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Earth System Science Panorama

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

Prologue

The primary goal of this section is the compilation and highlighting of recent research findings, news, and developments within the realms of Earth, climate, planetary, and environmental science and dissemination of the advanced knowledge and insights for the benefit of students, educators, and the wider public with an interest in these specialized fields, aligning with the objectives outlined in the Patron's message. Our global environment is under peril. The biggest question arises whether we shall survive or shall extinct by the fury of global warming and climate change. The inclusion of remedial measures reflects an intention to not only highlight problems but also offer potential solutions. The content is crafted to encourage readers to critically analyse all aspects. By encouraging critical analysis, providing potential solutions, and desiring an interactive global platform for feedback, this section aims to foster a community-driven approach toward understanding and addressing issues related to Earth, climate, planetary, and environmental sciences.

Climate and Environmental Sciences

1. Himachal Pradesh based environmentalists call to rethink policies for a sustainable future

In a devastating turn of events, Himachal Pradesh has recently experienced an unprecedented disaster during the monsoon season.

In the aftermath of the flood of July and August 2023, Himachal Pradesh is battling to rebuild the ravaged regions, environmental groups have called on the state government to rethink its policies that are proving detrimental to the environment and focus on sustainable growth to conserve the Himalayas. **Between July and August 2023, the relentless rainfall caused 168 landslides and 72 flash floods across the state, severely affecting districts such as Kullu, Mandi, Shimla, Sirmaur, Solan, and Chamba**. In a devastating turn of events, **Himachal Pradesh** has recently experienced an unprecedented disaster during the monsoon season. The state was battered by continuous rainfall, resulting in flash floods, landslides, and widespread destruction. The catastrophe resulted in significant loss of life and property. The toll on human life has been staggering, with 481 people losing their lives, 40 individuals still missing, and 505 suffering injuries. As, many as 21,129 animals perished, and 6,030 cow sheds were destroyed. The destruction of residential and public buildings has been widespread, with 1,186 pucca houses, 1,745 kutcha houses, and 419 commercial buildings in the basement affected. Another 12,264 houses suffered partial damage, displacing a significant portion of the population. Chamba-based environmental group "Himalayan Niti Abhiyaan", headed by Kulbushan Upmanyu, submitted an eight-page report to Governor Rev. Shiv Pratap Shukla containing suggestions and recommendations to minimize the losses caused by natural disasters in the future.

One of the key recommendations is the training of micro-level scientists for the precise demarcation of flood-prone areas and the implementation of strict regulations on infrastructure development within these zones. The report also emphasizes the importance of safe disposal of debris from under-construction projects, with a call for closer monitoring and scientific investigation of debris found in villages. Furthermore, the report stresses the need to review land use policies and prioritize geological sensitivity when selecting sites for construction projects. "Input from geologists should be considered in large infrastructure projects, roads, and four-lane highways to mitigate risks associated with landslides and other geological hazards," said Upmanyu. Experts believe that the floods in the Beas Valley were not solely caused by heavy rainfall, major factor behind the high flood impact was the floating load, including debris from road and tunnel construction, which blocked riverbanks and mid-water. This debris uprooted trees

and diverted the river towards urban areas and four-lane highways, intensifying the disaster. Commercial construction projects have emerged as a significant driver of deforestation, endangering biodiversity and worsening the ongoing climate crisis. The growing demand for water resources, fuelled by these projects, has accelerated deforestation rates. Simultaneously, the threat of destruction, including landslides and forest fires, looms over both the environment and human settlements. The report advocates for a paradigm shift away from the current trajectory of infrastructure development and commercial projects. Instead, it calls for the revival of mixed forestry, which not only safeguards against natural disasters but also provides vital resources for local communities, including food, fuel, medicine, and wood. **Unchecked urbanization presents another existential threat, as unplanned growth without adequate drainage infrastructure sets the stage for landslides and building collapses**. The controversial "2041 Shimla Development Plan," despite being cancelled by the NGT in 2018, still lingers, poised to double Shimla's population by 2041. The report suggests that political pressures influenced its creation and advocates for its withdrawal. Recognizing the urgency of the situation, the report underscores the importance of involving local civil society, NGOs, and self-governing institutions in decision-making processes. Their perspectives, born from intimate knowledge of their regions, should be central in shaping policies and implementation strategies the report suggests. The crisis has also taken a toll on tourism, a vital contributor to the region's GDP. Infrastructure breakdowns and overcrowding have plagued the sector. **The unchecked construction, excessive vehicular traffic, and environmental mismanagement have triggered a crisis. The report urges a transition to "responsible tourism," fostering local empowerment and regulation to curb real estate speculation in the name of tourism**.

