

## Earth System Science Panorama

(The News, Events, Awareness and Researches on Climate, Planetary and Environmental Sciences)

### 1. The Loss of Nature threatens Global Economy: A Review

The ongoing loss of natural spaces, including forests, has become a systemic risk for the global economy, warns a new report from the United Nations Environment Programme (UNEP) and several partners. Over the past decade, 26 percent of global tree cover loss was caused by the production of just six agricultural commodities – oil palm, soya, cocoa, rubber, coffee, and wood fibre – said the *State of Financing for Nature* report. Barring major changes, the toll on forests and other wild spaces will continue to mount, ultimately imperiling industries that rely on natural resources. The authors of the report urged governments, financial institutions, and businesses to place nature at the heart of future economic growth by tripling the financing available for environmental friendly projects by 2030. The report's launch comes on the eve of the **United Nations Decade on Ecosystem Restoration**, a global effort to revive natural spaces lost to development. Forests have been hit especially hard by human activity. Every year, the world **loses 10 million hectares** of tree cover, an area the size of the Republic of Korea. Forests provide drinking water to one-third of the world's largest cities and support more than 65 percent of amphibian, bird, and mammal species. The State of Finance for Nature report was produced by UNEP, the **World Economic Forum** and the **Economics of Land Degradation Initiative** in collaboration with **Vivid Economics**. It showcases the investment opportunities that nature can offer and emphasize its importance to the global economy. By demonstrating the value of nature, the report authors show countries that it is possible to safeguard the planet with spurring economic growth and sustainable development. The report said that reviewing public subsidies, factoring the costs of ecosystem degradation into products or services and integrating the value of nature into credit risk analysis could lead to greener economies. Investments in nature-based solutions (NbS) are key components of transformational change, the report noted. They provide economic, social, and environmental stimulus by creating jobs, protecting nature, accelerating decarbonization, and improving climate resilience. There is a lack of data on how much public and private capital is flowing to productive and non-productive activities that constitute NbS. However, governments, financiers, and businesses are becoming increasingly interested in nature-based solutions, the report said. Two-thirds of governments have now committed to restoring or protecting ecosystems in their Nationally Determined Contributions, the commitments according to the Paris climate change agreement. There is also growing interest from companies to commit to "net zero" targets for greenhouse gas emissions. But much remains to be done to create demand for NbS, to put in place robust environmental and social safeguards, and to address legal hurdles. One lever to generate investment opportunities is to focus on economic stimulus and positive societal outcomes. The more stakeholders pursue these win-win opportunities, the more public and private investments in NbS will rise over time. Governments must create the enabling environment that allows this to happen, the report said. They can do that by revisiting agricultural policies and tariffs and developing taxonomies to determine what is sustainable and what is not. Companies and financial institutions must also share the risk and commit to increasing finance and investment in nature-based solutions in an ambitious way, with clear time-bound targets. A nature finance action track, acting as a shared vision can guide land-use decisions in support of healthy natural systems and sustainable development, the report added. Several case studies in the *State of Finance for Nature* illustrate the business and investment case for nature, along a pathway to transition towards a net-zero, nature-positive economy. They range from the Scottish government's commitment to spend £250 million on peatland restoration over the next 10 years, to Credit Union's Social Performance Management initiative, which provides innovative financing schemes to support integrated landscape projects in Indonesia.

Courtesy: <https://www.unep.org/news-and-stories/story/nature-loss-threatens-global-economy-report>

### 2. Unprecedented 'bomb cyclone' in US, Canada (December 23-28 2022): What is happening, and why? What is a bomb cyclone?

The term "bomb cyclone" comes from the term "**bombogenesis**." It is a **storm that intensifies rapidly and can create large impacts such as heavy snow, rain, high winds, and coastal flooding**. Storms form when a mass of low-pressure air meets a high-pressure mass. The air flows from high pressure to

low, creating winds. What defines a bomb cyclone is how rapidly the pressure drops in the low-pressure mass — by at least 24 millibars in 24 hours. This quickly increases the pressure difference, or gradient, between the two air masses, therefore making the winds stronger. This process of rapid intensification has an even more ferocious-sounding name: bombogenesis. John Moore, a meteorologist, and spokesperson for the National Weather Service explained in an article in *The New York Times* that as the area where the two air masses meet moves northward and eastward, conditions for bombogenesis should continue moving as well. As the temperature has continued dipping, many houses are without heat and lights. An intense blizzard (or snowstorm) is wreaking havoc across the United States and Canada, with more than 50 people confirmed dead in the US as of Monday, December 26. Four people died in Canada after a road accident on an icy path. At one of the most important periods for travel and tourism around the world, and especially in these two countries as families come together to celebrate the holiday season, life has been interrupted.

### **What is happening with the blizzard?**

According to an AP report, the scope of the storm has been nearly “unprecedented”, stretching from the Great Lakes near Canada to the Rio Grande along the border with Mexico. About 60% of the US population faced some sort of winter weather advisory or warning, and temperatures plummeted drastically below normal in major areas of the country, the National Weather Service said. NASA’s Earth Observatory had shown on December 22, 2022, that “a blast of Arctic air will plunge south and help trigger a powerful blizzard that will churn through the central and eastern US.” New York Governor Kathy Hochul called it an “epic, once-in-a-lifetime” weather disaster that ranked as the fiercest winter storm to hit the Greater Buffalo area in New York since a 1977 blizzard that killed nearly 30 people. At present, thousands of flights have been delayed or cancelled. As the temperature has continued dipping, many houses are without heat and lights. In New York, about 34,000 households were still without power, and while power is restored, thousands of households are still under cold and dark conditions. Migrants from Mexico and Central America attempting to reach the United States are also facing issues as a result, with authorities struggling to provide them with shelter.

### **What are the precautions being advised so far?**

But as the Arctic air spreads over most of the country it will eventually warm, reducing the pressure difference, so the storm will eventually dissipate. Forecasts are indeed calling for above-average temperatures across most of the country next week, Moore said. **Gigantic US winter storm leaves millions without power and cancels holiday plans Power outages leave more than 1.4 million homes and businesses in the dark, while thousands of US flights were cancelled.** The winter storm that forecasters dubbed Elliott intensified into a bomb cyclone near the Great Lakes, bringing high winds and blizzard conditions from the Northern plains to western and upstate New York, along with **life-threatening flooding, flash-freezing, and travel chaos as it went. Airline cancellations topped 5,700 flights, with tens of thousands of holiday travellers grounded in airports with limited expectations of making further progress.** Travel on the roads was disrupted due to snowy weather or crashes and authorities in parts of Indiana, Michigan, New York, and Ohio urged motorists to avoid nonessential travel. Transportation secretary Pete Buttigieg told CNN the US aviation system “is operating under enormous strain”. About 10% of US flights were cancelled on Thursday, Buttigieg said. The storm, estimated to be 2,000 miles wide, has produced driving snow and plummeting temperatures, knocking out power from Texas to Maine. Officials ordered cars off the roads as US forecasters warned of “potentially crippling impacts across central and eastern” parts of the country. The arrival of the arctic blast produced widespread disruption to utilities, with more than 1.5m households estimated to be without power. About 200 million people in the 48 contiguous states were under extreme weather alerts, said forecaster Bob Oravec of the National Weather Service (NWS). An advisory warned that the powerful cold front would engulf the eastern US tonight “with widespread dangerous cold expected to continue across much of the eastern two-thirds of the US into the holiday weekend” Rapid temperature drops, sometimes 50 or more degrees colder than the previous day,” Oravec told the Associated Press. “It’s a pretty powerful system.” The precipitous drop in temperatures was accompanied by high winds. A 79-mph gust was recorded in downtown Buffalo, New York, where snow fall produced a rare “zero visibility” observation at the airport. “There are some people in Buffalo saying this is one of the worst storms they’ve ever seen,” said the city’s mayor, Byron W Brown.

“Buffalo is used to dealing with normal snowfall. In Ohio, what was described as a “mass casualty incident” was declared after more than 100 vehicles were piled up. Forecasters had said the scale of the weather pattern was nearly unprecedented in its scope, exposing more than 200 million people – about 60% of the US population – to some sort of winter advisory or warning. The weather service’s map “depicts one of the greatest extents of winter weather warnings and advisories ever,” forecasters said. Tens of thousands of homes have been left without power, and governors in at least 13 states have drawn up emergency response plans, including National Guard deployments, for the holiday weekend, with heavy snow and ice creating treacherous road conditions and some drivers stranded. Temperatures in Colorado on Thursday dipped to a record-breaking low of -9F (-22.7C) from 42F (5.5C), while Cheyenne, Wyoming, recorded its greatest one-hour temperature drop, plunging from 43F to 3F. The NWS said temperatures of -50F to -70F were possible over the weekend in some parts of the US, warning that even in big metropolitan areas such as Des Moines, Iowa, frostbite could become a significant danger. Ahead of one of the busiest travel periods of the year, the American Automobile Association (AAA) said more than 112 million people planned to travel 50 miles (80 km) or more from home between 23 December and 2 January. Even though fleets of snow plows and salt trucks have been deployed across the US, driving was extremely dangerous and even deadly. The Ohio governor, Mike DeWine, called it “a unique and dangerous situation”. The NWS has described the storm as “once in a generation” weather event, saying more than 100 daily cold temperature records could be equaled or broken over the coming days. Florida is projected to experience its coldest Christmas in 30 years.

*Source: NASA Earth Observatory, December 28, 2022*

<https://indianexpress.com/article/explained/explained-climate/what-is-a-bomb-cyclone-an-intense-blizzard-currently-sweeping-across-the-us-8345285>

<https://www.theguardian.com/us-news/2022/dec/23/us-weather-bomb-cyclone-us-christmas-latest>

### **3. Towards economical application of carbon capture and utilization technology with near-zero carbon emission**

Carbon capture and utilization technology has been studied for its practical ability to reduce CO<sub>2</sub> emissions and enable economical chemical production. The main challenge of this technology is that a large amount of thermal energy must be provided to supply high-purity CO<sub>2</sub> and purify the product. Herein, we propose a new concept called reaction swing absorption, which produces synthesis gas (syngas) with net-zero CO<sub>2</sub> emission through direct electrochemical CO<sub>2</sub> reduction in a newly proposed amine solution, triethylamine. Experimental investigations show high CO<sub>2</sub> absorption rates (>84%) of triethylamine from low CO<sub>2</sub>-concentrated flue gas. In addition, the CO Faradaic efficiency in a triethylamine-supplied membrane electrode assembly electrolyzer is approximately 30% (@-200 mA cm<sup>-2</sup>), twice higher than those in conventional alkanolamine solvents. Based on the experimental results and rigorous process modeling, we reveal that reaction swing absorption produces high-pressure syngas at a reasonable cost with negligible CO<sub>2</sub> emissions. This system provides a fundamental solution for the CO<sub>2</sub> crossover and low system stability of electrochemical CO<sub>2</sub> reduction.

