

26th June DSC

Two Billion People Lack Access to Safe Drinking Water

Context & Scope

Globally, around 2 billion individuals do not have access to safely managed drinking water. Each year, more than 800,000 people die from illnesses that stem from consuming contaminated water.

Having access to clean water is fundamental to health, human dignity, and overall societal progress.

Relevance: GS 2 (Health, Social Issues)

Key Definitions

Safe Drinking Water (as per SDG 6.1, since 2017):

Water must be free from harmful contaminants, readily available at the household level, and accessible whenever needed.

Improved Water Source (previous measurement indicator):

Includes sources like protected springs, boreholes, and piped water — although not always clean or safe at the point of consumption.

Current Global Landscape

Out of 8 billion people, 6 billion have safe water access.

The remaining 2 billion do not — however:

Only 156 million people depend on surface sources like lakes or rivers.

Most use improved water sources that are either distant from home or irregular in supply.

Underlying Issues

The burden of collecting water — mainly shouldered by women and children — significantly affects education and work productivity.

Even improved water sources can get contaminated during transport or while being stored.

Although 95% of the global population uses improved sources, not all of them meet the criteria for being safely managed under SDG 6.1.

Health Impacts

Unsafe water leads to diseases such as diarrhea, cholera, hepatitis, polio, and contributes to malnourishment.

In many low-income nations, over 5% of deaths are linked to unsafe water use.

Child mortality and poor nutrition are strongly associated with water scarcity and insecurity.

Developmental Barriers

It is relatively easier to provide basic improved water sources than to ensure they are safely managed at the household level.

Achieving this requires infrastructure development, regular maintenance, and control of contamination risks.

True progress under SDG 6.1 demands that every household have reliable access to safe drinking water.

Conclusion

Achieving universal access to safe water (SDG 6) is critical for:

- Public health improvement

- Ensuring social justice
- Economic advancement
- Meeting broader Sustainable Development Goals (SDGs)

U.S. Launches Heavy Airstrikes on Iran's Nuclear Facilities

Context & Strategic Importance

On June 21, 2025, the U.S. launched targeted airstrikes on Iran's key nuclear facilities at Fordow, Natanz, and Isfahan.

Codenamed **"Midnight Hammer,"** the operation aimed to severely damage Iran's uranium enrichment capacity.

This marked direct U.S. military involvement in the Israel-Iran conflict that erupted on June 13.

Relevance: GS 2 (International Relations)

Execution of the Strike

Seven B-2 Spirit stealth bombers undertook a 37-hour mission, with several mid-air refueling operations.

The lead B-2 dropped two GBU-57 Massive Ordnance Penetrators (MOPs) on the heavily fortified Fordow site.

Deception methods were used, such as decoy planes flying westward to mislead Iranian radar systems.

In total, the operation used 14 bunker-busters and 75 precision-guided munitions, including submarine-launched Tomahawk missiles.

Rationale for Using B-2 and MOPs

Fordow is buried under 80–90 meters of reinforced rock, a depth Israel's military cannot effectively target.

The 30,000-pound GBU-57 MOP is built to destroy deep underground bunkers.

The B-2 Spirit is the only U.S. aircraft capable of carrying and delivering MOPs.

Capabilities and Limitations of B-2 Bombers

Out of the original fleet, only 19 B-2s remain in service; each costs over \$2 billion.

The aircraft is extremely stealthy, evading detection via radar, sound, heat, and sight.

It is maintenance-intensive, requiring 100 hours of servicing for each flight hour.

It needs climate-controlled hangars to maintain its stealth materials.

It holds records for the longest air combat operations, such as the 44-hour mission during the 2001 Afghan war.

Military and Political Fallout

The U.S. stated the goal was not regime change but neutralizing threats and reinforcing Israeli defense.

Key concerns now include:

- Assessing actual damage to Iran's nuclear sites, especially Fordow
- The status of enriched uranium stockpiles
- Potential for Iranian retaliation and regional escalation

Next-Gen B-21 Raider

The U.S. is developing the B-21 Raider to eventually replace the B-2 fleet. It is a dual-use stealth bomber with modular architecture for rapid software updates. Estimated cost per unit is \$550 million; the Air Force aims to acquire over 100 units.