Courtesy: Gaurav Bisht, Shimla, Hindustan Times, September 30, 2023

2. Action for Climate Empowerment

Action for Climate Empowerment (ACE) represents the collective efforts within the UN Framework Convention on Climate Change, encapsulated in Article 6 of the Convention and Article 12 of the Paris Agreement. **ACE aims to enable all segments of society to participate in climate action, centered around six key elements: climate change education, public awareness, training, public participation, public access to information, and international cooperation on these matters. The overarching objective of ACE is to empower individuals, including young people, to actively engage in the shift towards a low-emission, climate-resilient world. Essential to achieving this goal is the promotion of sustainable lifestyles and consumption patterns, which are crucial for reducing greenhouse gas emissions and fortifying resilience against the unavoidable impacts of climate change**. The successful implementation of all six ACE elements is pivotal in the global fight against climate change. Collaboration across government levels and societal sectors is imperative for progress. Parties to the UNFCCC have adopted a comprehensive four-year ACE action plan under the Glasgow work programme (Decisions 23/CP.27 and 22/CMA.4). This action plan outlines specific, time-bound activities across the priority areas of the work programme and the ACE elements. **Its purpose is to empower all members of society, including children and youth, to actively participate in climate action, representing a significant step towards collective engagement in addressing climate challenges**.

Courtesy: Karolina Grabowska

3. "World Is Collapsing": Pope Francis Warns of 'Irreversible' Climate Change

Climate change has been a major theme of Pope Francis' ten years as head of the world's 1.3 billion Catholics.

Pope Francis has been a consistent advocate for addressing climate change during his tenure as the head of the Catholic Church, a position he has held for ten years. His recent warning, delivered on October 4, emphasizes the urgent need to address global warming, stating that the world is "collapsing" due to this climate crisis. In his 12-page letter, Pope Francis expressed concern about the inadequacy of past responses to the environmental crisis and highlighted that some damage caused by climate change is already irreversible. He called upon the participants of the upcoming COP28 climate talks, scheduled to take place in Dubai on November 30, **to commit to binding policies aimed at phasing out the use of fossil fuels in favour of renewable energy sources like wind and solar**

power. Referencing his previous landmark encyclical "Laudato Si" ("Praise Be To You") published in 2015, Pope Francis reiterated the urgency of addressing climate change and protecting the planet. Despite the global commitment made during the UN climate talks in Paris to limit global warming to "well below" two degrees Celsius, recent warnings from the UN and climate monitors suggest that the world is not on track to meet these goals. 2023 was predicted to be the hottest year in human history, with various regions experiencing heatwaves, droughts, and wildfires. The Pope's message emphasized the need for a decisive acceleration toward transitioning to clean energy sources. He acknowledged the challenge of holding climate talks in an oil-rich country like the United Arab Emirates but also highlighted the nation's significant investments in renewable energy. Pope Francis criticized the prioritization of economic growth over environmental concerns, especially by powerful economic nations. **He urged changes in the "irresponsible lifestyle" of affluent countries, stressing that relying solely on technological innovation is insufficient to address the crisis. He pointed out the disparity in carbon emissions between affluent nations and the poorest countries, emphasizing the need for global equity in addressing climate change. While some doubt the impact of Pope Francis' new document compared to his previous encyclical, voices within the environmental movement, such as Bill McKibben, highlight the importance of moral and spiritual leadership in complementing the efforts of scientists and engineers in tackling the climate crisis**.They emphasize the need for a collective shift in human values and priorities to effectively address the environmental challenges we face.
Courtesy: https://http://www.ndtv.com/world-news/global-warming-world-is-collapsing-pope-francis-warns-of-irreversible-climate-change-4449184
World News Agency, France-Presse Updated: October 04, 2023