*Courtesy: Kezia Megagita Gerby Langie et al. Nature Communications volume 13, Article number: 7482 (2022). <https://www.nature.com/articles/s41467-022-35239-9>*

### **4. Carbon capture, utilization, and storage (CCUS) refers to a suite of technologies that can play a diverse role in meeting global energy and climate goals**

CCUS facilities currently capture almost 45 Mt CO<sub>2</sub> globally, but this needs to increase. There are around 35 commercial facilities applying CCUS to industrial processes, fuel transformation, and power generation, with a total annual capture capacity of almost 45 Mt CO<sub>2</sub>. CCUS deployment has been behind expectations in the past but momentum has grown substantially in recent years, with around 300 projects in various stages of development across the CCUS value chain. Project developers have announced ambitions for over 200 new capture facilities to be operating by 2030, capturing over 220 Mt CO<sub>2</sub> per year. However, only around 10 commercial capture projects under development have taken FID as of June 2022. Nevertheless, even at such a level, CCUS deployment would remain substantially below what is required in the Net Zero Scenario. **CO<sub>2</sub> use can bring important climate benefits, but with caveats Around 230 Mt of CO<sub>2</sub> are currently used each year, mainly in direct-use pathways in the fertilizer industry for urea manufacturing (~130 Mt) and for enhanced oil recovery (~80 Mt). New utilization pathways in the production of CO<sub>2</sub>-based synthetic fuels, chemicals,**

**and building aggregates are gaining momentum.** Climate benefits associated with a given CO<sub>2</sub> use depend on the source of the CO<sub>2</sub> (natural, fossil, biogenic, or air-captured), the product or service the CO<sub>2</sub>-based product is displacing, the carbon intensity of the energy used for the conversion process, how long the CO<sub>2</sub> is retained in the product, and the scale of the market for this particular use. The use of low-carbon energy is particularly critical for CO<sub>2</sub> use in fuels and chemical intermediates, as these processes are highly energy-intensive. World's fastest carbon capture system claims 99% efficiency in ambient air.

#### **Electrochemical CO<sub>2</sub> reduction reaction (CO<sub>2</sub>RR)**

Electrochemical CO<sub>2</sub> reduction reaction (CO<sub>2</sub>RR) **provides a promising approach to curbing harmful emissions contributing to global warming.** Electrolysis is **the process by which ionic substances are decomposed into simpler substances when a current is passed through them.** Electrolysis Process: ionic compounds contain charged particles called ions. For example, Sodium Chloride contains positively charged Sodium ions and negatively charged Chlorine ions. However, several challenges hinder the commercialization of this technology, including high over potentials, electrode instability, and low Faradic efficiencies of desirable products

### **5. Climate Change Solution**

Climate change is happening now, and it's the most serious threat to life on our planet. Fortunately, there are plenty of solutions to climate change, and they are well-understood. In 2015, world leaders signed a major treaty called the Paris agreement, to put these solutions into practice. Core to all climate change solutions is reducing greenhouse gas emissions, which must get to zero as soon as possible. Because, both forests and oceans play important roles in regulating our climate, increasing the natural ability of forests and oceans to absorb carbon dioxide to reduce global warming.

The main ways to stop climate change are :

- **Keep fossil fuels in the ground.** Fossil fuels include coal, oil, and gas – and the more that are extracted and burned, the worse climate change will get. All countries need to move their economies away from fossil fuels as soon as possible.
- **Invest in renewable energy.** Changing our main energy sources to clean and renewable energy is the best way to stop using fossil fuels. These include technologies like solar, wind, wave, tidal and geothermal power.
- **Switch to sustainable transport.** Petrol and diesel vehicles, planes, and ships use fossil fuels. Reducing car use, switching to electric vehicles and minimizing plane travel will not only help to reduce climate change, but it will also reduce air pollution too.
- **Help us keep our homes cozy.** Homes shouldn't be draughty and cold – it's a waste of money, and miserable in the winter. The government can help households heat in a green way – such as by insulating walls and roofs and switching away from oil or gas boilers to heat pumps.
- **Improve farming and encourage vegan diets.** One of the best ways for individuals to help stop climate change is by reducing meat and dairy consumption, or by going fully vegan. Businesses and food retailers can improve farming practices and provide more plant-based products to help people make the shift.
- **Restore nature to absorb more carbon.** The natural world is very good at cleaning up our emissions, but we need to look after it. Planting trees in the right places or giving land back to nature through 'rewilding' schemes is a good place to start. This is because photosynthesizing plants draw down carbon dioxide as they grow, locking it away in soils.
- **Protect forests like the Amazon.** Forests are crucial in the fight against climate change, and protecting them is an important climate solution. Cutting down forests on an industrial scale destroys giant trees which could be sucking up huge amounts of carbon. Yet companies destroy forests to make way for animal farming, soya, or palm oil plantations. Governments can stop them by making better laws.
- **Protect the oceans.** Oceans also absorb large amounts of carbon dioxide from the atmosphere, which helps to keep our climate stable. But many oceans are overfished, used for oil and gas drilling or threatened by deep-sea mining. Protecting oceans and the life in them is ultimately a way to protect ourselves from climate change.

• **Reduction in consumption of people.** Our transport, fashion, food and other lifestyle choices all have different impacts on the climate. Of all the plastic we use, 40% is used just once. Every year we use several items such as bags, bottles, trays, and food packaging. Supermarkets are full of it. Some people are careless with packaging and leave it behind as litter. But there are also places where people can't do it because there is no waste collection system. It is without a doubt that even if most people do their best, much of that single-use plastic enters the environment, and is one of the biggest causes of plastic pollution.

• **Reduction in plastic use:** Plastic is so widely used, it almost always ends up in the environment, causing more plastic pollution. Plastic is made from oil, and the process of extracting, refining and turning oil into plastic (or even polyester, for clothing) is **surprisingly carbon-intense**. Plastic carried by water flows downhill to the sea causes plastic pollution to reach the oceans. Rivers, for example, transport a lot of plastic to the sea. But that's not the only way plastic moves around; it can also be transported by the wind. Even in gentle winds, plastic, which is very light, blows away – especially from landfill sites where it is dumped. It doesn't break down quickly in nature so a lot of plastic is burnt, which contributes to emissions. Demand for plastic is rising so quickly that creating and disposing of plastics will account for **17% of the global carbon budget by 2050** (this is the emissions count we need to stay within according to the Paris agreement). Fishing industries release an enormous amount of garbage including plastic material (about 150,000 tons) every year to the water bodies like oceans, rivers, etc. which adversely affects aquatic biodiversity.

**1. Wean yourself off disposable plastics.** Ninety percent of the plastic items in our daily lives are used once and then chucked: grocery bags, plastic wraps, disposable cutlery, straws, and coffee-cup lids. Take note of how often you rely on these products and replace them with reusable versions. It only takes a little time to bring your own bags to the store, silverware to the office, or a travel mug to Starbucks before it becomes a habit.

**2. Stop buying water.** Each year, close to 20 billion plastic bottles are tossed in the trash.

**Carry a reusable bottle in your bag,** those little plastic scrubbers found in so many beauty products—facial scrubs, toothpaste, body washes—might look harmless, but their tiny size allows them to slip through water-treatment plants. Unfortunately, they also look just like food to some marine animals. Opt for products with natural exfoliants, like oatmeal or salt, instead.

**3. Recycle (duh).** It seems obvious, but we're not doing a great job of it. For example, less than 14 percent of plastic packaging is recycled. Confused about what can and can't go in the bin? Check out the number on the bottom of the container. Most beverage and liquid cleaner bottles will be #1 (PET), which is commonly accepted by most curbside recycling companies. Containers marked #2 (HDPE; typically, slightly heavier-duty bottles for milk, juice, and laundry detergent) and #5 (PP; plastic cutlery, yogurt, and margarine tubs, ketchup bottles) are also recyclable in some areas. For the specifics on your area, check out Earth911.org's recycling directory.

**4. Buy in bulk** Single-serving yogurts, travel-size toiletries, tiny packages of nuts—consider the product-to-packaging ratio of items you tend to buy often and select the bigger container instead of buying several smaller ones over time.

**5. Bring your own garment bag to the dry cleaner.** Invest in a zippered fabric bag and request that your cleaned items be returned in it instead of sheathed in plastic. (And while you're at it, make sure you're frequenting a dry cleaner that skips the perc, a toxic chemical found in some cleaning solvents).

**6. Put pressure on manufacturers.** Though we can make a difference through our own habits, corporations obviously have a much bigger footprint. If you believe a company could be smarter about its packaging, make your voice heard. Write a letter, send a tweet, or hit them where it really hurts: Give your money to a more sustainable competitor.

