the Members. There is separate Human Resource Management unit which deals with HR management, Financial management, training and administration of the CWC. National Water Academy in Pune is responsible for training of the Central and state engineer's in-service training.

Chairman being the head of the organization responsible for various activities related to overall planning and development of water resources of the country and management of Commission. Sh. S.Masood Husain is holding the charge of Chairman.

CWC is a technical organization on India in the field of water conservation and carrying out following activities as listed below,

- To carry out Techno-economic appraisal of irrigation, flood control and multipurpose projects proposed by State Governments.
- Survey, investigation, design schemes and construction of work for the development of river valleys.
- To advice the Govt. of India and the concerned State Governments basin wise development of water resources.
- Collect, maintain and publish statistical data relating to water resources.
- Training of Indian Engineers in India and abroad in all aspects of river valley development.
- Standardization of instruments, methods of observation and record, materials for construction, design and operation of irrigation projects.
- Monitoring of selected major and medium irrigation projects to ensure the achievement of physical and financial targets.
- To provide flood forecasting services to all major flood prone inter- state river basins of India through a network of 175 flood forecasting stations.
- To conduct studies on dam safety aspects for the existing dams.

• To promote and create mass awareness regarding the progress and achievements made by the country in the water resources development, use and conservation. etc.

Since its formation in 1945, CWC has been playing vital role in the development of the water resource sector of the country. It is also providing necessary support to the department of Water resources, river development and Ganga Rejuvenation on all technical and policy matters such as inter- state matters , sharing of water with neighbouring countries and MoUs ect. . CWC also conducted hydrological studies of water resource projects. CWC implemented World Bank aided National Hydrological Projects and Dam Rehabilitation and Improvement project (DRIP).

CWC's head quarter is at New-Delhi. There are eighteen organization headed by Chief Engineer with headquarter at New-Delhi. Out of which nine are under Planning and projects Wing(WP&P), six are under Designs and Research wing (D&R), two are under River Management Wing (RM) and one Human Resource Management (HRM).

In order to have better coordination with State Government and to achieve better results in water resources sector CWC has established regional offices in the major river basins at thirteen locations in India, namely at Bangalore, Bhopal, Bhubaneshwar, Chandigarh, Coimbatore, Delhi, Gandhi Nagar, Hyderabad, Lucknow, Nagpur, Patna, Shilong and Siliguri.

Water Resource Development :

CWC has been making periodic assessment of country's water resources. The water resources potential of the country is about 1869 Billion Cubic Meters(BMC). Due to topography and uneven distribution, only 1123 BMC of water annually can be used. This is achieved through 690 BMC of surface water and 433 BMC through ground water.

Water for drinking has been given top priority in water use. Irrigation is the main consumer of water. Maximum irrigation potential that can be created in the county is 139.89 Mha. Irrigation which was 12.9 Mha in 1951 risen to 126.73 Mha in 2018. Seeing the future requirement of water and food grain of the country priority areas for water resources have been indentified,

• Improving water utilization efficiency.
• Command area development and participatory irrigation management.
• Flood management and erosion control.
• Dam safety and rehabilitation.
• Revival and restoration of existing water bodies.
• Appropriate regulation and management of ground water.
• Ground water recharge.

CWC is running three main projects for irrigation they are major, medium and minor. In 1951 during first five year plan there were 74 major and 143 medium irrigation projects in the country. But by 2012, there were 339 major, 1136 medium and 226 minor irrigation projects were taken up and out of which completed projects were 221 major, 878 medium and 139 minor. CWC has classified irrigation water as per electrical conductivity of water and sodium absorption ratio of water.

Water quality of main rivers of India monitored by CWC at 371 key locations. For analysis of water parameters CWC is maintaining a thee tier laboratory system. Level-I laboratories are

located at 258 field water quality monitoring stations on various rivers where temperature, color, odour, specific conductivity, total dissolved solids, pH and dissolved Oxygen. There are 24 Level-II laboratories at selected Division Offices to analysis 25 numbers of physico-chemical characteristics and bacterial parameters of river water. Four Level-III/II + laboratories are functioning at Varanasi, Delhi, Hyderabad and Coimbatore where 41 parameters including heavy metals, toxic parameters and pesticides are analyzed.

River Management :

India has total geographical area of 329 Mha and annual precipitation of 4000 BCM . From river point of view India has been divided into 20 river basins. For achieving various objectives, collection of hydro-meteorological data from river basin is important. Objectives are planning and development of water resources projects, studies related to assessment of impacts due to climate change, water availability studies, design flood and sedimentation studies, flood level, solving of International and inter state issues, river morphology studies, reservoir siltation studies, development of inland waterways etc.

CWC is operating a network of 878 Hydrological Observation stations in different river basins of the country to collect 1) water level, 2) discharge, 3) water quality, 4) silt and selected metrological parameters. CWC operates 76 metrological observation stations in various basins in the country.