4. Water shortage drives biggest elephant migration from Zimbabwe since 2019

A large number of elephants from Zimbabwe's biggest national park are moving to neighbouring Botswana in search of water. "Many animals are moving from Hwange National Park into Botswana" Zimbabwe Parks and Wildlife Management Authority spokesman Tinashe Farawo told AFP. **Hwange National Park covers an area of more than 14,600 square kilometers (5,600 square miles) and is home to about 50,000 elephants**. "Water bodies have dried up and the animals are in search for water and food," the spokesman said, adding buffaloes and "all types of animals present in the park" were also migrating in scores. The migration began in August 2023."The number of animals migrating has definitely increased over the years due to the increase in water shortages," Farawo added. The authority said wildlife migration between Hwange National Park to Botswana is not uncommon, however this year it had come "too early", citing climate change. The mass movement of wild animals could lead to an increase in conflict between humans and wildlife as they pass through populated areas in Zimbabwe. "It means more animals are going to invade communities, people competing for water with animals," Farawo warned. Conflict between humans and wildlife is a significant problem in remote parts of Zimbabwe, caused in part by population growth. Elephants killed at least 60 people last year, according to government figures. Zimbabwe has around 100,000 elephants, the second largest population in the world, and almost double the capacity of its parks, conservationists say. **Botswana is home to around 130,000, the world's largest elephant population**. The Intergovernmental Panel on Climate Change has classified southern Africa as a region at risk, facing increased risks of extreme heat and reduced rainfall due to global warming.
Courtesy: https://www.bloomberg.com > news > articles > droug...

5. Heat waves are hitting the deep ocean floor with potentially catastrophic results

The recent study discussed in the Live Science article highlights a concerning phenomenon: heat waves occurring at the bottom of the Earth's oceans. These "bottom marine heat waves" pose a significant threat to marine ecosystems, as they can have devastating and long-lasting effects on key species residing in the depths of the ocean. **Traditionally, the impact of increased water temperatures has been associated with surface water, leading to well-documented consequences for marine life. However, the focus has now shifted to the effects of rising temperatures on the bottom layers of the ocean. These heat waves**

at the ocean floor can persist for extended periods, causing detrimental effects on various critical species such as lobster and cod. Unlike surface heat waves, which may dissipate relatively quickly, the extended duration of bottom marine heat waves poses a more persistent threat to the ecosystem. **The warming of surface waters during this period had far-reaching consequences, severely impacting fish populations, the primary food source for seabirds. This event resulted in the deaths of approximately 1 million seabirds, demonstrating the profound impact of temperature changes in the ocean on higher trophic levels in the food chain. This new understanding of heat waves affecting the depths of the oceans raises concerns about the vulnerability of marine ecosystems**. It underscores the need for continued research, monitoring, and conservation efforts to protect the biodiversity and stability of these ecosystems, especially in the face of climate change-induced alterations in ocean temperatures.
Courtesy: Jennifer Nalewicki, March 25, 2023, Live Science https://www.livescience.com -Rivers & Oceans

6. Flooding in Libya is emblematic of climate change and conflict in vulnerable communities The recent occurrence of Storm Daniel in Libya has once again highlighted the critical situation faced by communities in the country, particularly those affected by conflict and vulnerable to the impacts of climate change. The International Rescue Committee (IRC) emphasizes that climate change has intensified extreme weather events, making them more frequent, severe, and prolonged, exacerbating the challenges faced by already vulnerable populations. Libya, a nation dealing with over a decade of conflict, has been severely affected by the intensifying consequences of climate change. The IRC's Country Director, Libya, Elie Abouaoun, highlights the lethal combination of climate-related disasters, prolonged crisis of conflict, and economic instability in Libya. This convergence of challenges has left communities with limited preparedness, inadequate infrastructure, and restricted access to essential services, making it exceedingly difficult for them to cope and recover. Even before the devastating flooding caused by Storm Daniel, Libya was already grappling with the aftermath of prolonged conflict, leaving around 800,000 people in urgent need of humanitarian assistance. The overwhelming rainfall, coupled with ineffective early warning systems and poorly maintained critical infrastructure, exacerbated the existing humanitarian crisis. The IRC stresses that vulnerable communities affected by both conflict and climate change often face marginalization in global climate action efforts. They receive inadequate funding and struggle with delivery approaches that heavily rely on absent or weak governmental and formal institutions in conflict zones. The emphasis of climate action is predominantly on emission mitigation, neglecting crucial aspects like adaptation, anticipatory measures, and resilience-building. The IRC urges global attention to prioritize conflict-affected communities in climate action discussions. They call for the allocation of sufficient resources and the development of innovative strategies to address the unique challenges faced by these communities. The organization reaffirms its commitment to supporting vulnerable communities in Libya and globally, emphasizing collaboration with governments, organizations, and individuals to ensure that no one is overlooked in the fight against climate change. As the world moves forward, the IRC views the upcoming United Nations General Assembly (UNGA) as a crucial opportunity leading up to COP28. They stress the need for conflict-affected communities to be central in climate action discussions, advocating for proactive measures, resource allocation, and inclusive strategies to combat climate change's impacts on vulnerable populations.
Courtesy: International Rescue Committee (IRC), 15 September 2023