Conclusion

Operation Midnight Hammer exemplifies a U.S. strategy centered on technological precision and stealth power. It highlights the strategic role of modern stealth aircraft and bunker-busting weapons. The strike may significantly impact nuclear diplomacy, U.S.-Iran relations, and stability in West Asia.

Agricultural Fungicide Linked to Drug-Resistant *Candida tropicalis*

Context & Concern

Candida tropicalis is a key fungal pathogen in India and worldwide, with fatality rates between 55–60%.

Hospitals are increasingly reporting drug-resistant infections of this fungus.

Common antifungal drugs like fluconazole and voriconazole are losing effectiveness.

Relevance: GS 2 (Health), GS 3 (Science)

Key Discovery

A study in *PLoS Biology* connects rising azole resistance in *C. tropicalis* to the agricultural use of tebuconazole, a triazole fungicide.

Tebuconazole builds up in the environment and prompts cross-resistance in human fungal strains.

Mechanism: Ploidy Plasticity

Resistant *C. tropicalis* strains showed abnormal chromosome numbers (haploid to triploid).

These mutations increased resistance but slowed growth in drug-free environments.

Genetic changes included:

- Duplication of the TAC1 gene → increased drug-efflux proteins
- Deletion of HMG1 gene → altered ergosterol synthesis aiding resistance

Public Health Consequences

Resistant strains proved more lethal in mice, even with antifungal drugs.

It demonstrates how misusing antifungals in agriculture can create clinically dangerous superbugs.

This underlines the One Health framework — the interlinkage of environment, agriculture, and human health.

Accidental Discoveries

Researchers identified the first stable haploid *C. tropicalis* strains that can mate, increasing the genetic spread of resistance.

Two naturally haploid clinical strains were also found in global genome data.

Broader Implications

The research underscores the dangers of indiscriminate triazole use in farming, which may

foster drug resistance in pathogens.

The warning is clear: “Sow the wind, reap the whirlwind” — showcasing unintended public health consequences of unsustainable practices.

India Enters Top 100 in Global SDG Rankings for the First Time

Context: India's SDG 2025 Performance

India ranked 99th out of 167 nations in the 2025 SDG Index — breaking into the top 100 for the first time.

Its score reached 67, a marked improvement from previous years:

2021: 120 | 2022: 121 | 2023: 112 | 2024: 109 → 2025: 99

Relevance: GS 2 (Governance), GS 3 (SDG)

Regional Comparison

- China: 49 (score: 74.4)
- Bhutan: 74 (70.5)
- Nepal: 85 (68.6)
- Bangladesh: 114 (63.9)
- Pakistan: 140 (57)
- Sri Lanka: 93
- Maldives: 53

About the SDG Index

Published by the UN Sustainable Development Solutions Network.

Measures progress toward the 17 goals adopted in 2015.

Scores range from 0–100, where 100 denotes full SDG achievement.

The index is led by economist Jeffrey Sachs.

Global Concerns and Trends

Only 17% of SDG targets are projected to be met by 2030.

This slow progress stems from:

- Ongoing geopolitical tensions
- Structural vulnerabilities
- Fiscal constraints in many countries

Top Performing Nations

European countries dominate:

- Finland, Sweden, and Denmark lead the list
- 19 out of the top 20 are from Europe
- Even top-ranked nations face serious sustainability issues, including:
- Climate change

- Biodiversity loss
- Unsustainable consumption
Urgent action is needed in lagging areas like:
- SDG 13: Climate action
- SDG 5: Gender equality
- SDG 4: Quality education
- SDG 3: Health

Shipping Industry Alarmed by Mandatory Retirement of Older Vessels

Context

Directorate General of Shipping's Order 6/2023 enforces mandatory retirement of ships over 20 years old.

The International Maritime Federation (IMF) warns of severe consequences:

- Over 700 Indian-flagged ships could face premature scrapping
 - More than 20,000 seafaring jobs are at risk
 - Over 100,000 people may be indirectly affected
- Relevance:** GS 2 (Governance), GS 3 (Infrastructure, Transport)

IMF's Concerns

A blanket age cap ignores individual ship condition and safety.

Recruitment and Placement Services Licence (RPSL) firms face disproportionate penalties, adding to industry strain.

IMF views the move as an existential threat to India's maritime sector.