Source: <https://www.greenpeace.org.uk/challenges/climate-change/solutions-climate-change/>

## **6. COP27 (Conference of Parties) Reaches Breakthrough Agreement on New “Loss and Damage” Fund for Vulnerable Countries**

**UN Climate Change News, 20 November 2022** – The United Nations Climate Change Conference COP27 was closed with a breakthrough agreement to provide “loss and damage” funding for vulnerable countries hit hard by climate disasters. The parties have determined a way forward **on a decades-long conversation on funding for loss and damage – deliberating over how we address the impacts on communities whose lives and livelihoods have been ruined by the very worst impacts of climate change.**” Set against a difficult geopolitical backdrop, COP27 resulted in countries delivering a package of decisions that reaffirmed their commitment to limit global temperature rise to 1.5 degrees Celsius above pre-industrial levels. **The package also strengthened action by countries to cut greenhouse**

**gas emissions and adapt to the inevitable impacts of climate change, as well as boosting the support of finance, technology, and capacity building needed by developing countries.** Creating a specific fund for loss and damage marked an important point of progress, with the issue added to the official agenda and adopted for the first time at COP27. Parties also agreed on the institutional arrangements to operationalize the Santiago Network for Loss and Damage, to **catalyze technical assistance to developing countries that are particularly vulnerable to the adverse effects of climate change.** COP27 saw significant progress on adaptation, with governments agreeing **on the way to move forward on the Global Goal on Adaptation**, which will conclude at COP28 and inform the first Global Stocktake, improving resilience amongst the most vulnerable countries. **New pledges, totaling more than USD 230 million, were made to the Adaptation Fund at COP27.** These pledges will help many more vulnerable communities adapt to climate change through concrete adaptation solutions. COP27 President Sameh Shoukry announced the Sharm el-Sheikh Adaptation Agenda, enhancing resilience for people living in the most climate-vulnerable communities by 2030. UN Climate Change's Standing Committee on Finance was requested to prepare a report on doubling adaptation finance for consideration at COP28 next year. **The cover decision, known as the Sharm el-Sheikh Implementation Plan, highlights that a global transformation to a low-carbon economy is expected to require investments of at least USD 4-6 trillion a year.** Delivering such funding will require a swift and comprehensive transformation of the financial system and its structures and processes, engaging governments, central banks, commercial banks, institutional investors, and other financial actors. Serious concern was expressed that the goal of developed country Parties to mobilize jointly USD 100 billion per year by 2020 has not yet been met, with developed countries urged to meet the goal, and multilateral development banks and international financial institutions called on to mobilize climate finance. At COP27, deliberations continued on setting a 'new collective quantified goal on climate finance' in 2024, taking into account the needs and priorities of developing countries. **It gives the key political signals that indicate the phasedown of all fossil fuels is happening.** The World Leaders Summit, held over two days during the first week of the conference, convened six high-level roundtable discussions. The discussions highlighted solutions – on themes including food security, vulnerable communities, and just transition – to chart a path to overcome climate challenges and how to provide the finance, resources, and tools to effectively deliver climate action at scale. COP27 brought together more than 45,000 participants to share ideas and solutions, and build partnerships and coalitions. Indigenous peoples, local communities, cities, and civil society, including youth and children, showcased how they are addressing climate change and shared how it impacts their lives. The decisions taken here today also reemphasize the critical importance of empowering all stakeholders to engage in climate action; in particular, through the five-year action plan on Action for Climate Empowerment and the intermediate review of the Gender Action Plan. These outcomes will allow all Parties to work together to address imbalances in participation and provide stakeholders with the tools required to drive greater and more inclusive climate action at all levels. In parallel with the formal negotiations, the Global Climate Action space at COP27 provided a platform for governments, businesses and civil society to collaborate and showcase their real-world climate solutions. The UN Climate Change High-Level Champions held a two-week programme of more than 50 events. This included a number of major African-led initiatives to cut emissions and build climate resilience and significant work on the mobilization of finance. According to the report, the implementation of current pledges by national governments put the world on track for a 2.5°C warmer world by the end of the century. The UN's Intergovernmental Panel on Climate Change indicates that greenhouse gas emissions must decline 45% by 2030 to limit global warming to 1.5°C. Despite the difficulties and challenges of our times, the divergence of views, level of ambition, or apprehension, the parties remain committed to the fight against climate change rose to the occasion, upheld their responsibilities, and undertook the important decisive political decisions that millions around the world expect from them.

A summary of some of the other key outcomes of COP27 follows below.

**Technology:** COP27 saw the launch of a new five-year work program at COP27 to promote climate technology solutions in developing countries.

**Mitigation:** COP27 significantly advanced the work on mitigation. A mitigation work programme was launched in Sharm el-Sheikh, aimed at urgently scaling up mitigation ambition and implementation. The work programme will start immediately following COP27 and continue until 2026 when there will

be a review to consider its extension. Governments were also requested to revisit and strengthen the 2030 targets in their national climate plans by the end of 2023, as well as accelerate efforts to phasedown unabated coal power and phase-out inefficient fossil fuel subsidies. The decision text recognizes that the unprecedented global energy crisis underlines the urgency to rapidly transform energy systems to be more secure, reliable, and resilient, by accelerating clean and just transitions to renewable energy during this critical decade of action.

**Global Stocktake:** Delegates at the UN Climate Change Conference COP27 wrapped up the second technical dialogue of the first global stocktake, a mechanism to raise ambition under the Paris Agreement. The UN Secretary-General will convene a ‘climate ambition summit’ in 2023, ahead of the conclusion of the stocktake at COP28 next year.

#### **Snapshot of other announcements**

- Countries launched a package of 25 new collaborative actions in five key areas: power, road transport, steel, hydrogen, and agriculture.
- UN Secretary-General António Guterres announced a USD 3.1 billion plan to ensure everyone on the planet is protected by early warning systems within the next five years.  
The UN Secretary-General’s High-Level Expert Group on Net-Zero Commitments published a report at COP27, serving as a how-to guide to ensure credible, accountable net-zero pledges by industry, financial institutions, cities, and regions.
- The G7 and the V20 (‘the Vulnerable Twenty’) launched the Global Shield against Climate Risks, with new commitments of over USD 200 million as initial funding. Implementation is to start immediately.
- Announcing a total of USD 105.6 million in new funding, Denmark, Finland, Germany, Ireland, Slovenia, Sweden, Switzerland, and the Walloon Region of Belgium, stressed the need for even more support for the Global Environment Facility funds targeting the immediate climate adaptation needs of low-lying and low-income states.
- The new Indonesia Just Energy Transition Partnership, announced at the G20 Summit held in parallel with COP27, will mobilize USD 20 billion over the next three to five years to accelerate a just energy transition.
- Important progress was made on forest protection with the launch of the Forest and Climate Leaders’ Partnership, which aims to unite action by governments, businesses, and community leaders to halt forest loss and land degradation by 2030.

*Courtesy: Kiara Worth*

## **7. Biggest Environmental Problems of 2022**

**While the climate crisis has many factors that play a role in the exacerbation of the environment, there are some that warrant more attention than others. Here are some of the biggest environmental problems of our lifetime, from deforestation and biodiversity loss to food waste and fast fashion.**

### **a. Global Warming from Fossil Fuels**

At the time of publication, CO<sub>2</sub> PPM (parts per million) is at 418 and the global temperature rise is 1.1 degrees Celsius compared to pre-industrial levels. The last time carbon dioxide levels on our planet were as high as today was more than 4 million years ago. Increased emissions of greenhouse gases have led to a rapid and steady increase in global temperatures, which in turn is causing catastrophic events all over the world – from Australia and the US experiencing some of the most devastating bushfire seasons ever recorded, locusts swarming across parts of Africa, the Middle East and Asia, decimating crops, and a heat wave in Antarctica that saw temperatures rise above 20 degrees for the first time. Scientists are constantly warning that the planet has crossed a series of tipping points that could have catastrophic consequences, such as advancing permafrost melt in Arctic regions, the Greenland ice sheet melting at an unprecedented rate, accelerating sixth mass extinction, and increasing deforestation in the Amazon rainforest, just to name a few. The climate crisis is causing tropical storms and other weather events such as hurricanes, heatwaves, and flooding to be more intense and frequent than seen before. However, even if all greenhouse gas emissions were halted immediately, global temperatures would continue to rise in the coming years. That is why it is absolutely imperative that we start now to drastically reduce greenhouse gas emissions, invest in renewable energy sources, and phase out our fossil fuels as fast as possible.

### **b. Poor Governance**

According to economists like Nicholas Stern, the climate crisis is a result of multiple market failures. Economists and environmentalists have urged policymakers for years to increase the price of activities that emit greenhouse gases (one of our biggest environmental problems), the lack of which constitutes the largest market failure, for example through carbon taxes, which will stimulate innovations in low-carbon technologies. To cut emissions quickly and effectively enough, governments must not only massively increase funding for green innovation to bring down the costs of low-carbon energy sources, but they also need to adopt a range of other policies that address each of the other market failures. A national carbon tax is currently implemented in 27 countries around the world, including various countries in the EU, Canada, Singapore, Japan, Ukraine, and Argentina. However, according to the 2019 OECD Tax Energy Use report, current tax structures are not adequately aligned with the pollution profile of energy sources. For example, the OECD suggests that carbon taxes are not harsh enough on coal production, although it has proved to be effective for the electricity industry. A carbon tax has been effectively implemented in Sweden; the carbon tax is USD \$127 per tonne and has reduced emissions by 25% since 1995, while its economy has expanded 75% in the same time period. Further, organizations such as the United Nations are not fit to deal with the climate crisis: it was assembled to prevent another world war and is not fit for purpose. Anyway, members of the UN are not mandated to comply with any suggestions or recommendations made by the organization. For example, the Paris Agreement, an agreement within the United Nations Framework Convention on Climate Change, says that countries need to reduce greenhouse gas emissions significantly so that global temperature rise is below 2 degrees Celsius by 2100, and ideally under 1.5 degrees. But signing on to it is voluntary, and there are no real repercussions for non-compliance. Further, the issue of equity remains a contentious issue whereby developing countries are allowed to emit more in order to develop to the point where they can develop technologies to emit less, and it allows some countries, such as China, to exploit this.

### **c. Food Waste**

A third of the food intended for human consumption – around 1.3 billion tons – is wasted or lost. in a year This is enough to feed 3 billion people. Food waste and loss account for one-third of the total greenhouse gas emissions annually. Thus, food waste is the third highest emitter of greenhouse gases in China and the US. Food waste and loss occur at different stages in developing and developed countries; in developing countries, 40% of food waste occurs at the post-harvest and processing levels, while in developed countries, 40% of food waste occurs at the retail and consumer levels. At the retail level, a shocking amount of food is wasted because of aesthetic reasons; in fact, in the US, more than 50% of all produce is thrown away because it is deemed to be “too ugly” to be sold to consumers- this amounts to about 60 million tons of fruits and vegetables. This leads to food insecurity, This is the biggest environmental problem on the list.

### **d. Biodiversity Loss**

The past 50 years have seen rapid growth in human consumption, population, global trade, and urbanization, resulting in humanity using more of the Earth’s resources than it can replenish naturally. A recent WWF report found that the population sizes of **mammals, fish, birds, reptiles, and amphibians have experienced a decline of an average of 68% between 1970 and 2016**. The report attributes this biodiversity loss to a variety of factors, **but mainly land-use change, particularly the conversion of habitats, like forests, grasslands, and mangroves, into agricultural systems**. Animals such as pangolins, sharks, and seahorses are significantly affected by the illegal wildlife trade, and pangolins are critically endangered because of it. More broadly, a recent analysis has found that **the sixth mass extinction of wildlife on Earth is accelerating. More than 500 species of land animals are on the brink of extinction and are likely to be lost within 20 years**; the same number were lost over the whole of the last century. Scientists say that without the human destruction of nature, this rate of loss would have taken thousands of years.