7. Glacial Lake outburst and excess rainfall led to Sikkim flash floods (GOLF), says NDMA
The National Disaster Response Force (NDRF) personnel conducted a rescue operation after the flash flood in Sikkim's Singtam on 4th Oct 2023. **The apex disaster management authority added that nearly 25 glacial lakes in Sikkim are assessed to be at risk**. At least 22 persons were killed and another 120 people, including 23 army personnel, went missing after the flash flood hit north Sikkim in the early hours of 4th Oct. There was a sudden surge in water flow in the Teesta River, which washed away several bridges, of NH-10, the Chungthang Dam has impacted several small villages, towns, and infrastructure projects in the upper reaches of

the river valley. The main districts affected are Mangan, Gangtok, Pakyong, and Namchi. "**While scientists are investigating the exact cause of the flash flood, the primary reason for the sudden surge appears to be a likely combination of excess rainfall and a GLOF (Glacial Lake Outburst Flood) event at South Lhonak Lake in North Sikkim**," **NDMA said in a statement**. The lake is at a height of 5,200 metres, with a towering ice-capped feature at about 6,800 metres to the north of and in close proximity to the lake. Satellite images received from the National Remote Sensing Centre or NRSC reveal "the draining out of more than half the lake water, most likely as a result of an avalanche from the ice-capped feature", NDMA added. NDMA said that continued snowfall in upper reaches and rainfall and clouds in lower reaches is hampering the deployment of helicopters and relief operations. **The Himalayan ranges, NDMA said, are host to many glacial lakes, estimated through remote sensing techniques at about 7,500**. "Of these, Sikkim has about 10%, of which nearly 25 are assessed to be at-risk," NDMA added. To mitigate the impact of a GLOF event in these lakes, an NDMA-led expedition in the first week of September 2023 surveyed two at-risk lakes in order to eventually deploy early warning systems for real-time alerts. **It has planned to install early warning systems for real- time alerts at most 56 at-risk glacial lakes in India, NDMA said**. "Efforts to expand the mitigation programme are being expedited, while sustained investigations into the causes of this event are underway. **Further, this region is known for highly localized heavy rainfall events. Therefore, efforts to improve the predictive ability for such events will also be intensified in collaboration with relevant agencies," it said**. Meanwhile, Union cabinet secretary Rajiv Gauba chaired a meeting of the National Crisis Management Committee (NCMC) to review the situation and asked officials to evacuate people stranded in the tunnel of Chungthang dam and tourists in the area on a "priority basis". He also asked for the deployment of additional National Disaster Response Force (NDRF) teams and restoring the road and mobile connectivity at the earliest.

