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DownToEarth
FORTNIGHTLY ON POLITICS OF DEVELOPMENT,
ENVIRONMENT AND HEALTH

**Science
Reporter**



MK Yadav Sir

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Why scarce rainfall restricted the passage of ships through Panama Canal

ARJUN SENGUPTA
NEW DELHI, AUGUST 16

THE FIRST ship passed through the Panama Canal on August 15, 1914. One hundred and ten years later, one of the most important shipping lanes in the world faces an existential threat from climate change.

The 82-km canal, one of history's greatest engineering feats, cuts through the Isthmus of Panama in Central America, shortening the voyage between New York on the Atlantic Ocean to San Francisco on the Pacific by about 12,600 km.

At least 36-38 ships pass through the canal every day on average. Last December however, traffic fell to 22 ships a day, with more than 160 stuck in anchor at either end of the canal. The reason: following a drought, the level of Lake Gatun, the artificial freshwater reservoir that is vital to the operation of the canal system, fell significantly.

Traffic has since been restored to more than 35 ships a day, but many experts fear this could be only a temporary respite. How does the Panama Canal work?

Water elevators

The canal is not a simple channel between two larger water bodies – it is a highly-engineered system that employs a sophisticated system of locks and elevators to carry ships across.

The system is needed because the Pacific at the canal's southern end is slightly higher than the Atlantic on the other end. This means that a ship that enters the canal from the north must gain elevation during its journey. This is achieved using a lock system which lifts and drops vessels to the required sea level at each end of the canal.

The locks act as water elevators that are flooded or drained to help ships gain or lose elevation respectively. The three sets of locks – 12 locks in all – are serviced using artificial lakes and channels. Here's how a set of locks works.

■ A ship approaches the first, lowest chamber of a lock, which lies at sea level.

■ The gate is opened to allow the ship into the chamber, and shut behind it.

■ The valve between the first and second chamber (at a higher elevation) is opened to



raise the level of water in the first chamber;

■ Once the water level is equalised, the gate between the chambers is opened, and the ship enters the next chamber.

The process is repeated to gain elevation, and the opposite process is used to lower the vessel. Ships entering from the Atlantic side gain 26 m in elevation at Lake Gatun, before losing some elevation closer

to the Pacific side. (See illustration)

Falling water level

Most of the water needed to facilitate the passage of ships through the system of locks is supplied from Lake Gatun by force of gravity (no pumps are needed).

According to a report by *The New York Times*, the passage of a single ship requires

almost 200 million litres of water. Every day, the canal uses two and a half times the volume of water consumed by the 8 million residents of New York City.

Last year, less water in Lake Gatun meant fewer ships could pass through the canal every day, and many that did make the passage could do so only after cutting their cargo load. While water from the oceans can be used to work the system of locks, this increases the salinity of Lake Gatun, which is also the source of drinking water for more than half of Panama's 4.4 million people.

Better rainfall has led to the situation improving this year. However, experts caution that the problem remains. "Rain not only washes the streets, it washes our minds and we think the problem is gone," Carlos Uriola, president of SSA International, which operates shipping terminals around the world, including at the Panama Canal, told *The NYT*. "The problem of water is a permanent one."

The threat derives from, and is exacerbated by, climate change. While extreme rainfall deficits are not unheard of in Panama, they have become increasingly frequent – and could become even more so in the future.

"Historically there has been a [rainfall] shortage on average once every 20 years due to major El Niño events. In the last 26 years this is the third major rainfall deficit. So it seems that something is changing our rainfall patterns," Steven Paton, climate change expert at the Panama-based Smithsonian Tropical Research Institute, told *The Guardian* in 2023. What happened last year statistically "has no analogue in the previous 100 years of data", he said.

A contentious solution

The Panama Canal authorities have proposed to create a second source of water for the canal by damming the Rio Indio river. Last month, Panama's Supreme Court struck down a law that made the river untouchable, opening the doors for the construction of a \$1.6 billion dam that is projected to fix the problem for at least the next 50 years.

But the dam's reservoir will also flood the homes of about 2,000 predominantly poor people. "They want to relocate us, but we don't think that way," Olegario Hernandez, one of the many people who will be displaced by the Rio Indio dam, told *The NYT*. "There's no place better."

Context: On August 15, 1914, the first ship navigated the Panama Canal, marking a historic milestone. Now, a century later, this crucial shipping lane faces a significant threat from climate change.