National Hydrology Project :

Hydrological Project was implemented by Govt. of India with an object to establish a functional Hydrologic Information System and to improve institutional capacity of nine states in Phase-I. And the states were Andhra Pradesh, Chhattisgarh, Gujarat, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Orissa and Tamil Nadu. The Phase-I project was implemented during 1995 to 2003. The project was for getting information on 56 parameters. Similarly phase-II was implemented in another four states viz. Himachal Pradesh, Punjab, Goa and Pondicherry and follow up of phase-I states. Project duration was 2006 to 2014. Following are the important achievements of CWC under National Hydrology Project during 2018-19,

- Extended Hydrological Prediction in Narmada, Yamuna and Cauvery.
- 'Aquatic Habitat Atlas' for major rivers of India.
- Estimation of sediment rate and sediment transport in seven river basin. Namely Ramganga basin, Barak basin, Narmada basin, Cauvery basin, Kuttiadipuzha basin, Peechi basin and Mangalam basin.

Flood Forecasting & Warning Services :

Flood forecasting and warning system is most important which gives advance knowledge of incoming floods thus plays important role in reducing flood damage by way of better planning. Flood forecast helps in regulations of reservoirs. Flood forecasting started in India since 1958 in scientific manner. At present there are 226 flood forecasting stations spread over 20 states. On an average over 6000 forecasts are issued by CWC during flood season. Normally they are issued 6 to 48 hrs. in advance covering pre- monsoon and post-monsoon period. During 2018 CWC issued 6495 flood warnings.

For management of floods Govt. of India initiated 'Flood Management Programme (FMP) in XI plan for providing Central assistance to the states for undertaking works related to river management, flood control, anti-erosion, drainage development, flood proofing etc.

Desalination :

Desalination refers to several processes that remove excess salt and other minerals from water to convert into freshwater for human consumption. This is focused in areas where availability of freshwater is limited. Large scale desalination require large amount of energy as well as specialized expensive infrastructure, makes it very costly compare to the use of freshwater from rivers or groundwater. Requirement of energy depends upon the salt content. More salt content requires more energy during desalination process. CWC is preparing detailed report on augmenting water availability by desalination of water.

CWC's Design and Research wing plays a important role in the field of design and consultancy for water resource resources projects. This wing is using and promoting State-of Art technology for planning and design of water resources projects at par with international standards. Contribution of this wing towards the development of water sector in the country are remarkable. Major activities of D&R wing are,

- Planning and design of water resources and hydropower projects.
- Hydrological studies.
- Review of safety aspects of existing dams and its monitoring.
- Preparation of detailed project reports of irrigation, hydropower and multipurpose river valley projects.

With the increasing population and consequently increase in demand of water for various uses, it has become necessary not only to construct new dams but also rehabilitate and maintain existing ones. The dam safety Organization of CWC has prepared and published data of all 3634 large dam of country in April 1990 that includes dams up to 1989. Status of large dams thereafter shown in following table, at the end of the article.

Maharashtra is having highest number of large dams in country followed by Madhya Pradesh and Gujarat. Apart from these large dams, India is having 'Dams of National Importance' which are

more than 100 mt. in height and having storage capacity of 1 billion cubic meters and above. As of now we

59 completed such dams and 10 are in construction stage. Out of 59, in Maharashtra we 7 dams of National Importance namely Vaitarna, Adivali, Ujjani, Jayakwadi, Koyana, Isapur and Totladoh.

For more information and details about CWC contact details are given below,

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	Year 2009			Year 2017			Year 2019		
	Completed	ongoing	Total	Completed	ongoing	Total	Completed	ongoing	Total
India	4762	382	5144	5254	447	5701	5334	411	5745
Maharashtra	1693	152	1845	2609	285	2354	2117	277	2395

Stockholm Water Prize 1993

Gajanan Deshpande, Pune

(M) : 9822754768

(An article series has been launched in August 2020 to learn more about the World Water Prize winners and their work.)

The prestigious Stockholm Water Prize for the year 1993 was awarded to Honourable Dr.Madhav Atmaram Chitale in a grand ceremony held at Stockholm at the hand of his highness King Karl Gustaf of Sweden.

Dr. Chitale played a big role in inculcating the thought in strategic planners of India that water is a resource and its quality and availability must be protected. He believes that, no matter how big the projects created for development, they should be used in an integrated manner for other development opportunities as well. It will symbolize the richness or high value of water and the commitment to manage it in the same way.

He also started celebrating Water Resources Day every year in India in the 1980s to raise awareness. Each year a different topic is chosen for this. This awareness movement has also had a great impact on the countries of South Asia.

Dr.Chitale had started this hard work in the 1960s. While carrying out the responsibility of building water resources projects, he worked in remote places living there with his family. In 1961, the dams at Panshet and Khadakwasla burst and the people of nearby city of Pune had to spend days without water. Dr. Chitale devoted himself to this task day and night in the efforts to restore the water supply in a short period of time. It was a great achievement and it brought him great fame.

In the mid-1960s, a project was launched with the help of the World Bank to supply drinking water to the huge city of Mumbai through a closed pipeline from a reservoir 60 km away. Dr.Chitale succeeded in changing the plan to include components of irrigation and hydropower generation in the project, which was planned for water supply only. After the completion of this scheme, Mumbai was supplied with two billion liters of water per day. In addition, drinking water was made available to villages in an area of 250 sq km between the reservoir and the city and also agriculture under the reservoir benefited from irrigation and cheap hydropower.