### **e. Plastic Pollution**

In 1950, the world produced more than 2 million tons of plastic per year. By 2015, this annual production swelled to 419 million tons and exacerbating plastic waste in the environment. A report by science journal, Nature, determined that currently, roughly 14 million tons of plastic make their way



into the oceans every year, harming wildlife habitats and the animals that live in them. The research found that if no action is taken, the plastic crisis will grow to 29 million metric tons per year by 2040. If we include microplastics into this, the cumulative amount of plastic in the ocean could reach 600 million tons by 2040. Shockingly, National Geographic found that 91% of all plastic is not recycled, representing not only one of the biggest environmental problems of our lifetime but another massive market failure. Considering that plastic takes 400 years to decompose, it will be many generations until it ceases to exist. There are irreversible effects of plastic on the environment in the long run.

#### **f. Deforestation**

Every hour, forests of the size of 300 football fields are cut down. By the year 2030, the planet might have only 10% of its forests; if deforestation isn't stopped, they could all be gone in less than 100 years. Agriculture is the leading cause of deforestation, causing the biggest environmental problems appearing on this list. The land is cleared to raise livestock or to plant other crops that are sold, such as sugar cane and palm oil. Besides, carbon sequestration, forests help to prevent soil erosion, because the tree roots bind the soil and prevent it from washing away, which also prevents landslides. The three countries experiencing the highest levels of deforestation are Brazil, the Democratic Republic of Congo, and Indonesia, however, Indonesia is tackling deforestation, now seeing the lowest rates since the beginning of the century.

#### **g. Air Pollution**

**Air pollution is one of the biggest environmental problems.** Research from the World Health Organization (WHO) shows that an estimated 4.2 to 7 million people die from air pollution worldwide every year and that nine out of 10 people breathe air that contains high levels of pollutants. **In Africa, 2,58,000 people died as a result of outdoor air pollution in 2017, up from 164,000 in 1990, according to UNICEF. Causes of air pollution mostly come from industrial sources and motor vehicles, as well as emissions from burning biomass and poor air quality due to dust storms. In Europe, a recent report from the EU's environment agency showed that air pollution contributed to 400 000 annual deaths in the EU in 2012 (the last year for which data was available). In the wake of the COVID-19 pandemic, attention has been put on the role that air pollution gases are spreading the virus molecules.** Preliminary studies have identified a positive correlation between COVID-19-related mortalities and air pollution and there is also a plausible association of airborne particles assisting the viral spread. This could have contributed to the high death toll in China, where air quality is notoriously poor, **although more definitive studies must be conducted before such a conclusion can be drawn.**

#### **h. Melting Ice Caps and Sea Level Rise**

The warming of the Arctic is more than twice as fast as anywhere else on the planet due to the climate crisis. The sea levels are rising more than twice as quickly in the 20th century as a result of increasing temperatures on Earth. Seas are now rising an average of 3.2 mm per year globally and they will continue to grow up to about 0.7 metres by the end of this century. **In the Arctic, the Greenland Ice Sheet poses the greatest risk for sea levels because melting land ice is the main cause of rising sea levels. The last year's summer triggered the loss of 60 billion tons of ice from Greenland, enough to raise global sea levels by 2.2mm in just two months.** According to satellite data, the Greenland ice sheet lost a record amount of ice in 2019: an average of a million tons per minute throughout the year, one of the biggest environmental problems that has cascading effects. If the entire Greenland ice sheet melts, sea level would rise by meters. **Meanwhile, the Antarctic continent contributes about 1 millimetre per year to sea level rise, which is one third of the annual global increase.** Additionally, the last fully intact ice shelf in Canada in the Arctic region recently collapsed, having lost about 80 square kilometers – or 40% – of its area over a two-day period in late July, according to the Canadian Ice Service. according to research and advocacy group Climate, The sea level rise will have a devastating impact on those living in coastal regions. **The sea level rise in this century could flood coastal areas that are now home to 340 million to 480 million people, forcing them to migrate to safer areas and contributing to overpopulation and strain of resources in the areas they migrate to.** Take Shanghai's megalopolis for example, which is built around the low-lying Yangtze River delta. As the fourth most populous city in the world, the flood risk in the area is high due to its geographical

position. **Any flooding caused by a higher rainfall can potentially be catastrophic in relation to evacuation, water management, and property damage.**

#### **i. Ocean Acidification**

The rise in Global temperature has not only affected the surface, but it is the main cause of ocean acidification. **Our oceans absorb about 30% of carbon dioxide that is released into the Earth's atmosphere.** As higher concentrations of carbon emissions are released to the atmosphere due to burning fossil fuels as well as increased rates of wildfires, more carbon dioxide is absorbed in the sea causing ocean acidification. **The smallest change in the pH scale can have a significant impact on the acidity of the ocean. Ocean acidification can have a ripple effect across marine ecosystems and species, its food webs, and provoke irreversible changes in habitat quality. Once pH levels reach too low, marine organisms such as oysters, their shells and skeleton could even start to dissolve.** However, one of the biggest environmental problems from ocean acidification is **coral bleaching and subsequent coral reef loss.** This is a phenomenon that occurs when rising ocean temperatures disrupt the symbiotic relationship between the reefs and algae that live within it, driving away the algae and causing coral reefs to lose their naturally vibrant colours. Some scientists have estimated coral reefs are at risk and shall be completely wiped out by 2050. **The higher acidity in the ocean would obstruct coral reef systems' i.e ability to rebuild their exoskeletons and recover from their coral bleaching events. Some studies have also found that ocean acidification can be linked as one of the effects on plastic pollution in the ocean. The accumulating bacteria and microorganisms derived from the plastic garbage dumps in the ocean can damage marine ecosystems and contribute towards coral bleaching.**

#### **j. Agriculture**

**Studies have shown that the global food system is responsible for up to one-third of all human-caused greenhouse gas emissions, of which 30% comes from livestock and fisheries.** Crop production releases greenhouse gases such as nitrous oxide through the use of fertilizers. **60% of the world's agricultural area is dedicated to cattle ranching, although it only makes up 24% of global meat consumption. Agriculture not only covers a vast amount of land but also consumes a vast amount of freshwater, another biggest environmental problem on this list. While arable lands and grazing pastures cover one-third of the Earth's land surfaces, they consume three-quarters of the world's limited freshwater resources. Scientists and environmentalists have continuously warned that we need to rethink our current food system; switching to a more plant-based diet which can dramatically reduce the carbon footprint of the conventional agriculture industry.**

#### **k. Food and Water Insecurity**

**Rising temperatures and unsustainable farming practices have resulted in an increasing threat to water and food insecurity, posing one of the biggest environmental problems today. Globally, more than 68 billion tonnes of top-soil is eroded every year at a rate 100 times faster than natural replenishment.** Laden with biocides and fertilizer, the soil ends up in waterways where it contaminates drinking water and protected areas downstream. Furthermore, exposed and lifeless **soil is more vulnerable to wind and water erosion due to the lack of root and mycelium systems that hold it together.** A key contributor to soil erosion is over-tilling: although it increases productivity in the short-term by mixing in surface nutrients (e.g. fertilizer), tilling is physically destructive to the soil's structure and in the long-term leads to soil compaction, loss of fertility, and surface crust formation that worsens topsoil erosion. With the global population expected to reach 9 billion people by the mid-century, the Food and Agriculture Organization of the United Nations (FAO) projects that global food demand may increase by 70% by 2050. Around the world, more than 820 million people do not get enough to eat. The UN secretary-general António Guterres says, "Unless immediate action is taken, it is increasingly clear that there is an impending global food security emergency that could have long-term impacts on hundreds of millions of adults and children." **He urged for countries to rethink their food systems and encouraged more sustainable farming practices. In terms of water security, only 3% of the world's water is fresh water, and two-thirds of that is tucked away in frozen glaciers or otherwise unavailable for our use. As a result, some 1.1 billion people worldwide lack access to water, and**

**a total of 2.7 billion find water scarce for at least one month of the year. By 2025, two-thirds of the world's population may face water shortages.**

### **l. Fast Fashion and Textile Waste**

The global demand for fashion and clothing has risen at an unprecedented rate that the **fashion industry now accounts for 10% of global carbon emissions, becoming one of the biggest environmental problems of our time.** Fashion alone produces more greenhouse gas emissions than both the aviation and shipping sectors combined, and **nearly 20% of global wastewater, or around 93 billion cubic metres from textile dyeing, according to the UN Environment Programme.** What's more, the world at least generated an estimated 92 million tonnes of textiles waste every year, and that number is expected to soar up to 134 million tonnes a year by 2030. **Discarded clothing and textile waste end up in landfills, most of which is non-biodegradable, while microplastics from clothing materials such as polyester, nylon, polyamide, acrylic and other synthetic materials, is leached into soil and nearby water sources.** Monumental amounts of clothing textiles are also dumped in less developed countries as seen with Chile's Atacama, the driest desert in the world, where at least 39,000 tonnes of textile waste from other nations are left there to rot. This rapidly growing issue is only exacerbated by the ever-expanding fast fashion business model, in which companies rely on cheap and speedy production of low-quality clothing to meet the latest and newest trends. While the United Nations Fashion Industry Charter for Climate Action sees signatory fashion and textile companies to commit to achieving net zero emissions by 2050, a majority of businesses around the world have yet to address their roles in climate change. While these are some of the biggest environmental problems plaguing our planet, there are many more that have not been mentioned, including overfishing, urban sprawl, toxic superfund sites, and land use changes. While there are many facets that need to be considered in formulating a response to the crisis, they must be coordinated, practical, and far-reaching enough to make enough of a difference.

### **m. Overfishing**

Over three billion people around the world rely on fish as their primary source of protein. About 12% of the world relies upon fisheries in some form or another, with 90% of these being small-scale fishermen – think a small crew in a boat, not a ship, using small nets or even rods and reels and lures not too different from the kind you probably use. Of the 18.9 million fishermen in the world, 90% of them fall under the latter category.