Panama Canal

- **About:** The Panama Canal, a man-made waterway, serves as a vital link connecting the Atlantic and Pacific oceans by traversing the Isthmus of Panama.
- **Strategic Importance:** Recognized as one of the world's two most crucial artificial water passages, the Panama Canal shares this distinction with the Suez Canal, playing a pivotal role in international maritime trade.
- **Dimensions:** Stretching approximately 80 kilometers in length, the canal serves as a remarkable feat of engineering, significantly shortening travel distances for ships.
 - The Panama Canal is a highly-engineered system, not just a simple waterway, utilizing locks and elevators to elevate ships from one end to the other.
- **Climate Change Threat:** The canal is vulnerable to climate change, with historical rainfall shortages occurring approximately every 20 years due to major El Niño events, and the last 26 years have seen three significant deficits.
- **Recent Rainfall Deficits:** In recent decades, the Panama Canal has experienced multiple major rainfall deficits, exacerbating challenges in maintaining its water supply for efficient operation.

A PANAMA CANAL TRANSIT

ATLANTIC OCEAN

START

The vessel pays the toll and transits through Gatun Locks.

GATUN LOCKS

In these locks, the vessel is raised 26 meters above sea level to the level of Gatun Lake.

GATUN LAKE

The vessel enters Gatun Lake and navigates 34 km until Culebra Cut.



A ship takes an average of 8 to 10 hours to transit the Panama Canal.

CULEBRA CUT

In Culebra Cut, the transit is 13.7 km until Pedro Miguel Locks.

MIRAFLORES LAKE

The vessel navigates 1.6 km until the next locks.

PEDRO MIGUEL LOCKS

In Pedro Miguel Locks, the vessel is lowered one step to the level of Miraflores Lake.

MIRAFLORES LOCKS

The vessel is lowered two steps to the level of the Pacific Ocean.

FINISH

The vessel reaches the Pacific Ocean and finishes its transit through the Panama Canal.

PACIFIC OCEAN

PM Modi Pays Homage To Sri Aurobindo On Birth Anniversary

Context: PM Modi paid homage to the revered philosopher, thinker, and spiritual leader Sri Aurobindo, on his 152nd birth anniversary.

Sri Aurobindo Ghosh

- **Early Life:** Born to surgeon Krishna Dhan Ghose and Swarnalata Devi in Calcutta on August 15, 1872.
- **Education:** Passed the Indian Civil Service Examination in 1890 but failed in the horsemanship test, preventing entry into the service.
 - Accepted an appointment in the Baroda state service in 1893, worked for 13 years, and rose to the post of principal of the Baroda State College.
- **Revolutionary:** He became a leading figure in the freedom movement, writing fearless articles for the English newspaper Bande Mataram.
- **Contributions:** Contributed articles to the Bengali weekly Yugantar.
- **Foundation:** Started the weekly English journal Dharma, promoting Swaraj or freedom from British rule.
- **Anushilan Samiti:** Helped found the youth club Anushilan Samiti, protesting against British government atrocities.
- **Opposition to Bengal Partition:** Protested against the 1905 Partition of Bengal and advocated for the boycott of British institutions and goods.
- **Alipore Bomb Case:** Charged in the Alipore Bomb Case (1906-1910), sentenced to jail, and spent one year in solitary confinement at Alipore Central Jail in Calcutta.
- **Founding:** Established a community of spiritual seekers that became the Sri Aurobindo Ashram in 1926.
- **Focus on Integral Yoga:** Devoted life to developing “integral” yoga, aiming to elevate consciousness and self-awareness.
- **Literary Works:** The Life Divine, Synthesis of Yoga and Savitri.

Endemic Malabar Tree Toad populations may decline 68.7% due to climate change: Study



Context: Climate change may decrease the distribution range of the Malabar Tree Toad (MTT) by up to 69% of the current estimated distribution in India's protected areas (PAs), according to a study conducted by a concerned group of citizens and scientists.

Malabar Tree Toad (MTT)

- **About:** MTT is endemic to India's Western Ghats, a unique region known for its biodiversity.
- **Monotypic Genus:** MTT is the only species in the monotypic genus *Pedostibes*, meaning it is the sole representative of this genus.
- **Arboreal Species:** It is the only arboreal toad species in India, capable of climbing trees, unlike most ground-dwelling toads in the region.
- **Discovery:** First discovered in 1876, MTT was not seen for over 100 years and was
- **Rediscovered in:** 1980 at Silent Valley National Park in Kerala.
- **Distribution:** The species is nearly widespread across the Western Ghats.
- **Threat:** A changing climate has endangered many species in the Western Ghats, a recognized global biodiversity hotspot.
 - The Western Ghats host 252 amphibian species, with 17 critically endangered and 40 classified as 'data deficient.'
 - Globally, 40.7% of amphibians (8,011 species) are the most threatened vertebrates due to human activities like agriculture, infrastructure development, and harvesting.
- **Conservation Status:** IUCN - Endangered

US Navy unveils longest-range missile: Will AIM-174B be game-changer in Indo-Pacific tensions?