The Yamuna, the main tributary of the Ganges, has been diverted to the eastern part of the capital, Delhi, by human efforts thereby making it green by the irrigation facility. Dr. Chitale says, "I have always been of the view that such a large project should be irrigated as much as possible, along with other development objectives. These are symbols of water prosperity and water management.

Dr. Madhav Chitale has been honored in various ways for his efforts in integrated water development work. In 1998, he was appointed as the Secretary in the Ministry of Water Resources, Government of India, a highest-ranking position an engineer could held there. In 1990, a new government body, "the National Water Council", was formed. For the creation of this organization and the implementation of the National Water Policy, Dr. Chitale's efforts were mainly responsible.

Dr. Madhav Atmaram Chitale was one of the promoters of the giant project Ganga Action Plan (GAP). It is an ambitious nationwide development program involving several rivers. In 1993, he was appointed General Secretary of the International Commission on Irrigation and Drainage (ICID) to improve the effectiveness of

irrigation and drainage and reduce the severity of floods.

He was involved in the work of the World Water Council and the World Water Partnership. He promoted local as well as national level water participation in South Asian countries. The Maharashtra State Water and Irrigation Commission, appointed under his chairmanship, prepared and published a thirty-year development and planning vision for water development. He is currently working on developing a network of NGOs in water management.

Apart from Dr. Madhav Chitale's technical and administrative skills, he also explains the relationship between water and spirituality. The importance of water is in the whole Hindu religion. It also seems to be reflected in the paintings in Hindu temples. Hindus consider the river as a mother. Everyone knows that there is no life without water.

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Culture came into being due to water,

but do not forget, water can destroy it also

Dr. D. G. Deshkar (M) : 9325203109

It is a well established fact that in the process of evolution, human being settled on the bank of rivers or lakes. Water was easily available there. Human beings started using the same for agriculture, drinking and even for navigation. Families came into being so also the social groups. He was not required to wander here or there now for food and started reaping the benefits of settled life. These social groups formed villages, started rearing cattle and birds, started maintaining their identity, developed their own ways of life and customs. That is what we call culture.

Culture is defined as all the behaviour, way of life, arts, beliefs and institutions of a population that can be passed from generation to generation. It can be called way of life of the entire community. Culture is an umbrella term which encompasses the social behaviour and norms found in the human societies. It was that water which brought them together, developed human relations and ways of life. In all the rituals framed by the Society water plays a very important role right from the birth till death.

After we shifted to agriculture we started learning the importance of water. As more and more uses of water were found, we started using water for anything and everything. We irrigated crops, wheel started by using water either by its built in force or steam after heating it. With the movement of wheel we shifted to factory system where variety of good could be manufactured. That helped us in enriching our life. We started using water for generating electricity. That again gave momentum in all directions. We found that water is the cheapest mode of transportation. In international trading, shipping started playing a major role. We have started using water even for entertainment.

It is a human tendency to offer divinity to that thing which helps us in enriching our life. Water also is given that status. We treat water as God and call it Jala Devata. In Vedas innumerable verses are written to praise GOD WATER and we pray Jala Devata to give us peace, happiness, satisfaction and prosperity. Divinity is also offered to those things we are afraid of. Dog is Khandoba for us. For snakes we celebrate Nagapanchami. Cows are more than God for us because anything cow gives us (even cow dung and urine) is useful to human beings. To offer water to a thirsty person is treated as divine. When any person visits our house we welcome him with a glass of water. That makes him comfortable and homely.

We have also learnt that water is a double edged weapon. It can make or even mar us. If we do not get water to drink for a long time there is dehydration and if it continues for long we may even die. Water content of a human body is more than 75 percent and if this percentage drops we may even face death. That is why we call water as life. Similarly if there are heavy floods those destroy us. There is a huge loss to property and life due to floods. One edge of water makes us whereas another kills us.

All the economic development could take place mainly due to water. Look at agriculture. If irrigation facility is available, the production may multiply manifold. Efforts of every country are to collect as much water as possible by constructing dams on rivers, by creating new water reservoirs, by recharging water in the soil. Drip and sprinkler irrigation have done magic by increasing

production in minimum quantity of water. Israel and Singapore developed the techniques of reuse of water so also of desalination of sea water. Science has blessed us by drawing water from thin air. Through canals water can be taken from one corner to other and make more land cultivable. We have found out how Rajasthan Canal brought prosperity to the desert of Rajasthan.

Industrial development could take place due to water only. Wheels could move due to the water pressure so also by vapour created after heating water. Railway engines also could move from place to place with the help of water, helping the industries to cater their product all over the country. Now a days, we talk about virtual water where we find the foot prints of water in each product. In Singapore each product sold in the market bears a tag showing how much water is required for producing that goods. People save water by using those commodities which require less water.

International Trade has its roots in water. Before the use of ships goods were carried on the back of camels from one country to another but now thousands of containers can be carried easily from one country to another. Opening of Suez and Panama canals has given a huge fillip to international trade. Water ways are the cheapest way to transport material anywhere and everywhere.