International Context & Contradictions

Data from 130,000+ vessels and 370,000+ safety inspections reveal:

Older ships (25+ years) sometimes perform better in safety due to:

- Strict maintenance routines
- Survivorship bias — only robust ships remain operational

Domestic Impact

India's ambitions for a blue economy and coastal shipping expansion may falter due to reduced vessel numbers.

May discourage investment in Indian-flagged ships and boost reliance on foreign fleets.

Policy Recommendations

Switch to a condition-based inspection regime instead of an age-based one.

Ensure fair and proportional penalties for RPSL agencies.

Bring national norms in line with international safety and maritime standards.

In Vivo CAR T-Cell Therapy Could Revolutionize Cancer Treatment

What Is CAR T-Cell Therapy?

A type of immunotherapy in which a patient's T-cells are genetically reprogrammed to identify and destroy cancer cells.

Traditionally, this involves extracting T-cells from the patient, engineering them with chimeric antigen receptors (CARs) in a lab, and reinfusing them.

Typically used to treat B-cell-related cancers such as leukemia and lymphoma.

Relevance: GS 3 (Science and Technology)

Current Limitations of CAR T-Cell Therapy

The process is highly complex and expensive — costing around ₹60–70 lakh per patient in India. It requires:

- Personalised cell engineering in specialized labs
 - Use of viral vectors for gene delivery
 - Chemotherapy to suppress the immune system before infusion
- The procedure is also associated with severe side effects, including cytokine storms, infections, and genetic risks.

Breakthrough: In Vivo CAR T-Cell Generation

In a June 2025 *Science* study, researchers reported a new method that reprograms T-cells directly inside the body.

They used messenger RNA (mRNA) combined with lipid nanoparticles (LNPs) to deliver genetic instructions.

Targeted CD8+ T-cells by using antibody-coated nanoparticles.

This method **eliminates the need for:**

- Extracting and processing cells outside the body
- Chemotherapy as a preparatory step

Promising Preclinical Results

In mice, tumors shrank after T-cells were reprogrammed internally.

In monkeys:

- B-cells were wiped out from multiple organs
- 85–95% of T-cells converted after just 2–3 infusions
- Partial immune system reset observed in autoimmune models

Benefits of the In Vivo Approach

Because the CAR instructions are delivered via mRNA, the effects are temporary — reducing the long-term genetic risks.

No chemotherapy is required, making the therapy safer for older or immunocompromised patients.

The new method enables scalable production and standardized dosing, akin to vaccines or biologic drugs.

Lipid 829, a biodegradable carrier used in the study, also reduces the risk of inflammation.

Safety Considerations

Although generally mild, some inflammation occurred — manageable with medication.

However, one monkey developed a severe immune condition (hemophagocytic lymphohistiocytosis or HLH), highlighting the need for precise dosing. Human clinical trials are essential to evaluate safety, effectiveness, and long-term impact.

Implications for India

India faces a high burden of B-cell cancers like DLBCL and ALL. Autoimmune diseases are also rising, especially post-COVID. However, treatment access is hindered by limited infrastructure and high costs. This new in vivo approach could democratize access and reduce costs in resource-constrained settings.

Broader Impact

May fundamentally reshape cancer and autoimmune therapy models. Could pave the way for future in vivo gene therapy technologies. Offers the potential for personalized yet affordable treatments, especially in developing countries.

Crushed Rock Spread on Farms as a Tool to Capture Carbon

What is Enhanced Rock Weathering (ERW)?

A strategy to combat climate change by speeding up the natural weathering of rocks to sequester carbon dioxide (CO₂).

It involves spreading finely crushed rocks like basalt on agricultural land.

ERW is being applied in sugarcane fields in Brazil and Australia, tea estates in India, and oil palm plantations in Malaysia.

Relevance: GS 3 (Environment and Ecology)

Mechanism

When CO₂ dissolves in water, it forms carbonic acid, which breaks down rocks into ions. This leads to the formation of bicarbonates, which eventually settle as limestone in oceans — locking carbon away.

ERW works by:

- Grinding rocks to increase surface area
- Enhancing exposure to air, water, and soil for faster reactions

What Research Shows

A U.S. study found that applying 50 tonnes of basalt per hectare per year could remove up to 10.5 tonnes of CO₂ per hectare over four years.