*Courtesy: Deena Robinson, Africa Americas Asia Europe Global Commons Oceania Sept 3rd 2022*

### **8. Using vegetable peels as fertilizer – a natural way to nourish your plants**

Using vegetable peels as fertilizer is an organic way to improve your plants' health and cut down on food waste (Using vegetable peels as fertilizer is a tried-and-tested method that we love. From celery and broccoli to potatoes, these foods are famed for their healthy relationship to the human body. Experts have revealed that these pieces of organic goodness are just as impactful in the garden, where you can use your offcuts and leftover vegetables as a fertilizer – to boost your plant growth the natural way. While this garden idea may sound surprising, the steps behind its success are refreshingly simple – and you will reap the benefits throughout the season ahead. This is how to use vegetable peels as fertilizer, the expert way.

#### **Using Vegetable Peels As Fertilizer – Liquid Method**

There are two main ways to use your vegetable peels as fertilizer – the first involves creating a mixture using your peels and water. According to garden expert and the founder of Urban Organic Yield (opens in new tab), Lindsey Hyland, this method comes with a host of benefits, including a 'high level of nitrogen, potassium, and phosphorus – all nutrients that plants need to thrive. Begin by collecting your vegetable peels and placing them in a container. Then pour water over the top of the leftovers until they are covered and leave them to soak for at least 24 hours. Then you should pour the mixture through a strainer (to remove the peels) before adding the remaining liquid to your garden beds or potted plants. 'Using vegetable peel as fertilizer, or banana peels as fertilizer can help to improve the structure of your soil and increase its ability to retain moisture,' Lindsey adds. 'And, if you want to regain control of your garden, using orange peels to deter pest will help tremendously. This method is also recommended by

the founder of Hello Gardening, Michael Alves, who adds that this technique will drench your plants in 'micronutrients' and prevent you from having to invest in commercial fertilizer. This is the kitchen garden idea that may change how you plant for good.

### **Using Vegetable Peels As Fertilizer – Trench Method**

Another way to use vegetable peels as fertilizer is through a planting method – approved by Kelsey Lorencz, a Registered Dietitian Nutritionist at Graciously Green Eats.' Vegetable peels and scraps break down and add nutrients like vitamin C and calcium to the soil, which makes them ideal for composting. If you don't have a composting system, you can still reap the benefits of using vegetable peels in your garden to fertilize your plants and cut down on food waste,' Kelsey says. You begin by digging a trench that is 8-12 inches deep in your garden before filling the trench with your vegetable peels and scraps. 'The smaller they are, the more quickly they will decompose to add nutrients to the soil,' the nutritionist explains. Then cover the scraps with at least 6 inches of soil (to prevent pests from finding and digging them out). 'To avoid having to dig and fill as often, keep a bag in your freezer filled with vegetable peels and scraps and add them to the garden weekly or when it's full,' Kelsey adds. When your kitchen ideas meet your garden, it's a match made in plant heaven.

### **9. World's largest International Thermonuclear Experimental Reactor (ITER) as part of a global effort to harness nuclear fusion power for CLEAN ENERGY in France.**

A total of 35 countries are working together on this nuclear fusion program at a facility in Provence (France), near Marseilles, hoping it could **pave the way for a new source of unlimited, clean energy for the entire planet.** Notably, ITER is one of the last international scientific projects in which Russia is still participating amid the ongoing Ukraine crisis. The ship carrying the Russian-made magnet, or 'the 200-ton poloidal field coil,' was despatched from St. Petersburg on November 1, 2022. This coil will act as a magnet once an electric current flows through it. "The 200-ton coil is a unique, innovative solution and a key element of the thermonuclear reactor. Fourteen years of fruitful creative work have been completed. Today we are shipping this coil, which is a truly significant event," the special representative of the state corporation Rosatom for international and scientific and technical projects, Vyacheslav Pershukov, said. The 200-ton, nine-meter-wide coil had been tightly wrapped to withstand the two-week trip to Marseille in the south of France. It is only one of six such poloidal field coils that are expected to start and maintain thermonuclear fusion. The press service of the equipment developer, DV Yefremov NIIIEFA, told TASS that Chinese specialists are responsible for manufacturing one coil. The remaining four larger coils will be made in France.

### **Nuclear Fusion vs. Fission**

Currently, the nuclear power plants on the planet produce energy through nuclear fission, in which high-speed neutrons bombard atoms to split them apart, releasing a massive amount of energy. Nuclear fusion is the opposite of this process, as it involves the fusion of two atoms into one, which also releases immense energy. Fission and fusion nuclear reactions are chain reactions, which means that one nuclear event causes successive nuclear reactions. This cycle of reactions can quickly get out of control, making the fission reaction, in particular, very risky. If a fission reaction gets out of control, it will either explode or the reactor generating it will melt down into a giant pile of radioactive slag, releasing tons of radioactive particles into the air and contaminating large areas. On the other hand, when a fusion reaction loses control, it slows down, and the internal temperatures drop until the reaction stops, producing little radioactive waste in the process. Any damage would be confined to the immediate surroundings of the fusion reactor. Therefore, nuclear fusion is considered a clean, safe, and unlimited energy source.

### **The ITER (International Thermonuclear Experimental Reactor) Project**

**As part of the ITER project, the 35 partner countries are building the world's largest 'tokamak' – a giant, doughnut-shaped magnetic fusion device. The device is designed to use three primary types of magnets or coils, namely the central solenoid magnet, poloidal magnets, and toroidal-field coils.** The central solenoid is a coil positioned in the center to induce and maintain a powerful electric current in the plasma – a gas of charged particles – which will result in the energy-producing fusion reaction. The current inside the central solenoid induces a current within the plasma, which must

be shaped to keep it away from the walls, and this is where the poloidal field coils come in. The six horizontal circular coils around the outer edges of the tokamak are supposed to direct the plasma current toward the centre, thereby keeping it from approaching the walls. Then the 18 toroidal-field coils, which are huge D-shaped windings that wrap around the plasma. They are supposed to generate a field parallel to the plasma current to induce a spiral motion, which will also help stabilize the plasma and keep it away from the walls. The Russian-made poloidal field coil was initially scheduled for shipping in May 2022, but sanctions forbade Russian ships from docking in Europe. "Without (the Russian coil), the tokamak will not work," senior ITER center scientist Leonid Khimchenko told AFP. Andrey Mednikov, a scientist in charge of producing the poloidal field coil, praised the continuing international cooperation. "If this cooperation were halted, everyone would lose," Mednikov said. The ongoing tensions between Russia and the West are reminiscent of the circumstances under which the ITER project was set in motion in 1985 when US President Ronald Reagan and Soviet Union leader Mikhail Gorbachev met to discuss how to cool tensions between the two superpowers. **U.S. President Ronald Reagan and Soviet General Secretary Mikhail Gorbachev met for the first time in 1985 in Geneva, where they jointly proposed an extensive international scientific collaboration to open the way to a new source of energy "for the benefit of all mankind."** "They would jointly work on fusion as an energy source," From that meeting, the idea of the ITER project developed further, taking various iterations until it grew to include participation from 35 partner nations, including China, India, South Korea, Japan, and the nations of the European Union.

*Courtesy: Tanmay Kadam, Nov 4 2022, E-Mail: tanmaykadam700@gmail.com*

#### **10. Earth Is Now In A "Code Red" Situation Due To Climate Change.**

**Scientists have warned that the earth's condition has deteriorated to the point where "humanity is unequivocally facing a climate hazard.** A report released on October 26, 2022 - An international team of scientists claims that the state of the planet Earth has deteriorated to the point that humanity is unequivocally facing a Climate Emergency with climate extreme level, released in the journal *BioScience*. Therefore, we urge scientists, citizens, and world leaders to read this special report and quickly take the necessary actions to avoid the worst effects of climate change, the report warns. **According to the report, 2022 marks the 30th anniversary of the "World Scientists' Warning to Humanity," signed by more than 1700 scientists in 1992. Since this original warning, there has been a roughly 40% increase in global greenhouse gas emissions.**" As Earth's temperatures are creeping up, the frequency or magnitude of some types of climate disasters may actually be leaping up," said the University of Sydney's Thomas Newsome. **"We urge our fellow scientists around the world to speak out on climate change." The report further stated that humans are now regularly seeing events and disasters that previously occurred only rarely. Tragically, these disasters disproportionately harm poor people in low-income regions that have made minimal contributions to the build-up of greenhouse gases. "For example, in the summer of 2022, one-third of Pakistan was flooded, displacing 33 million people and affecting 16 million children."** The report is a follow-up to the 1992 publication of the World Scientists' Warning to Humanity and the 2017 update, World Scientists' Warning to Humanity: A Second Notice, which was co-signed by more than 15,000 scientists from 184 nations.

*Source: <https://timesofindia.indiatimes.com/city/bhubaneswar/study-climate-change-making-odisha-vulnerable-to-cyclones/articleshow/95069882.cms>*

*World News Edited by Nikhil Pandey Updated: October 29, 2022*

#### **11. Climate change making Odisha vulnerable to cyclones- A Study**

A joint study conducted by professors of the National Institute of Science Education and Research (NISER) and Berhampur University has **suggested that the frequency of cyclones in coastal Odisha has gone up alarmingly since 1999, the year of the Super Cyclone. The paper said while the state faced 10 cyclones since since 1737, between 1999 and 2021, it faced nine, including two of the most disastrous ones - Phailin (2013) and Fani (2019), the later being an extremely severe cyclonic storm. The study - conducted by Amarendra Das, Associate professor of school of economics, humanities and social sciences, NISER; Sasmita Behera, a research scholar at NISER and Dr Bibhunandini Das, Assistant professor of economics at Berhampur University - focuses on a micro level (at panchayat and urban body) funding, planning and preparedness to mitigate disasters. It**

broadly stresses on making panchayats and urban bodies self-sufficient in terms of funding to handle natural calamities - floods, cyclones, droughts, heatwaves, and earthquakes - at their end. For this, the researchers said the local self-governance institutions need to be accorded statutory power so that they are able to take their own decisions. **"Owing to climate change, Odisha has been facing quite a few challenges in terms of natural calamities - be it flood, cyclone in coastal region or unbearable heat wave across the state, mostly in western districts.** The sixth assessment report of the intergovernmental panel on climate change (IPCC) forecasts that global warming will increase by 1.5 degree Celsius between 2021 and 2040, compared to the mean temperature of the pre-industrial era (1850-1900)," said Das. In December 2021, the Odisha government had brought an ordinance to amend the Odisha Grama Panchayat Act (OGPA), 1964, and Odisha Panchayat Samiti Act (OPSA), 1959. Thus, the government had expanded the powers of the panchayats provided under Clause 44 (h), which required them to introduce measures to control the spread of epidemic and other infectious diseases. The amendment also empowered the panchayats to prepare disaster management plans at the village level. **The paper said local governance has the advantage of being close to the communities and that can help assess the vulnerabilities of the people.**