And what about entertainment? Every housing society has its own swimming pool where children, women, senior citizens enjoy swimming to their heart's content. Boating, canoeing, yachting, swimming competitions are becoming very popular. In Olympics there are many events related to water. Water polo, scuba diving, snorkeling, deep sea diving are popular water games. All these are possible only because of water. Past generations have passed their knowledge and information to us through a well established water culture. But alas! What proved to be beneficial is proving to be hazardous now. Water pollution, water disputes, greed for water have spoiled the picture which we were observing all these days. That is why that water which brought this culture to us is itself taking it away from us.

Sometimes, it is Nature which destroys water culture. Take the example of Sindhu culture or Saraswati culture. Because of earthquakes, some sudden changes took place under the soil and the course of rivers got changed. Saraswati river which once upon a time was joining Ganga and Yamuna got shifted and later disappeared. The human habitation and the culture which was famous all over the world stands nowhere now. People who were enjoying this cultural life dispersed all over the northern part of the country and wherever they stabilized they called any river nearby by the name Saraswati. In northern India we may find many rivers known by that name.

But now, it is the man who has started destroying the water culture. There is not a single river in the county now which is not polluted. All the waste water from towns and cities is left in the rivers and ponds without treating and the quality of water therein is deteriorating very fast. At the origin of every river, water is very clean but as we go ahead, every town and city adds their waste water in the rivers. In some of the rivers, human corpses are merged in the river water with a belief that the person would get MOKSHA. For the MOKSHA of one person Innumerable human beings are required to sacrifice their life if they consume that polluted water. Polluted water is responsible for spreading the diseases very fast and that is how the dead bodies of thousands of fish are seen floating on the river water when they consume that polluted water.

River water always flows. Flowing water absorbs oxygen from the air and there is a possibility of some improvement in the quality but that is not the case with water in lakes and tanks where the water is more or less stagnant. Streams carrying polluted water from all sides of that water body bring the polluted water from all the localities in the vicinity and thereby the quality of such water bodies deteriorates very fast. Does the human being not know what he is doing? He finds the most convenient way to dispose of the waste water and

with growth of big towns and cities, the position is worsening day by day.

The waste water from localities is less harmful as compared to the waste water coming from industrial units. That water carries chemicals, oil waste and sometimes the metals which are hazardous to the human body. Same is the case with agricultural waste water. That water carries with it the residue of the fertilizers and chemicals.

The story does not end here. If surface water is polluted, that polluted water percolates in the soil and that spoils the ground water as well. Surface water can be treated very easily. But that is not the case with ground water. Leave this aside, even rain water gets polluted due to the chemical fumes which are emitted by the chemical and other factories. A time has come now that a man can survive only if he drinks bottled water manufactured by standard companies.

We talk too much on equitable distribution of water but in reality we are greedily using water even at the cost of others. The best example is that of Latur. Trains were used to supply water to Latur city and at the same time, three sugar factories in the nearby area were running in full swing. At present, where water is there, there are disputes. Some rivers pass from one state to another, one country to another and create innumerable problems of distribution of water. Karnataka and Tamilnadu problem, India- Pakistan problem are some of the examples. Nile river passes through 10 different countries. Till now, Egypt was the only country taking the benefit of Nile water but now other countries also are on the path of development. They have also started using Nile water. Egypt is bound to face a very serious problem in years to come. It was said that wars would be waged for water. But now, that time is not really very far off.

Climate change also is one of the problem created by man. We may not go deep into this issue but we can very well visualize the outcome of this issue. That is, rise in sea level. With great efforts we have developed big cities like Mumbai, Singapore, Chennai but what will happen to these cities if the sea level increases? The fate of Maldives is in the dark. People from Maldives have started purchasing lands in other countries to save their life. The entire country would be submerged in water and the people living there will have to leave their hard earned property at the mercy of Sea water.

We have now gone one step ahead. We have started using water as a weapon. China has constructed hundreds of dams which can control water flowing to different countries. India is one of the sufferers. Whether to supply river water to these countries or not is in the hands of China. Thailand was a major exported of rice to western counties but now the exports are getting reduced as China is not giving them adequate water. India has also given a threat to Pakistan that it would stop the flow of five rivers passing from India to Pakistan. The situation in the world can explode any time and water would be the root cause of the third world war.

How dreadful the situation would be if all these things take place? The water culture, we have developed with great efforts all these years, would be nowhere. One great philosopher has defined life in very apt words. He says, LIFE is nothing but the postponement of DEATH. We can live for one day more if we are successful in postponing our death by one day. That water which gave us life would kill us one day if proper precautions are not taken. Is it not in our hands to save ourselves?

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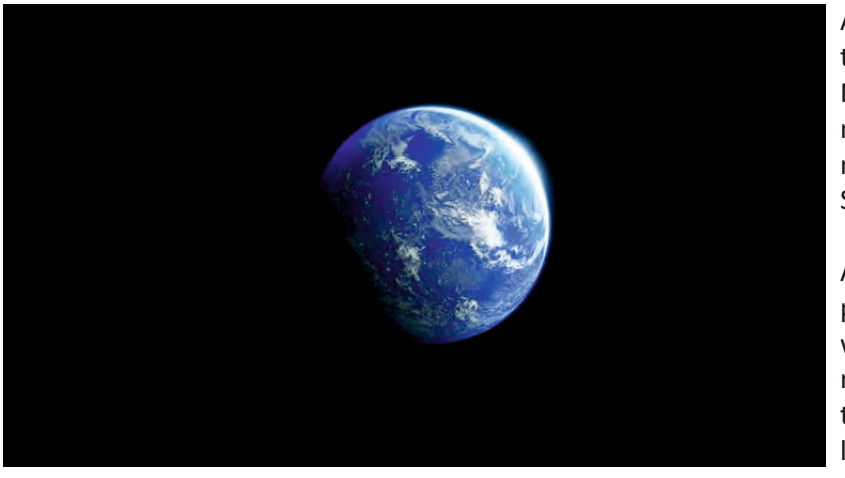
Melting of glaciers is triggering the movement of Earth's crust

Researchers gathered satellite data on ice loss from Greenland, Antarctica, mountain glaciers and ice caps and combined them with a model of how Earth's crust responds to changes in mass.