Courtesy: Hindustan Times October 04, 2023

8. Role of COPs

The provided information outlines the comprehensive nature and objectives of the 28th Conference of the Parties (COP 28) under the aegis of the United Nations Framework Convention on Climate Change (UNFCCC), which took place in Dubai, United Arab Emirates, spanning from November 30 to December 12, 2023. COP conferences represented a crucial global platform for discussions and strategic planning to address the challenges posed by climate change. **The primary focuses of COP 28 included critical agendas such as curbing global temperature rise, facilitating adaptation efforts, and achieving the ambitious target of net-zero emissions by 2050. This event brought together a diverse array of attendees, including delegates from UNFCCC member states, business leaders, youth representatives, climate scientists, Indigenous People, journalists, and various stakeholders, totalling over 70,000 participants**. The emphasis was given on implementing and strengthening the Paris Climate Change Agreement. **Key areas of discussion during the conference encompassed topics like addressing loss and damage, providing financial support for vulnerable communities, transitioning to sustainable energy sources, reducing emissions, and conducting the global stocktake**. The latter aims to evaluate progress made towards the goals of the Paris Agreement and reinforce the urgency for swifter and more decisive climate action. The conference featured multiple meetings, including the Conference of the Parties (COP), the decision-making body of the Paris Agreement (CMA), and the decision-making body of the Kyoto Protocol (CMP). Additionally, subsidiary bodies (SBI and SBSTA) provided technical guidance and recommendations to the primary decision-making bodies. These sessions comprised closed-door negotiations, technical meetings, press conferences, and a high-level segment attended by world leaders. The conference venue was divided into two distinct zones: the blue zone and the green zone. The blue zone served as the official negotiation space, accessible to Party delegations, Heads of State, accredited observers, and the press. Conversely, the green zone, managed by the host country, provided an open platform for civil society engagement, discussions, presentations, and exhibitions, showcasing solutions and pathways toward achieving a net-zero emissions future. **Overall, COP 28 aimed to foster dialogue, collaboration, and concrete actions to address climate**

change challenges and accelerate progress towards achieving the goals set forth in the Paris Agreement.
Courtesy: https://unfccc.int/dec-2023/about-cop-28

9. Community Forest governance and synergies among carbon, biodiversity, and livelihoods

The strategic significance of forest landscape restoration has surged, aiming to capture atmospheric carbon, safeguard biodiversity, and foster livelihoods for indigenous and local communities. Leveraging data from 314 forest communal areas across 15 tropical nations in Africa, Asia, and Latin America, this study explores the connections between carbon sequestration in aboveground woody biomass, tree species diversity, and the community benefits derived from forests. It discerns five distinct clusters of forest communal areas, unveiling both synergistic advantages and conflicting outcomes across various aspects. **Remarkably, the presence of formal community management structures and active local engagement consistently forecast numerous positive outcomes. These findings, drawn from diverse global contexts, suggest that empowering local forest governance can concurrently fortify multiple objectives of forest restoration**. This analysis enriches our understanding of the institutional dimensions linked to restoration endeavours, emphasizing the crucial need to examine the interplay among diverse forest benefits to formulate effective strategies for comprehensive tropical forest interventions.
***Courtesy**: Harry W. Fischer et al., Nature Climate Change volume 13, abstract p.1340, November 2023*

10. Five important Strategies to Minimize Loss and Damage from Climate Change

The provided text offers insights into several key strategies and approaches necessary for addressing climate change and achieving sustainable development goals:

- **People-Centered Approach in Understanding Climate Risk**: Acknowledging non-economic losses and understanding the societal and environmental intersections of these losses is crucial in comprehending climate risk. Empowering vulnerable communities and co-producing strategies to mitigate these risks through ACE elements (climate change education, public awareness, training, participation, access to information, and international cooperation) are highlighted.
- **Adaptation Pathways**: Adaptation involves modifying longstanding development processes and institutions to suit changing climatic conditions. The development of participatory adaptation pathways aids in understanding when and how to implement changes as climate conditions evolve.
- **Investment in Ecosystem and Nature Based Solutions**: Stress on vulnerable ecosystems is often more influenced by human actions than direct climate change impacts. Prioritizing investments in ecosystem preservation and nature-based solutions can significantly contribute to mitigating these stresses.
- **Investment in Human and Social Development**: Reducing vulnerability to climate risks requires addressing socio-environmental processes. For instance, enhancing access to quality water supply and empowering marginalized groups, like women, in decision-making processes can minimize the effects of climate change, such as hunger.
- **Continuous Learning and Innovation in Adaptation**: Establishing systems for ongoing learning and innovation based on on-the-ground adaptation experiences is crucial. This enables effective responses to continuously evolving climate risks.

Additionally, the text highlights India's ambitious goals of energy independence by 2047 and achieving Net Zero by 2070. To accomplish these objectives, the emphasis is on leveraging renewable energy, particularly Green Hydrogen. **The information originates from the Asian Development Blog, serving as a platform for commentary and insights from development experts, aiming to address issues and challenges in Asia and the Pacific region**.