Field data from Malaysia and Australia show lower results, implying earlier removal estimates may have been overly optimistic.

Effectiveness depends on:

- Type of rock and its grain size
- Soil composition
- Temperature and humidity
- How the land is managed

Challenges in Measuring CO₂ Capture

Often, CO₂ removal is inferred from cation release during weathering.

However, many acids (not just carbonic acid) release cations, potentially leading to inflated estimates.

There is a need for improved methods to precisely quantify ERW's impact on carbon sequestration.

Additional Environmental and Farming Benefits

Increases soil pH, which can:

- Enhance crop productivity
 - Boost nutrient absorption
 - Promote healthy soil formation
- Also reduces acidic runoff into water bodies, thereby preventing CO₂ release from aquatic ecosystems.

Risks and Constraints

Crushed rock may contain harmful metals like nickel and chromium.

Dust from spreading rock can pose health risks to farm workers — protective gear is essential.

The actual amount of CO₂ removed at scale may not match theoretical predictions.

Carbon Market Opportunities

Corporations — including tech companies, airlines, and apparel brands — are investing in ERW as a carbon offset strategy.

If standardized and measurable, ERW could become part of international carbon credit systems.

26th June Daily MCQs

1. Question

Which of the following health concerns are commonly linked to the consumption of unsafe drinking water?

1. Diarrhea
2. Hepatitis
3. Malnutrition
4. Heart disease

Options:

- (a) 1, 2, and 3 only
- (b) 2, 3, and 4 only
- (c) 1, 3, and 4 only
- (d) All of the above

Correct Answer: (a) 1, 2, and 3 only

Explanation:

Contaminated water is a major source of infections like diarrhea and hepatitis. It also

contributes to undernutrition, particularly in children, due to repeated illnesses. However, heart-related diseases aren't directly caused by water contamination.

2. Question

With reference to the B-2 Spirit stealth aircraft, consider the following:

1. It is capable of deploying GBU-57 bunker-busting bombs weighing 30,000 pounds.
2. It is low-maintenance and readily deployable in large numbers.
3. It has set endurance records for long-duration combat flights.

Which of the above statement is/are correct?

- (a) 1 and 2 only
- (b) 2 and 3 only
- (c) 1 and 3 only
- (d) 1, 2, and 3

Correct Answer: (c) 1 and 3 only

Explanation:

The B-2 Spirit is designed for stealth and strategic long-range bombing, including the delivery of massive bunker-buster bombs. It has proven its endurance in extended missions. However, due to high costs and complexity, it is neither easy to maintain nor widely deployed.

3. Question

What best defines the “One Health” framework as discussed in recent global health studies?

- (a) Ensuring equal healthcare access for urban and rural populations
- (b) A multidisciplinary strategy that links human, animal, and environmental health
- (c) Using genetically enhanced crops to improve nutrition
- (d) Employing AI technology in personalized medicine

Correct Answer: (b) A multidisciplinary strategy that links human, animal, and environmental health

Explanation:

The One Health approach promotes collaboration between sectors addressing human, animal, and ecological health to combat challenges like zoonoses, antimicrobial resistance, and pollution.

4. Question

Which South Asian country leads the region in the 2025 Sustainable Development Goals (SDG) Index rankings?

- (a) Bhutan
- (b) Maldives
- (c) Sri Lanka
- (d) Nepal

Correct Answer: (b) Maldives

Explanation:

In the latest SDG Index (2025), Maldives ranks 53rd globally—higher than its South Asian counterparts—indicating strong progress in meeting sustainable development goals.

5. Question

Regarding Enhanced Rock Weathering (ERW), consider these statements:

1. It involves dispersing finely crushed rock to speed up natural carbon absorption.
2. It has been implemented in crops like sugarcane and tea.
3. It is officially included in international carbon credit systems.

Which of the above statement is/are correct?

- (a) 1 and 2 only
- (b) 1 and 3 only
- (c) 2 and 3 only
- (d) All of the above

Correct Answer: (a) 1 and 2 only

Explanation:

ERW uses ground minerals such as basalt on farmland to boost the natural process of carbon capture. Field trials have taken place in crops like sugarcane and tea. Although it's gaining attention, ERW hasn't yet been fully adopted into formal carbon markets.