Earth's crust is moving as climate change takes a toll on ice sheets and glaciers across the world. The continuous melting of these ice sheets from Greenland and Antarctica is causing the planet's crust to deform as water is redistributed to the global oceans leading to rising sea levels.

The movement is due to sudden loss of overlaying weight on the surface as massive chunks of ice melts leading to a vertical and horizontal movement. While scientists have studied the vertical response to the changes as land lifts up, the horizontal movement has been tracked for the first time.

In a study published in the Geophysical Research Letters, a team of scientists found that the surface motion is on average several tenths of a millimetre per year, and it varies significantly year-to-year. "The redistribution of mass between continents and oceans results in significant and time-varying crustal deformation," the paper said as it set out to analyse the mass balance of ice sheets and glaciers in a progressively warming planet.

Studying crustal movement

Led by Sophie Coulson at Harvard University in Cambridge, researchers gathered satellite data on ice loss from Greenland, Antarctica, mountain glaciers and ice caps and combined them with a model of how Earth's crust responds to changes in mass.

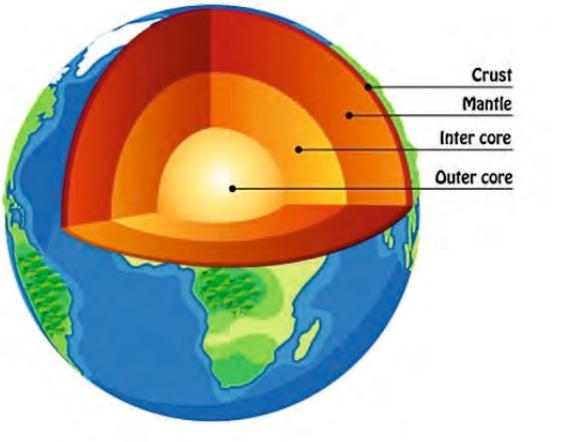
They found that between 2003 and 2018, ice melting from Greenland and Arctic glaciers forced the ground to shift horizontally across the Northern Hemisphere, and by as much as 0.3 millimetres a year in much of Canada and the United States.

The ice-mass loss from Arctic glaciers also produces pervasive horizontal motions with a magnitude up to 0.15 millimetres per year. They found that rather than only being localized to regions of ice loss, melting of the Greenland Ice Sheet and Arctic glaciers has caused significant horizontal and vertical deformation of the crust that extends over much of the Northern Hemisphere.

Signs of life beyond the solar system could be detected within two to three years

What is Earth's crust?

The crust forms the outermost shell of Earth with a depth extending up to 40 kilometres under the surface. According to the National Geographic Society, the crust is made of solid rocks



and minerals and Earth's layers constantly interact with each other, and that the crust and upper portion of the mantle are part of a single geologic unit called the lithosphere.

Just as the depth of the crust varies, so does its temperature. The upper crust withstands the ambient temperature of the atmosphere or ocean—hot in arid deserts and freezing in ocean trenches. The crust is made up of igneous, metamorphic, and sedimentary rocks.

Climate change plays the villain

Climate change has triggered rapid ice loss in both the Arctic and the Antarctic as well as in the vast swathes of Greenland. Glaciers are losing 31 per cent more snow and ice per year than they did 15 years earlier. Scientists had in April documented the massive ice loss using 20 years of declassified satellite data.

They calculated that the world's 220,000 mountain glaciers are losing more than 328 billion tons (298 billion metric tons) of ice and snow per year since 2015.

India will also be affected by the massive melt triggered by global warming as 12 cities could be nearly three feet underwater by the century's end. Nasa identified 12 Indian cities that are likely to experience the brunt of climate change and rising sea levels if the situation is not contained.

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Red alert' for rain declared in China as flood death toll hits 21

Five cities in the central Chinese province of Hubei have declared "red alerts" after torrential rain left 21 people dead and forced the evacuation of nearly 6,000 people, state media reported.

Dozens of people died while trapped in flooded subway carriages, underground car parks, and tunnels. The deaths were recorded in the township of Liulin, part of the city of Suizhou in the north of the province.

According to Chinese state media, over 2,700 houses and shops suffered flood damage and power, transportation and communications were also disrupted.

Rescue crews have been dispatched to the worst affected areas, including the cities of Suizhou, Xiangyang and Xiaogan, China's Ministry of Emergency Management said. The city of Yicheng also saw a record 400 millimetres of rain.

Over 774 reservoirs in Hubei have exceeded their flood warning levels, the official Xinhua news agency reported.