Context: The US Navy has unveiled the AIM-174B missile to counter China's growing aerial dominance. This strategic move aims to enhance U.S. air defense capabilities in the region.

AIM-174B Missile

- **About:** The AIM-174B is an air-launched version of the versatile SM-6 missile developed by the US Navy.
- **Capabilities:** Its range exceeds that of China's PL-15 missile.
- **Range:** It is an extremely long-range air-to-air missile with the capability to strike targets up to 400 km (250 miles) away.
- **Deployment:** Deployed in the Indo-Pacific region as part of a broader strategy to enhance US power projection amid escalating regional tensions.
- **Engagement Capabilities:** It engages high-priority ground targets like air defense sites and warships, operating in a quasi-ballistic manner.
- **Advantages:**
 - **Extended Range:** The AIM-174B can fly several times farther than the AIM-120 AMRAAM, its predecessor.
 - **Surface Strike Capability:** It retains the surface strike capability of the SM-6, useful for targeting large maritime vessels.
 - **Strategic Deterrence:** It helps keep PLA carrier-hunting aircraft out of range and can threaten Chinese planes attacking Taiwan.

Indo-Pacific Region

- **About:** It includes the Pacific and Indian Oceans in Southeast Asia. Previously referred to as the Asia-Pacific region, it has recently been renamed to Indo-Pacific.
- It comprises 40 countries. (India is a part)

India should seek to curb bullion imports from UAE, says GTRI

FE BUREAU
New Delhi, August 16

AS INDIA SEEKS a review of the Comprehensive Economic Partnership Agreement (CEPA) with the United Arab Emirates (UAE), it should aim at withdrawal of duty concessions on gold, silver, platinum and diamonds and tweaks in rules of origin norms, according to the Global Trade Research Initiative (GTRI). The main goal of the review should be checking the surge in imports of bullion from the UAE after the pact became operational in May 2022 as it is distorting the trade, the trade policy think-tank said in a report. Starting with smaller concessions, the CEPA contains provisions for unlimited imports of duty-free gold, silver, platinum, and diamonds into India over the next few years. Under the CEPA, silver from the UAE

TAKING THE SHINE OFF TRADE PACT

After trade pact with the UAE, silver imports surged to \$1.74 bn in 2023-24 from \$29.2 mn in 2022-23

It is feared that duty concessions are leading to higher imports and distortion of trade balance



India should roll back tariff cuts and adjust value addition rules under CEPA, according to GTRI

GTRI also says government should stop imports of sanctioned metals from Russia via Dubai

significant loss of customs revenue and a drain on forex reserves.

Under CEPA, duty on silver will come down to zero over 10 years starting in 2022. Duty concessions on diamonds could also harm local industry. India imports rough diamonds, which are then cut and polished domestically before being exported. To support this local industry, India imposes zero duty on rough diamonds and a 5% duty on cut and polished diamonds. However, under the India-UAE CEPA, cut and polished diamonds can be imported at zero duty if they undergo just 6% value addition in Dubai. India's global exports of cut and polished diamonds are worth \$15.9 billion. Removing the 5% tariff will severely pressure the margins of the domestic diamond industry. Indian manufacturers will struggle to compete with zero-duty diamonds imported from

Dubai, potentially forcing many local businesses to shut down or relocate.

The review should aim to eliminate the profit element from value addition calculations. To supply silver granules to India, Dubai firms import silver bars from Russia and other countries, convert them into granules, and claim a 3.5% value addition in this process. Less than 0.5% value addition accrues in this process. The rest of value addition can be legally shown as profit and money can be laundered to show higher realisations. It also asked the government to stop imports of sanctioned metals from Russia via Dubai as it violates US sanctions and revoke special privileges to the GTRI bullion exchange due to misuse. Trades conducted at the GTRI exchange lack transparency, raising 'serious' concerns about pre-arranged deals and invoice manipulation.