## **12. Battery made of crab shell and zinc is rechargeable and biodegradable**

A zinc battery made using a compound from crab shells can be recharged at least 1000 times. **The Piles of crab shells could be used to make zinc batteries work more efficiently.** A rechargeable battery made from crab shells and zinc could store wind and solar energy, and then its parts can either safely biodegrade within a matter of years or be recycled. The key is chitosan, a compound derived from chitin, a substance found in crab and shrimp shells. The battery could provide impressive power storage and be recharged at least 1000 times, says Liangbing Hu at the University of Maryland. Lithium-ion batteries are the current standard, but their production requires mining lithium, which can damage the environment, and there are limited supplies of the metal. Batteries based on zinc ions are an interesting alternative because zinc is so abundant in nature, says Hu. However, zinc-ion batteries usually can't be charged many times and perform poorly because the water inside the battery – which is necessary as a conductor for the ions – corrodes the zinc and forms deposits on the anode that interfere with the battery's function. Hu decided to investigate chitosan because its molecules bond well with water, which means fewer water molecules should be available to react with the zinc, which might help prevent zinc corrosion. Biodegradable and widely available in nature throughout the world, chitosan is safe and inexpensive, says Hu. A single coin-sized cell battery membrane 2 centimeters wide that separates the anode from the cathode would only require 20 micrograms of commercially available chitosan powder, which would cost about US 0.00017 cents. Hu and his colleagues created a flexible, transparent membrane that contained chitosan and zinc ions, compressing it until it was flat and dense. They then placed this over the zinc anode. The cathode was made of an organic compound known as poly (benzoquinonyl sulphide) or PBQS. Testing showed that the membrane allowed high, fast conductivity of zinc ions without the typical zinc corrosion in water. Instead, particles of zinc turned into microscopic hexagonal platelets that piled up in flat layers along the side of the test battery's anode – continuing to help reduce unwanted reactions with the zinc. As for performance and lifespan, the prototype operated at a high current density of 50 milliamperes per square centimeter for 400 hours – or 1000 cycles of charge, which is comparable to small lithium batteries. "It is not an easy thing for batteries to operate at high current density," says Hu. Inside a closed battery, chitosan would gradually degrade over a period of several years, and the remaining zinc could be recycled, he says.

*Courtesy: Christa Lesté-Lasserre, Journal reference: Matter, DOI: 10.1016/j.matt.2022.07.015*

## **13. How does heat impact health?**

Heat gain in the human body can be caused by a combination of external heat from the environment and internal body heat generated from metabolic processes. **Rapid rises in heat gain due to exposure to hotter-than-average conditions compromise the body's ability to regulate temperature and can result in a cascade of illnesses, including heat cramps, heat exhaustion, heatstroke, and hyperthermia. Deaths and hospitalizations from heat can occur extremely rapid** on the same day or have a lagged effect (several days later) and result in accelerating death or illness. Even small differences from seasonal average temperatures are associated with increased illness and death. **Temperature extremes can also worsen chronic conditions, including cardiovascular, respiratory,**

**and cerebrovascular disease and diabetes-related conditions. Heat also has important indirect health effects. Heat conditions can alter human behavior, the transmission of diseases, health service delivery, air quality, and critical social infrastructure such as energy, transport, and water.** The scale and nature of the health impacts of heat depending on the timing, intensity, and duration of a temperature event, the level of acclimatization, and the adaptability of the local population, infrastructure, and institutions to the prevailing climate. The precise threshold at which temperature represents a hazardous condition varies by region, other factors such as humidity and wind, local levels of human acclimatization, and preparedness for heat conditions.

### **What actions should the public take?**

#### **Keep your home cool**

- Aim to keep your living space cool. Check the room temperature between 08:00 am and 10:00 am, at 13:00, and at night after 22:00. Ideally, the room temperature should be kept below 32 °C during the day and 24 °C during the night. This is especially important for infants or people who are over 60 years of age or have chronic health conditions.
- Use the night air to cool down your home. Open all windows and shutters during the night and the early morning, when the outside temperature is lower (if safe to do so).
- Reduce the heat load inside the apartment or house. Close windows and shutters (if available) especially those facing the sun during the day. Turn off artificial lighting and as many electrical devices as possible.
- Hang shades, draperies, awnings or louvers on windows that receive morning or afternoon sun.
- Hang wet towels to cool down the room air. Note that the humidity of the air increases at the same time.
- If your residence is air-conditioned, close the doors and windows and conserve electricity not needed to keep you cool, to ensure that power remains available and reduce the chance of a community-wide outage.
- Electric fans may provide relief, but when the temperature is above 35 °C, may not prevent heat-related illness. It is important to drink fluids.

#### **Keep out of the heat**

- Move to the coolest room in the home, especially at night.
- If it is not possible to keep your home cool, spend 2–3 hours of the day in a cool place (such as an air-conditioned public building).
- Avoid going outside during the hottest time of the day.
- Avoid strenuous physical activity if you can. If you must do strenuous activity, do it during the coolest part of the day, which is usually in the morning between 4:00 and 7:00.
- Stay in the shade.
- Do not leave children or animals in parked vehicles.

#### **Keep the body cool and hydrated**

- Take cool showers or baths. Alternatives include cold packs and wraps, towels, sponging, foot baths, etc.
- Wear light, loose-fitting clothes of natural materials. If you go outside, wear a wide-brimmed hat or cap and sunglasses.
- Use light bed linen and sheets, and no cushions, to avoid heat accumulation.
- Drink regularly, but avoid alcohol and too much caffeine and sugar.
- Eat small meals and eat more often. Avoid foods that are high in protein

#### **Help others**

- Plan to check on family, friends, and neighbors who spend much of their time alone. Vulnerable people might need assistance on hot days.
- Discuss extreme heat-waves with your family. Everyone should know what to do in the places where they spend time.
- If anyone you know is at risk, help him or her to get advice and support. Elderly or sick people living alone should be visited at least daily.
- If a person is taking medication, ask the treating doctor how it can influence thermoregulation and fluid balance.

- Get training. Take a first-aid course to learn how to treat heat emergencies and other packaging). emergencies. Everyone should know how to respond.
- Keep medicines below 25 °C or in the refrigerator (read the storage instructions on the Seek medical advice if you are suffering from a chronic medical condition or taking multiple medications).

#### **If you or others feel unwell**

- Try to get help if you feel dizzy, weak, anxious, or have intense thirst and headache; move to a cool place as soon as possible and measure your body temperature.
- Drink some water or fruit juice to rehydrate.
- Rest immediately in a cool place if you have painful muscular spasms (particularly in the legs, arms or abdomen, in many cases after sustained exercise during very hot weather), and drink oral rehydration solutions containing electrolytes. Medical attention is needed if heat cramps last more than one hour.
- Consult your doctor if you feel unusual symptoms or if symptoms persist. If one of your family members or people you assist presents hot dry skin and delirium, convulsions, and/or unconsciousness, call a doctor/ambulance immediately. While waiting for help, move the person to a cool place, put him or her in a horizontal position and elevate legs and hips, remove clothing and initiate external cooling, for example, by placing cold packs on the neck, axillae, and groin, fanning continuously and spraying the skin with water at 25–30 °C. Measure the body temperature. Do not give acetylsalicylic acid or paracetamol.

#### **14. Biodiversity and Health**

Humanity relies on well-functioning ecosystems. They provide clean air, fresh water, medicines, and food security. They also limit disease and stabilize the climate. **But biodiversity loss is happening at unprecedented rates, impacting human health worldwide, according to a state of knowledge report jointly published by the Convention on Biological Diversity (CBD) and the World Health Organization (WHO).** Biodiversity underpins all life on Earth, and refers to biological variety in all its forms, from the genetic makeup of plants and animals to cultural diversity. People depend on biodiversity in their daily lives, in ways that are not always apparent or appreciated. Human health ultimately depends upon ecosystem products and services (such as the availability of fresh water, food and fuel sources) which are requisite for good human health and productive livelihoods. Biodiversity loss can have significant direct human health impacts if ecosystem services are no longer adequate to meet social needs. **Indirectly, changes in ecosystem services affect livelihoods, income, and local migration and, on occasion, may even cause or exacerbate political conflict. Additionally, the biological diversity of microorganisms, flora, and fauna provides extensive benefits for biological, health, and pharmacological sciences. Significant medical and pharmacological discoveries are made through a greater understanding of the earth's biodiversity. Loss of biodiversity may limit the discovery of potential treatments for many diseases and health problems.**

#### **Threats to biodiversity and health**

There is growing concern about the health consequences of biodiversity loss. **Biodiversity changes affect ecosystem functioning and significant disruptions of ecosystems can result in life-sustaining ecosystem goods and services. Biodiversity loss also means that we are losing, before discovery, many of nature's chemicals and genes, of the kind that have already provided humankind with enormous health benefits.**

#### **Nutritional impact of biodiversity**

Biodiversity plays a crucial role in human nutrition through its influence on world food production, as it **ensures the sustainable productivity of soils and provides the genetic resources for all crops, livestock, and marine species harvested for food.** Access to the sufficiency of a nutritious variety of food is a fundamental determinant of health. Nutrition and biodiversity are linked at many levels: the ecosystem, with food production as an ecosystem service; the species in the ecosystem and the genetic diversity within species. The nutritional composition between foods and among varieties/cultivars/breeds of the same food can differ dramatically, affecting micronutrient availability in the diet. Healthy local diets, with adequate average levels of nutrient intake, necessitate the maintenance of high biodiversity levels. **Intensified and enhanced food production through irrigation, use of fertilizer, plant protection (pesticides) or the introduction of crop varieties and**



**cropping patterns affect biodiversity**, and thus impact global nutritional status and human health. Habitat simplification, species loss, and species succession often enhance communities' vulnerabilities as a function of environmental receptivity to ill health.