11. National Green Hydrogen Mission

- **The National Green Hydrogen Mission aims to position India as a leading producer and supplier of Green Hydrogen**

globally, reducing dependence on imported fossil fuels, fostering indigenous manufacturing capabilities, and promoting economic development. India has set its sights on becoming energy-independent by 2047 and achieving Net Zero by 2070. To achieve this target, increasing renewable energy use across all economic spheres is central to India's Energy Transition. **Green Hydrogen** is produced using electrolysis of water with electricity generated by renewable energy. The carbon intensity ultimately depends on the carbon neutrality of the source of electricity (i.e., **the more renewable energy there is in the electricity fuel mix, the "greener" the hydrogen produced**).

- **Green Hydrogen is considered a promising alternative for enabling this transition**. Hydrogen can be utilized for long-duration storage of renewable energy, replacement of fossil fuels in industry, clean transportation, and potential also for decentralized power generation, aviation, and marine transport.

The National Green Hydrogen Mission was approved by the Union Cabinet on 4 January 2022, with the intended objectives of:

- **Making India a leading producer and supplier of Green Hydrogen in the world**
- **Creation of export opportunities for Green Hydrogen and its derivatives**
- **Reduction in dependence on imported fossil fuels and feedstock**
- **Development of indigenous manufacturing capabilities**
- **Attracting investment and business opportunities for the industry**
- **Creating opportunities for employment and economic development**
- **Supporting R&D projects**

Mission outcome

The mission outcomes projected by 2030 are:

- Development of green hydrogen production capacity of at least 5 MMT (Million Metric Tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country
- Over Rs.Eight lakh crore in total investments
- Creation of over Six lakh jobs
- Cumulative reduction in fossil fuel imports over Rs. One lakh crore
- Abatement of nearly 50 MMT of annual greenhouse gas emissions

Types of Hydrogen Based on Extraction Methods

Depending on the nature of the method of its extraction, hydrogen is categorized into three categories, namely, Grey, Blue, and Green.

- **Grey Hydrogen**: It is produced via coal or lignite gasification (black or brown), or via a process called steam methane reformation (SMR) of natural gas or methane (grey). These tend to be mostly carbon- intensive processes.
- **Blue Hydrogen**: It is produced via natural gas or coal gasification combined with carbon capture storage (CCS) or carbon capture use (CCU) technologies to reduce carbon emissions.
- **Green Hydrogen**: It is produced using electrolysis of water with electricity generated by renewable energy. The carbon intensity ultimately depends on the carbon neutrality of the source of electricity (i.e., **the more renewable energy there is in the electricity fuel mix, the "greener" the hydrogen produced**).

This text highlights the emergence and significance of green hydrogen as a pivotal element in reshaping India's energy landscape. Authored by Anish De and Anvesha Thakker from KPMG International, the discussion delves into the potential of green hydrogen to decrease India's dependence on imported fossil fuels, thereby enhancing energy security and mitigating environmental pollution. It begins by defining grey hydrogen, produced from natural gas without capturing the carbon dioxide generated in the process, and contrasts it with green hydrogen, generated through renewable energy sources, which holds promise for

decarbonizing various industries. While acknowledging the enthusiasm and investment surrounding green hydrogen, the conversation also addresses the existing challenges, particularly its cost competitiveness compared to conventional grey hydrogen. **Despite cost challenges, green hydrogen holds significant promise for India due to several key advantages**. The country's robust electricity grid infrastructure, abundant renewable energy resources, and focus on sustainable energy solutions position it favorably for green hydrogen production. Additionally, India's skilled labor force in engineering, technology, and manufacturing sectors can contribute to the development and maintenance of green hydrogen projects**. By investing in green hydrogen, India can reduce its vulnerability to global price fluctuations and supply disruptions related to imported fossil fuels. Furthermore, it aligns with India's climate goals by substantially reducing greenhouse gas emissions**. Thus, it emphasizes that green hydrogen's transformative potential extends beyond industry and economy, signaling a shift toward a greener and more sustainable future. Discussions and initiatives revolving around green hydrogen pave the way for sustainable practices in the global economy and national energy policies.
Courtesy: https://www.india.gov.in/spotlight/national-green-hydrogen-mission