gold jewellery, adjust value addition rules to exclude profit margins from the value addition calculations in the rules of origin, ban the conversion of expensive products (silver bars) to cheaper ones (silver granules) to exploit CEPA benefits, stop imports of sanctioned metals from Russia via Dubai, and revoke special privileges

to the GTRI bullion exchange due to misuse, GTRI founder Ajay Srivastava said. According to the report, India has agreed to a zero tariff on unlimited quantities of platinum from Dubai, with the tariff set to decrease from 5% today to zero by 2036. This is a major concern for India because,

according to World Customs Organisation (WCO) classification rules, any metal with just 2% platinum can be classified as platinum. Some firms have taken advantage of this by importing platinum that actually contains 98% gold. This loophole would allow unlimited gold imports from Dubai at zero duty leading to a

Context: As India reviews the **Comprehensive Economic Partnership Agreement (CEPA)** with the UAE, it should target the removal of duty concessions on gold, silver, platinum, and diamonds, and consider adjustments to rules of origin norms, according to the **Global Trade Research Initiative (GTRI)**.

Global Trade Research Initiative (GTRI)

- **About:** A research Group focused on Climate Change, technology and trade.
- **Aims:** To create high-quality and jargon-free outputs for governments and industry from the perspective of development and poverty reduction.

GTRI Report on India-UAE CEPA:

- Trade data showed that **silver imports, largely coming from the UAE, surged more than 400%** in July compared to period last year.
- The **UAE is the third largest trading partner** of India with \$83.65 billion bilateral trade in 2023-24.
- As regards Comprehensive Economic Partnership Agreement (CEPA), **there are two things:** one is the value addition norms and the second is reduction (of customs duties).
- **India-UAE CEPA allows unlimited imports of gold, silver, platinum, and diamonds** from the UAE into India with zero tariffs in the coming years.
 - This will lead to **significant annual revenue losses**, move import business from banks to a few private traders, and replace top suppliers with Dubai-based firms.

India-UAE Comprehensive Economic Partnership Agreement (CEPA):

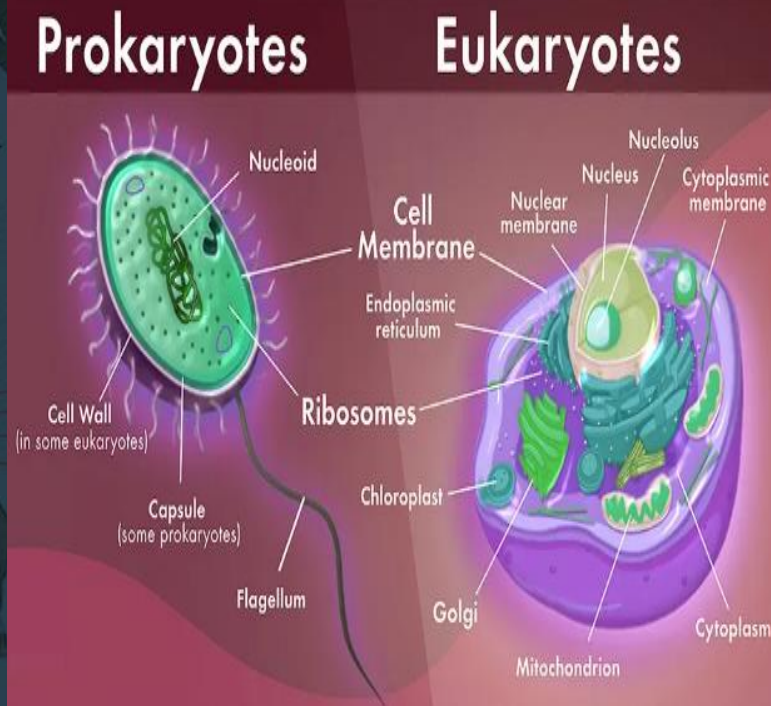
- Both countries signed the CEPA in February 2022 and a **Local Currency Settlement (LCS)** System in July 2023 to promote the use of Indian Rupee and AED (United Arab Emirates Dirham) for cross-border transactions.
- The CEPA came into force from May 1, 2022.
- The trade pact provides for numerous benefits, including the elimination and reduction of tariffs, fostering an open trade environment, and enhances market access for service providers across various sectors.

Climate change may allow the Earth's oldest, tiniest creatures to dominate — and that's seriously bad news

Context: Scientists have discovered that prokaryotes are exceptionally resilient to climate change and may increasingly dominate marine environments as a result. This finding highlights their adaptability and potential impact on ocean ecosystems.