The country has been hit the deadliest floods in a decade wreaked havoc, killing over 300 people and damaging thousands of cars and buildings.

The floods also triggered record insurance claims worth $1.7 billion after thousands of cars and buildings were damaged, insurer Goldman Sachs said in a report.

The local government last week said economic losses due to the floods have ballooned to over $20.65 billion and promised swift compensation.

Around 80,000 were evacuated in the southwestern province of Sichuan last weekend and record rainfall in Henan last month caused floods that killed more than 300 people.

The China Meteorological Administration warned that heavy rainstorms were likely to continue until next week, with regions along the Yangtze river vulnerable to flooding.

State weather forecasters also issued a geological disaster warning late on Thursday, saying areas at risk include the central provinces of Hubei, Hunan, Henan and Anhui, Chongqing, Sichuan, and Guizhou in the southwest as well as Zhejiang on the eastern coast.

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Report by Inter-governmental Panel on Climate Change

Report submitted by the Working Group-I study issued on Monday stated that greater heat waves and droughts, increased rainfall events, and higher cyclonic activity are projected to occur across India and the subcontinent during the next several decades.

According to this frightening report on the condition of the world's climate, the fatal heat waves, floods, and droughts that are upending the lives of millions of people throughout the world will only grow worse as global temperatures continue to climb.

For the Indian subcontinent, the report stated, "the observed mean surface temperature increase has clearly emerged out of the range of internal variability compared to 1850-1900. Heat extremes have increased while cold extremes have decreased, and these trends will continue over the coming decades."

According to the latest research by the WGI (Working Group I), the world would warm by 1.5 degrees Celsius in all scenarios.

Even under the most aggressive emissions cut scenario, the temperature would rise to 1.5°C in the 2030s, overshoot to 1.6°C, and then fall to 1.4°C by the end of the century.

Warming over India is likely to follow the worldwide average, with an increase in the frequency and intensity of hot extremes, according to the IPCC study, which also forecasts a rise in annual mean precipitation. Rainfall the monsoon season is also expected to rise.

The most recent study includes a far better grasp of how people are unmistakably to blame for climate change that has occurred since pre-industrial times.

The scientists warn that there is clear doubt that human activities have warmed the globe and caused quick and broad changes, with some effects already locked in.

Without substantial, profound emissions reductions, the study predicts that the world would continue to suffer unprecedented change.

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Deforestation in Amazon forest hits the highest annual level in a decade

A new report reveals that deforestation in the Amazon forest has hit the highest annual level in a decade.

Between August 2020 and July 2021, the rainforest lost 10.476 square kilometres, an area nearly seven times bigger than greater London and 13 times the size of New York City, reveals by Imazon, a Brazilian research institute that has been tracking the Amazon deforestation since 2008. The figure is 57 per cent higher than in the previous year and is the worst since 2012.

Carlos Souza, a researcher at Imazon, was

quoted by The Guardian as saying, "Deforestation is still out of control.""“Brazil is going against the global climate agenda that is seeking to urgently reduce greenhouse gas emissions.”

Souza further urged for the urgent resumption of government actions to stop the destruction. This includes measures like the

enforcement of illegal agriculture-led deforestation in the region.

Marcio Astrini, the executive-secretary of the organisation Climate Observatory, said, "The data shows that it didn’t work".

“No army operation will be able to mask or reverse the attacks of the federal government against the forest.”

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States across American west see hottest summer on record

California experienced its hottest summer on record this year as the climate crisis caused deadly heatwaves and intense wildfires in the state and across the western parts of America.

According to the National Oceanic and Atmospheric Administration, Idaho, Nevada, Oregon and Utah, totalling 18.4 per cent of the contiguous US also endured record hot summers. Sixteen other states recorded a top-five warmest summer.

Across the lower 48 states, the average temperature in June, July and August was 76F, 2.6F above average. This slightly exceeds that of the Dust Bowl summer of 1936.

The west faced historic heatwaves this summer, with cities across the typically cool Pacific north-west hitting their highest temperatures on record. Early summer heatwave killed hundreds of people in Oregon and Washington.

Also, nearly 500 people in Canada’s westernmost province lost their lives. Experts also warned that the heat had probably also killed more than 1 billion marine animals along Canada’s Pacific coast.

In the US, the heat strained the power grid and forced schools, businesses, outdoor pools, COVID-19 testing sites and mobile vaccination units to close.

A detailed scientific analysis has revealed that the heatwave would have been virtually impossible without human-caused climate change.

Thom Porter, the Cal Fire chief, last month said, "There is fire activity happening in California that we have never seen before. The critical thing for the public to know is evacuate early".

He further added, "Every acre can and will burn someday in this state.”

Drinking water is fundamental right: Bombay High Court on water supply failure in Thane village

The observations were made by a Bench of Justices SJ Kathawalla and Milind Jadhav while hearing a petition by residents of Kambe village in Thane district, Maharashtra seeking supply of drinking water on daily basis.

The Bombay High Court on Wednesday

said that supply of regular drinking water is a fundamental right and it is unfortunate that citizens have to knock the doors of the Court for water supply even after 75 years of independence (Shobha Vikas Bhoi & Ors. v. State of Maharashtra & Ors.)