### **Importance of biodiversity for health research and traditional medicine**

**Traditional medicines continue to play an essential role in health care, especially in primary health care. Traditional medicines are estimated to be used by 60% of the world's population and in some countries are extensively incorporated into the public health system. Medicinal plant use is the most common medication tool in traditional medicine and complementary medicine worldwide.** Medicinal plants are supplied through collection from wild populations and cultivation. Many communities rely on natural products collected from ecosystems for medicinal and cultural purposes, in addition to food. Although synthetic medicines are available for many purposes, the global need and demand for natural products persist for use as medicinal products and biomedical research that relies on plants, animals, and microbes to understand human physiology and to understand and treat human diseases.

### **Infectious diseases**

**Human activities are disturbing both the structure and functions of ecosystems and altering native biodiversity.** Such disturbances reduce the abundance of some organisms, cause population growth in others, modify the interactions among organisms, and alter the interactions between organisms and their physical and chemical environments. Patterns of infectious diseases are sensitive to these disturbances. **Major processes affecting infectious disease reservoirs and transmission include deforestation; land-use change; water management e.g. through dam construction, irrigation, uncontrolled urbanization or urban sprawl; resistance to pesticide chemicals used to control certain disease vectors; climate variability and change; migration and international travel and trade; and the accidental or intentional human introduction of pathogens.**

### **Climate change, biodiversity and health**

Biodiversity provides numerous ecosystem services that are crucial to human well-being at present and in the future. Climate is an integral part of ecosystem functioning and human health is impacted directly and indirectly by the results of climatic conditions upon terrestrial and marine ecosystems. **Marine biodiversity is affected by ocean acidification related to levels of carbon in the atmosphere. Terrestrial biodiversity is influenced by climate variability, such as extreme weather events (i.e. drought, flooding) that directly influence ecosystem health and the productivity and availability of ecosystem goods and services for human use.** Longer-term changes in climate affect the viability and health of ecosystems, influencing shifts in the distribution of plants, pathogens, animals, and even human settlements.

### **Key Facts**

The management of natural resources can determine that **Biodiversity provides many goods and services essential to life on earth** baseline health status of a community. **Environmental stewardship can contribute to secure livelihoods and improve the resilience of communities. The loss of these resources can create the conditions responsible for morbidity or mortality.**

- **Biodiversity supports human and societal needs, including food and nutrition security, energy, development of medicines and pharmaceuticals, and freshwater, which together underpin good health. It also supports economic opportunities and leisure activities that contribute to overall well-being.**
- **Land use change, pollution, poor water quality, chemical and waste contamination, climate change, and other causes of ecosystem degradation all contribute to biodiversity loss and, can pose considerable threats to human health.**
- **Human health and well-being are influenced by the health of local plant and animal communities, and the integrity of the local ecosystems that they form.**
- **Infectious diseases** cause over one billion human infections per year, with millions of deaths each year globally. Approximately two-thirds of known human infectious diseases are shared with animals, and the majority of recently emerging diseases are associated with wildlife.

### **15. NASA Satellite Image Shows World's Largest Iceberg Heading To Its Doom**

Antarctic iceberg A-76A, is the biggest remaining piece of the largest floating iceberg. **It was slowly drifting along Antarctica for more than a year, but its melting has accelerated now and the iceberg is heading for its demise.** In a new satellite image revealed by American space agency NASA, Antarctic iceberg A-76A, the biggest remaining piece of what was once the largest iceberg, could be soon heading towards its demise. As per the US National Ice Centre, the iceberg is 135 kilometres long and 26 kilometres wide (measured in June 2021) - an area equal to about twice the size of London. It is the **biggest chunk of the Rhode Island-size A-76, the previous largest iceberg in the world, which broke off from the western side of the Ronne Ice Shelf in Antarctica in May 2021 and later split into three pieces: 76A, 76B, and 76C,** *Live Science* reported. Iceberg 76A is the largest among these pieces. It was slowly drifting along Antarctica for more than a year, but its melting has accelerated now and the iceberg is heading for its eventual demise, the outlet further said. A-76A was photographed on October 31 by NASA's Terra satellite, in its natural-colour image, as it floated in the mouth of the Drake Passage, a narrow strait connecting the Pacific and Atlantic oceans between Cape Horn in South Africa and the South Shetland Islands to the north of the Antarctic Peninsula. The iceberg is currently visible in the image between Elephant Island and the South Orkney Islands, which are both hidden by clouds, at the southern end of the route, but its path suggests that it may soon move farther north into the canal. The picture was published online by NASA's Earth Observatory on November 4. NASA said, "Icebergs are not sea ice; they are the floating fragments of glaciers or ice shelves, whereas sea ice is frozen seawater that floats on the ocean surface." It remains to be seen where A-76A will drift next. It is already more than 500 kilometres north of its position in July 2022, when the European Space Agency's Sentinel-1 satellite showed the berg passing the Antarctic Peninsula, the space agency further said.

*Courtesy: Anushka Sharma, Updated: November 12, 2022*

### **16. Millimetre-wave beams could give us access to deep geothermal energy**

Optimised in the field of fusion research, **millimetre-wave beam technology could be adapted to access the heat that lies several kilometres below Earth's surface.** For years, those looking to generate electricity without using fossil fuels have dreamed of tapping the virtually unlimited heat source that lies 8 kilometers or more beneath the Earth's surface. Prior efforts have been stymied because getting to that heat entails drilling into the rock that is too hard for conventional techniques. Now, one tantalising possibility involves repurposing an existing technology to tap into this source and produce electricity at a lower cost than any existing form of power generation. This isn't, however, simply a matter of economics. Even if all nations were to meet the pledges that were made under the Paris Agreement on climate change.

*Courtesy: Eugene Linden, 10 August 2022*

## **PLANETARY SCIENCE**

### **17. NASA's Artemis mission**

The **Artemis program** is a robotic and human Moon exploration program led by the United States National Aeronautics and Space Administration (NASA) along with three partner agencies: European Space Agency (ESA), Japan Aerospace Exploration Agency (JAXA), and Canadian Space Agency (CSA). The Artemis program intends to re-establish a human presence on the Moon for the first time since the Apollo 17 mission in 1972. The major components of the program are the Space Launch System (SLS), Orion spacecraft, the Lunar Gateway space station, and the commercial Human Landing Systems. The program's long-term goal is to establish a permanent base camp on the Moon and facilitate human missions to Mars. The Artemis program is a collaboration of government space agencies and private spaceflight companies, bound together by the Artemis Accords and supporting contracts. As of July 2022, twenty-one countries have signed the accords, including traditional U.S. space partners (such as the European Space Agency as well as agencies from Canada, Japan, and the United Kingdom) and emerging space powers such as Brazil, South Korea, and the United Arab Emirates. The Artemis program was formally established in 2017 during the Trump administration; however, many of its components such as the Orion spacecraft were developed during the previous Constellation program

(2005–2010) during the Bush administration. Orion's first launch, and the **first use of the Space Launch System, was originally set for 2016 but was rescheduled and launched on 16 November 2022 as the Artemis 1 mission, with robots and mannequins aboard. According to the plan, the crewed Artemis 2 launch will take place in 2024, the Artemis 3 crewed lunar landing in 2025, the Artemis 4 docking with the Lunar Gateway in 2027, and future yearly landings on the Moon thereafter.** However, some observers note that the program's cost and timeline are likely to be overrun and delayed due to, according to internal and external reviews, NASA's inadequate management of contractors.

### **Planned missions of Artemis program**

The Artemis program is organized around a series of Space Launch System (SLS) missions. These space missions will increase in complexity and are scheduled to occur at intervals of a year or more. NASA and its partners have planned Artemis 1 through Artemis 5 missions; later Artemis missions have also been proposed. Each SLS mission centers on the launch of an SLS launch vehicle carrying an Orion spacecraft. Missions after Artemis 2 will depend on support missions launched by other organizations and spacecraft for support functions.

### **SLS missions**

Artemis 1 (2022) is an uncrewed test of the SLS and Orion and is the first test flight for both crafts.[a] The goal of the Artemis 1 mission is to place Orion into a lunar orbit, and then return it to Earth. The SLS uses the ICPS second stage, which will perform the trans-lunar injection burn to send Orion to lunar space. Orion will brake into a retrograde distant polar lunar orbit and remain for about six days before boosting back toward Earth. The Orion capsule will separate from its service module, re-enter the atmosphere for aerobraking, and splash down under parachutes. **Artemis 2 (2024) will be the first crewed test flight of SLS and the Orion spacecraft. The four crew members will perform extensive testing in Earth orbit,** and Orion will then be boosted into a free-return trajectory around the Moon, which will return Orion back to Earth for re-entry and splashdown. The launch is scheduled no earlier than May 2024. Artemis 3 (2025) will be a crewed lunar landing. The mission depends on a support mission to place a Human Landing System (HLS) in place in a near-rectilinear halo orbit (NRHO) of the Moon prior to the launch of SLS/Orion. After HLS reaches NRHO, SLS/Orion will send the Orion spacecraft with a crew of four, which is intended to include the first woman and the first person of color to land on the Moon, to rendezvous, and dock with HLS. Two astronauts will transfer to HLS, which will descend to the lunar surface and spend about 6.5 days on the surface. The astronauts will perform at least two EVAs on the surface before the HLS ascends to return them to a rendezvous with Orion. Orion will return the four astronauts to Earth. The launch is scheduled no earlier than 2025. Artemis 4 (2027) is a crewed mission to the Lunar Gateway station in NRHO, using an SLS Block 1B. A prior support mission will deliver the first two gateway modules to NRHO. The extra power of Block 1B will allow SLS/Orion to deliver the I-HAB gateway module for connection to the Gateway. The launch is scheduled no earlier than 2027. Artemis 5 through Artemis 8 and beyond are proposed to land astronauts on the lunar surface, where they will take advantage of increasing amounts of infrastructure that are to be landed by support missions. These will include habitats, rovers, scientific instruments, and resource extraction equipment.