Prokaryotes

- **Definition:** These are organisms that lack a true nucleus and membrane-bound organelles.
- **Genetic Material:** Typically a circular DNA molecule, is present in the cytoplasm without being enclosed within a nuclear membrane.
- **Types:** Bacteria and archaea.
- **Features of Prokaryotic Cells:**
 - **Shape:** They come in various shapes and sizes (0.5-5 μm), with four basic shapes being rod-like (bacillus), spherical (coccus), comma-shaped (vibrio), and spiral (spirillum).
 - **Cell Organisation:** Prokaryotic cells have a basic structural organisation, which includes a cell wall (except in mycoplasma), cytoplasm, and a plasma membrane. However, they lack a well-defined nucleus.
 - **Organelles:** They lack membrane-bound organelles, except for ribosomes. They do have unique structures called mesosomes, which are extensions of the plasma membrane used for various functions.
 - **Reproduction:** Prokaryotic cells reproduce primarily through binary fission, a type of asexual reproduction.
 - **DNA:** Most prokaryotic cells have a single chromosome, which carries hereditary genes in the form of DNA.
- **Eukaryote:** Any cell or organism that possesses a clearly defined nucleus.



After launch success, ISRO says SSLV development is complete

ANONNA DUTT

NEW DELHI, AUGUST 16

THE SMALLEST launch vehicle of the Indian Space Research Organisation (ISRO) — SSLV (Small Satellite Launch Vehicle) — in its third and final developmental flight Friday placed the EOS-08 and SR-0 satellites into a precise 475-km circular orbit. With this, the SSLV will be inducted into the space agency's fleet of operational launch vehicles.

The technology of the vehicle, however, will be transferred to the private industry for commercial flights in bigger numbers.

Congratulating those involved in the successful launch, Prime Minister Narendra Modi in a post on X said: "A remarkable milestone! Congratulations to our scientists and industry for this feat. It is a matter of immense joy that India now has a new launch vehicle. The cost-effective SSLV will play an important role in space missions and will also encourage private industry."

ISRO Chairperson S. Somnath said: "With this third flight of SSLV, we can declare that the development process is completed. We are in the process of transfer of technology to industries for serial production and launches of SSLV on a commercial basis. So, it is a great beginning for SSLV."

"Further, we are also looking for certain activities in the VTM stage and all that will be completed in due course of time," he said. The VTM or Velocity Trimming Module is the last liquid-propellant based stage of the

Context: The smallest launch vehicle of the Indian Space Research Organisation (ISRO) SSLV (Small Satellite Launch Vehicle) in its third and final developmental flight placed the EOS-08 and SR-0 satellites into a precise 475-km circular orbit.

EOS-08

- **About:** A pioneering satellite mission using ISRO's Microsat/IMS-1 bus, featuring advanced IR observation payloads, a GNSS-R Payload, and a SiC UV dosimeter.
- **Advanced Systems:** Equipped with a suite of technologies including an Integrated Avionics system (CBSP Package), Structural panel with PCB, embedded battery, Micro-DGA, M-PAA, Flexible solar panel, and Nano star sensor for technology demonstration.
- **Payloads:**
 - **EOIR Payload:** Images in Mid-Wave IR (MIR) and Long-Wave IR (LWIR) bands for surveillance, disaster monitoring, environmental monitoring, fire detection, volcanic activity, and industrial disaster assessment.
 - **GNSS-R Payload:** Demonstrates GNSS-R-based remote sensing for applications like ocean surface winds, soil moisture, cryosphere studies, flood detection, and inland water body detection.
 - **SiC UV Dosimeter:** Monitors UV irradiance at the Gaganyaan Mission's Crew Module view port and serves as a high-dose UV radiation alarm sensor.
- **Orbit and Life:** Operates in Circular Low Earth Orbit (LEO) at 475 km altitude with a 37.4° inclination, and has a mission life of 1 year.
- **Additional Payload:** Includes SR-0 DEMOSAT developed by Space Kidz India, also placed in the intended orbit.

SSLV

- **About:** It is a three-stage launch vehicle composed of three solid propulsion stages and a liquid propulsion-based Velocity Trimming Module (VTM) as its terminal stage.
- **Capabilities:** It is designed to launch mini, micro, or nanosatellites weighing between 10 to 500 kg into a 500 km planar orbit.
- **Solid and Liquid Propulsion:** The vehicle uses solid propulsion for the initial stages and a liquid propulsion system for the final Velocity Trimming Module.
- **Target Orbits:** SSLV effectively places satellites into low Earth orbit, specifically targeting a 500 km planar orbit.