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Chandrayaan-2 finds water-ice on the dark side of Moon

Chandrayaan-2 finds water-ice on the dark side of Moon that has not seen sunlight in two billion years Chandrayaan-2 pointed to the distribution of most possible locations for the existence of water-ice on the lunar pole.

In a major achievement for Chandrayaan-2, one of the eight payloads onboard the orbiter has confirmed the presence of water ice in the permanently shadowed regions on the Moon. The latest discovery was revealed by the Indian Space and Research Organisation (Isro) in the new science data set released to mark two years of the lunar mission.

"The permanently shadowed regions (PSRs) in Lunar poles are reported to contain water-ice of various concentrations mixed with the lunar regolith," Isro said.

The discovery confirms the earlier radar-based studies of the lunar polar region for the presence of water-ice. The observation was conducted by the Dual Frequency Synthetic Aperture Radar (DFSAR), one of the eight instruments on the Chandrayaan-2 orbiter, which is capable of peering inside the lunar surface up to a few meters depth.

"DFSAR instrument on Chandrayaan-2 is the first-ever fully polarimetric dual-frequency imaging radar system in lunar orbit and is capable of probing these regions up to a few meters depth with full scattering matrix information, unlike its predecessors like CH-1 MiniSAR and LRO-MiniRF," Isro said in the newly released data.

WATER-ICE ON LUNAR POLES

Chandrayaan-2 pointed to the distribution of most possible locations for the existence of water-ice mixed with lunar regolith within the permanently shadowed regions of Peary crater in the Lunar North Pole. The spacecraft also managed to observe few potential “dirty ice” patches within the Cabeus’s crater floor, which is located near the South Pole of the Moon and is the impact site of the Lunar Crater Observation and Sensing Satellite (LCROSS) experiment in 2009.

Patchy dirty ice includes ice crystals that are mixed with regolith from the moon's surface, unlike continuous ice sheets. "Spectral measurements of the LCROSS ejecta plume detected the presence of water and hydroxyl along with the presence of a number of other volatile species, including carbon dioxide, light hydrocarbons, ammonia, and sulfur-bearing species," Isro said, however, DFSAR analysis indicated "no presence of thick, pure water ice deposits within the top 2-3 meters of the surface" in either the permanently shadowed or the sunlit portion of the Cabeus interior analyzed in this

work. Isro is now studying this region for further characterisation of these icy patches.

WHAT IS PERMANENTLY SHADOWED REGION OF THE MOON?

The permanently shadowed regions of the Moon are lurking in the craters of the lunar south pole that do not receive any sunlight throughout the year. These areas have not seen a single ray of sun in over two billion years. According to Nasa, "they appear dark because unlike on the Earth, the axis of the Moon is nearly perpendicular to the direction of the sun's light. The result is that the bottoms of certain craters are never pointed toward the Sun, with some remaining dark for over two billion years."

Studying these dark regions has always remained a challenge with several countries attempting missions to the dark side. While China has succeeded in landing a rover on this polar region, Isro's Chandrayaan-2 mission crash-landed on the surface two years ago. However, Nasa has managed to map this region using Lunar Reconnaissance Orbiter.

HISTORY OF DISCOVERIES BY CHANDRAYAAN

Even after it crash-landed on the lunar surface, the Chandrayaan-2 is delivering key observations about the Moon thanks to its orbiter, which has now completed 9,000 orbits. Scientists using the data obtained from the Imaging Infrared Spectrometer (IIRS) had also confirmed the unambiguous detection of OH (hydroxyl) and H2O (water) signatures. The instrument collects information from the Moon's electromagnetic spectrum, to understand the mineral composition of the natural satellite.

The signatures were found on the Moon between 29 degrees north and 62 degrees north latitude and researchers estimate that the brighter sunlit highland regions at higher latitudes of the Moon have higher hydroxyl or possibly water molecules.

Not just the Moon, the Chandrayaan-2 has also led to studies around the Sun, identifying new developments on the hot outermost layer of the bright star known as Corona. The spacecraft found abundances of magnesium, aluminium and silicon in the solar corona and observed around 100 microflares, providing new insights about coronal mass heating.

Isro, which had discovered water on the moon with Chandrayaan-1, is now in preparation to launch the third mission part of the Chandrayaan series, which will use the orbiter hovering over the Moon as it studies the lunar surface.