### **Support missions**

Support missions include robotic landers, delivery of Gateway modules, Gateway logistics, delivery of the HLS, and delivery of elements of the Moon base. Most of these missions are executed under NASA contracts to commercial providers. Under the Commercial Lunar Payload Services (CLPS) program, several robotic landers will deliver scientific instruments and robotic rovers to the lunar surface after Artemis 1. Additional CLPS missions are planned throughout the Artemis program to deliver payloads to the Moon base. These include habitat modules and rovers in support of crewed missions. **The Human Landing System (HLS) is a spacecraft** that can convey crew members from NRHO to the lunar surface, support them on the surface, and return them to NRHO. Each crewed landing needs one HLS, although some or all of the spacecraft may be reusable. Each HLS must be launched from Earth and delivered to NRHO in one or more launches. The initial commercial contract was awarded to SpaceX for two Starship HLS missions, one uncrewed and one crewed as part of Artemis 3. These two missions

each require one HLS launch and multiple fueling launches, all on SpaceX Starship launchers. As of June 2022, NASA has also exercised an option under the initial contract to commission an upgraded Starship HLS design and third demonstration lunar mission under new sustainability rules it is drafting. It intends to pursue another HLS design from outside SpaceX in parallel, for redundancy and competition. The first two Gateway modules (PPE and HALO) will be delivered to NRHO in a single launch using a Falcon Heavy launcher. Originally planned to be available prior to Artemis 3, as of 2021 it is planned for availability before Artemis 4. The Gateway will be resupplied and supported by launches of Dragon XL spacecraft launched by Falcon Heavy. Each Dragon XL will remain attached to Gateway for up to six months. the Dragon XLs will not return to Earth but will be disposed of, probably by deliberate crashes on the lunar surface.

### **18. James Webb Space Telescope**

The James Webb Space Telescope (sometimes called JWST or Webb) is an orbiting infrared observatory that will complement and extend the discoveries of the Hubble Space Telescope, with longer wavelength coverage and greatly improved sensitivity. The longer wavelengths enable Webb to look much closer to the beginning of time and to hunt for the unobserved formation of the first galaxies, as well as to look inside dust clouds where stars and planetary systems are forming today.

#### **The Premier Observatory of The Next Decade**

The James Webb Space Telescope (sometimes called JWST or Webb) is a large infrared telescope with an approximately 6.5-meter primary mirror. Webb successfully launched from ESA's spaceport in French Guiana on December 25, 2021, 07:20 am EST (2021-12-25 12:20 GMT/UTC). Webb is the premier observatory of the next decade, serving thousands of astronomers worldwide. It will study every phase in the history of our Universe, ranging from the first luminous glows after the Big Bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own Solar System. Webb was formerly known as the "Next Generation Space Telescope" (NGST); it was renamed in Sept. 2002 after a former NASA administrator, James Webb.

#### **International Collaboration**

Webb is an international collaboration between NASA, the European Space Agency (ESA), and the Canadian Space Agency (CSA). The NASA Goddard Space Flight Center managed the development effort. The main industrial partner is Northrop Grumman; the Space Telescope Science Institute operates Webb after launch.

#### **Innovative Technologies**

Several innovative technologies have been developed for Webb. These include a primary mirror made of 18 separate segments that unfold and adjust to shape after launch. The mirrors are made of ultra-lightweight beryllium. Webb's biggest feature is a tennis court-sized five-layer sun-shield that attenuates heat from the Sun more than a million times. The telescope's four instruments - cameras and spectrometers - have detectors that are able to record extremely faint signals. One instrument (NIRSpec) has programmable microshutters, which enable the observation of up to 100 objects simultaneously. Webb also has a cryocooler for cooling the mid-infrared detectors of another instrument (MIRI) to a very cold 7 K so they can work.

#### **Discoveries through the James Webb telescope**

**The James Webb Space Telescope (JWST) found an “undiscovered country” of early galaxies existing close to the Big Bang 13.8 billion years ago—the beginning of the Universe—that no previous instrument had previously detected. NASA's Webb Indicates Several Stars 'Stirred Up' Southern Ring Nebula** (Dec 8, 2022). Some of the first data from NASA's James Webb Space Telescope has shown there were at least two, and possibly three, more unseen stars that crafted the oblong, curvy shapes of the Southern Ring Nebula. Webb will study every phase in the history of our universe, ranging from the first luminous glows after the big bang, to the formation of solar systems capable of supporting life on planets like Earth, to the evolution of our own solar system. It will build on the Hubble Space Telescope's discoveries. **An enormous mosaic of Stephan's Quintet is the largest image to date from NASA's James Webb Space Telescope**, covering about one-fifth of the

Moon's diameter. It contains over 150 million pixels and is constructed from almost 1,000 separate image files.

### **Larger version of this image**

**This landscape of “mountains” and “valleys” speckled with glittering stars is actually the edge of a nearby, young, star-forming region called NGC 3324 in the Carina Nebula. Captured in infrared light by NASA’s new James Webb Space Telescope, this image reveals for the first time previously invisible areas of star birth. Cosmic Cliffs, Webb’s seemingly three-dimensional picture looks like craggy mountains on a moonlit evening. In reality, it is the edge of the giant, gaseous cavity within NGC 3324, and the tallest “peaks” in this image are about 7 light-years high. The cavernous area has been carved from the nebula by the intense ultraviolet radiation and stellar winds from extremely massive, hot, young stars located in the center of the bubble, above the area shown in this image.**

*Courtesy: NASA, ESA, CSA, and STScI*

### **19. NASA's Perseverance Rover deposits First Sample on Mars Surface**

A titanium tube containing a rock sample is resting on the Red Planet’s surface after being placed there on Dec. 21 by NASA’s Perseverance Mars rover. Over the next two months, the rover will deposit a total of 10 tubes at the location, called “Three Forks,” building humanity’s first sample depot on another planet. The depot marks a historic early step in the Mars Sample Return campaign. Perseverance has been taking duplicate samples from rock targets the mission selects. The rover currently has the other 17 samples (including one atmospheric sample) taken so far in its belly. Based on the architecture of the Mars Sample Return campaign, the rover would deliver samples to a future robotic lander. The lander would, in turn, use a robotic arm to place the samples in a containment capsule aboard a small rocket that would blast off to Mars orbit, where another spacecraft would capture the sample container and return it safely to Earth. The depot will serve as a backup if Perseverance can’t deliver its samples. In that case, a pair of Sample Recovery Helicopters would be called upon to finish the job. The first sample to drop was a chalk-size core of igneous rock informally named “Malay,” which was collected on Jan. 31, 2022, in a region of Mars’ Jezero Crater called “South Séítah.” Perseverance’s complex Sampling and Caching System took almost an hour to retrieve the metal tube from inside the rover’s belly, view it one last time with its internal CacheCam, and drop the sample roughly 3 feet (89 centimeters) onto a carefully selected patch of Martian surface.

### **Testing a Sample Drop on the Mars Yard**

**Engineers use OPTIMISM, a full-size replica of NASA’s Perseverance rover, to test how it will deposit its first sample tube on the Martian surface.** But the job wasn’t done by engineers at NASA’s Jet Propulsion Laboratory in Southern California, which built Perseverance and leads the mission. Once they confirmed the tube had dropped, the team positioned the WATSON camera located at the end of Perseverance’s 7-foot-long (2-meter-long) robotic arm to peer beneath the rover, checking to be sure that the tube hadn’t rolled into the path of the rover’s wheels. They also wanted to ensure the tube hadn’t landed in such a way that it was standing on its end (each tube has a flat end piece called a “glove” to make it easier to be picked up by future missions). That occurred less than 5% of the time during testing with Perseverance’s Earthly twin in JPL’s Mars Yard. In case it does happen on Mars, the mission has written a series of commands for Perseverance to carefully knock the tube over with part of the turret at the end of its robotic arm. In the coming days, they’ll have other opportunities to see whether Perseverance needs to use the technique as the rover deposits more samples at the Three Forks cache. “Seeing our first sample on the ground is a great capstone to our prime mission period, which ends on Jan. 6,” said Rick Welch, Perseverance’s deputy project manager at JPL. “It’s a nice alignment that, just as we’re starting our cache, we’re also closing this first chapter of the mission

### **Bringing Mars Rock Samples Back to Earth**

This short animation features key moments of NASA and ESA’s Mars Sample Return campaign, from landing on Mars and securing the sample tubes to launching them off the surface and ferrying them back to Earth.

### **More About the Mission**

A key objective for Perseverance's mission on Mars is astrobiology, including the search for signs of ancient microbial life. The rover will characterize the planet's geology and past climate, paving the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith (broken rock and dust). Subsequent NASA missions, in cooperation with ESA (European Space Agency), would send spacecraft to Mars to collect these sealed samples from the surface and return them to Earth for in-depth analysis. The Mars 2020 Perseverance mission is part of NASA's Moon to Mars exploration approach, which includes Artemis missions to the Moon that will help prepare for human exploration of the Red Planet. JPL, which is managed for NASA by Caltech in Pasadena, California, built and manages operations of the Perseverance rover.

### **Stunning Picture of Einstein Ring Captured By James Webb Space Telescope**

The James Webb Space Telescope has been showing us some rather breathtaking facets of our universe. And now, it has captured an extremely rare phenomenon, an Einstein Ring. An Einstein Ring is seen when light from a star or a galaxy passes another galaxy or a massive object on its way toward Earth. Since the gravitational force of the large object bends the light, it develops gravitational lensing, forming a ring-like effect, making the light of the galaxy appear as an almost perfect ring. The galaxy being captured by the NIRCams is the SPT-S J041839-4751.8. This particular galaxy is around 12 billion light-years from Earth.

*Courtesy: Monit Khanna, Aug 30, 2022*

### **20. Launching of Heaviest Rocket Carrying 36 Satellites**

The Indian Space Research Organisation's (ISRO) heaviest rocket Launch Vehicle Mark 3 (LVM3 or GSLV Mark 3) took off from the second launch pad (SLP) of the Satish Dhawan Space Centre SHAR, Sriharikota at 12.07 a.m. (IST) has successfully orbited 36 communication satellites of U.K.-based OneWeb on 23 Oct 2022. ISRO has successfully launched 36 broadband communication satellites of a UK-based customer into the targeted orbits with the LVM3-M2 rocket, making the mission "historic" for the country, said the space agency. OneWeb Ltd is a UK-based customer of NewSpace India Ltd (NSIL).

*Courtesy: Sangeetha Kandavel*

*<https://www.thehindu.com/sci-tech/science/isros-dedicated-commercial-satellite-mission-lvm3-m2oneweb-india-1-lifts-off/article66046363.ece>*

**Compilation and Revampification: B. Mishra**