The Geneva Conventions at 75: Do the laws of war still have a fighting chance in today's bloody world?

Context: August marks the 75th anniversary of the adoption of the Geneva Conventions in 1949, commemorating a milestone in international humanitarian law.

Geneva Conventions

- **About:** It consists of four treaties with over 400 articles detailing the treatment of prisoners, protection for medical staff, humanitarian aid, and prohibition of torture, rape, and sexual violence.
- **Formalization Date:** The Conventions were formalized in 1949 by the United Nations.
- **Protocols:** There are three additional protocols: the first two were formalized in 1977, and the third in 2005.
- **Focus:** The Conventions focus on the treatment of non-combatants and prisoners of war, not on the use of conventional or biological and chemical weapons, which are covered by The Hague Conventions and the Geneva Protocol.
- **Signatories and Ratification:** The Geneva Conventions have been ratified by 196 states, including all UN member states.
- **List of Conventions:**
 - **The First Geneva Convention:** Protects wounded and sick soldiers on land during war, and applies to medical and religious personnel, medical units, and medical transports.
 - **The Second Geneva Convention:** Protects wounded, sick, and shipwrecked military personnel at sea during war, replacing the Hague Convention of 1907 related to maritime warfare.
 - **The Third Geneva Convention:** Applies to prisoners of war, establishing that they should be released and repatriated without delay after active hostilities cease.
 - **The Fourth Geneva Convention:** Protects civilians, including those in occupied territories, and addresses the general protection of populations against certain consequences of war without covering the conduct of hostilities.

Safe microbial substitute can replace synthetic surfactants in the food industry

Context: Recent research highlights the potential of biosurfactants to transform the food industry, focusing on their benefits and applications.

Biosurfactants

- **About:** These are active compounds that are produced at the microbial cell surface or excreted, and reduce surface and interfacial tension.
- **Substitute:** They serve as a healthier substitute for synthetic surfactants in the food industry.
- **Green Substrates:** Produced using green substrates from agro-industrial waste.
- **Physical Characteristics:**
 - **Performance and Stability:** Microbial biosurfactants exhibit high emulsification, solubilization, foaming, adsorption, and other physical characteristics, and are stable in a wide range of pH, temperature, and salinity.
 - **Non-Toxic and Safe:** Biosurfactants are eco-friendly biomolecules that do not impart toxic effects and are considered safe for human consumption.

Research Findings

- The study highlights the need for more research on toxicity, dose effects, and interactions with other food components for regulatory approvals.
- Cost-effective biosurfactants derived from agro-industrial waste offer a sustainable and healthier alternative to synthetic surfactants.
- They help emulsify fats, improve shelf life, act as dispersing agents, retain moisture, remove heavy metals from vegetables, boost immunity in fish, and serve as natural antioxidants.

Surfactants

- **About:** These are molecules that slither across surfaces of oil and water, water and oil, or air and water to form an emulsion.
- **Uses:** Surfactants are very useful in the food industry as lubricants and foamers to emulsify fats in batters, improve shelf life, as dispersing agents, and retain moisture.

Toxic mercury trapped in Arctic's permafrost is now leaking into environment due to global warming: Study

Context: A recent study warns that the thawing Arctic permafrost is releasing large amounts of toxic mercury into the environment, posing serious global health risks to both flora and fauna.

Mercury Pollution

- **About:** It is a naturally occurring element found in air, water, and soil.
- **Exposure:** Even small amounts of mercury exposure can cause serious health issues, particularly affecting the development of children in utero and early life.
- **Toxic Effects:** Mercury can have toxic effects on the nervous, digestive, and immune systems, as well as on the lungs, kidneys, skin, and eyes.
- **WHO Classification of Mercury:** It considers mercury one of the top ten chemicals or groups of chemicals of major public health concern.
- **Global Contaminant:** Mercury is a global environmental contaminant from both natural sources and human activities, with much of the Arctic contamination originating from outside the region through air and ocean pathways.
- **Minamata Disease:** People are mainly exposed to methylmercury, an organic compound, through eating fish and shellfish, making them more vulnerable to Minamata disease.
- **Release and Redistribution of Mercury:** Significant amounts of total mercury (THg) are released from permafrost during glacial erosion, with some of it being redeposited by rivers.
- **Minamata Disease:** Caused by methylmercury poisoning, was first identified in the inhabitants of Minamata Bay, Japan, characterized by sensory loss, tremors, and hearing and visual loss.
- **The Minamata Convention:** It is a global treaty aimed at protecting human health and the environment from mercury and its compounds.

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