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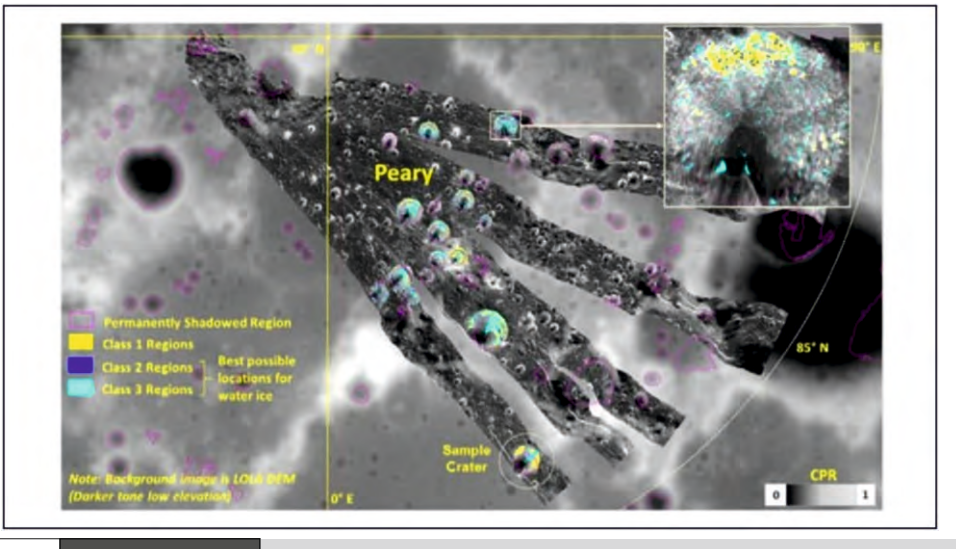


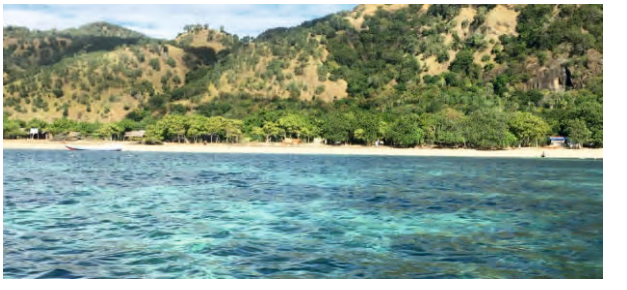
A reliable water drinking system for remote Atauro Island case study

A reliable water system for the water-stressed Atauro Island community

Goal

Atauro is an island located off the coast of Timor-Leste in the Indonesian Archipelago. In addition to its natural beauty, what makes this island particularly special is that, according to Conservation International, it is surrounded by "the most biodiverse waters anywhere in the world."

Because Atauro lacks reliable water infrastructure, community members face severe water stress and widespread water-borne illness as a result of contaminated or unreliable water sources. In an attempt to keep community members safe, bottled water is shipped in from the mainland and was the primary source of drinking water. But as a result, an excess of plastic waste threatened the precious marine life inhabiting Atauro's beaches and reefs.



Challenge

Faced with fresh water scarcity, a remote location, harsh landscape, and poverty, the Island of Atauro presented several obstacles to finding a sustainable, resilient drinking water solution. The community needed a way to breakaway from reliance on plastic bottles, but also needed access to a water supply that was both clean and resilient despite the challenging conditions of the island.

SOURCE Project

Conservation International, in partnership with the Atauro community and SOURCE, installed 80 Hydropanels across two villages on the island to provide a reliable supply of clean, safe drinking water completely free of infrastructure and made from only sunlight and air. With reliable water access for the first time, and free of the dependence on single-use plastic bottles, residents can shift their focus to helping their communities thrive and protecting the wildlife that calls Atauro home

Increase in Speed of Rainfall:

- Considering the rainfall of several years, average rainfall is found out. It can be observed that the rainfall in each year, if compared with the total average rainfall, touches the average with some minor difference here and there. Even in 1972, when there was a severe drought condition, yearly rainfall was not far away from the average. Every year, when the IMD declares estimates of rainfall, that percentage varies from 90 to 110 percent. Thus it can be concluded that rainfall maintains it average every year with some minor variations.
- It is not the quantum of rainfall but its distribution which has changed significantly. That is mainly because number of rainy days has decreased. As already pointed out, previously it used to rain for nearly 70 to 80 days but in recent years, number has come down to 35 to 40 days. It naturally means that the intensity of rainfall has increased substantially.
- Not only that, the spatial variation has also gone up significantly. The best example can be that of Mumbai rains. Some years before, there was a cloud burst in that city. In Mumbai, there are two major rain gauge centers viz. Colaba and Santacruz. You would be astonished to note that at one place the rainfall recorded was below hundred mm whereas at other place it was more than 900 mm. Such a huge variation in the same city! Now these variations have further increased. It is very rightly said that it rains in such a way that one horn of bullock is dry and the other is wet.
- Due to the high intensity of rain fall, run off has substantially increased causing flood like situation. Day by day huge floods have become very common. This year almost all the states in our country experienced floods causing heavy damages to the life and property.
- Such situation is not seen everywhere. In some areas it did not rain sufficiently creating a drought prone situation there. Thus, floods somewhere and droughts in the neighbouring areas was a common feature everywhere. This irregularity has affected the ground water level.
- Rural India mostly depends on ground water for domestic use, especially for drinking purpose. But unfortunately all their sources - rivers, tanks, lakes and even ground water are drying very fast. Since they observe water luxury in towns and cities they decide to move to urban area causing problems to both the areas. In Rural area, labour force is not available and in cities there is a problem of floating population pressure.
- Till now trees and other plantation used to reduce the speed of flow of water. But now, due to excessive cutting of trees, there is no interruption to the speed of the flow and the gift given by Nature is taken away and water flows back to the sea.
- This increased speed is responsible for soil erosion. Hundreds of years are needed for the formation of fertile soil but due to erosion that five to six inch surface is washed away within no time. Quality of soil deteriorates causing poor produce from the land.

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