12. Balancing urbanization with environmental preservation is key to combat urban flooding. An Approach that combines improved forecasting, flood-resilient infrastructure & sustainable urban development which are imperative to ensure the safety and well-being of urban populations
This text discusses the increasing challenge of urban flooding in India, emphasizing its complexity and urgency, especially in major cities like New Delhi, Bengaluru, and Gurugram. Urban flooding, which occurs rapidly and locally due to heavy rainfall, is exacerbated by factors such as rapid urbanization, reduced green spaces, and inadequate urban planning. The absence of proper stormwater drainage systems, poorly maintained drainage systems, excessive concretization of open spaces, and unregulated city expansion contribute to this issue. The loss of wetlands further amplifies the problem, as wetlands aid in flood mitigation. The text highlights the necessity of balancing urbanization with environmental preservation to effectively address urban flooding. Moreover, it stresses the importance of sustainable urban development as a solution to combat urban flooding, advocating for improved forecasting, flood-resilient infrastructure, and policies aligned with sustainable urban development goals. The subsequent part of the content discusses a study analyzing lightning fatalities in Odisha State, India, between 2000 and 2020. The study utilized spatiotemporal statistical analyses to assess the spatial patterns of lightning strikes and related deaths across all 30 districts of Odisha State. The study's findings revealed an increase in lightning strikes across the state, with specific districts experiencing higher incidence rates. It identified Mayurbhanj, Sundargarh, and Keonjhar districts as having the highest frequency of lightning strikes. Additionally, it highlighted a moderate correlation between lightning strikes and deaths, suggesting the need for further investigation regarding the seasonality, locational vulnerability, and temporal risk of lightning strikes in Odisha State. **In conclusion, the urban landscape worldwide is undergoing significant transformations, marked by high population densities, vulnerable migrant communities, and an alarming increase in urban flooding incidents. This phenomenon presents an immense challenge to city administrations and urban planners globally**.
Courtesy: https://www.downtoearth.org.in > blog > urbanisation

Earth and Planetary Science
1. Massive Phosphate Discovery in Norway
The recent discovery of vast phosphate reserves in southwest Norway, announced by Norge Mining, has marked a significant turning point in global resource narratives. Estimated at approximately 70 billion metric tons, this find has the potential to satisfy worldwide demands for fertilizers, solar panels, and electric vehicle batteries for at least a century, as per EURACTIV's report based on Norge Mining's announcement. Phosphate, a critical element for fertilizer production, holds strategic importance in the European Commission's considerations, as highlighted in their Critical Raw Materials Act. Around 90 percent of mined phosphate rock is utilized for phosphorous production, which is crucial for fertilizers

and is irreplaceable at present. **The global food supply chain heavily relies on fertilizers, making it sensitive to price fluctuations, especially during geopolitical tensions such as those witnessed in the Russia-Ukraine conflict. Apart from fertilizer production, phosphorous is integral to the manufacturing of solar panels and advanced lithium batteries used in electric vehicles, semiconductors, and computer chips. Europe, recognizing the strategic significance of these products in its transition towards green and digital advancements, has identified them as high priority for production**. While historically phosphate rock reserves were concentrated in regions like the Western Sahara in Morocco, China, Egypt, and Algeria, the discovery in Norway has shifted this paradigm. This newly discovered deposit, considered the world's largest, offers a potential solution to address the increasing global demand for these essential resources. Norge Mining's exploration unveiled a more extensive deposit than initially anticipated, extending approximately 4,500 meters underground. The company aims for environmentally sustainable operations, planning to capture carbon emissions and ensure greener mining processes. Given the strategic significance of the discovered phosphate deposit, both the Norwegian government and global stakeholders have taken a keen interest. This discovery is pivotal for Europe, aiding in reducing dependence on external suppliers for critical raw materials. Moreover, the presence of vanadium and titanium within the phosphate deposit has attracted attention from the aerospace and defense industries. **This discovery, coupled with neighboring Sweden's recent rare-earth metal discovery, is seen as a significant strategic advantage in the geopolitical landscape, especially concerning competition with Moscow and Beijing**. In conclusion, the massive phosphate discovery in Norway has far-reaching implications, potentially reshaping resource dynamics globally and reinforcing Europe's position in strategic industries.

Courtesy: Moneycontrol news, July, 2023

2. Environmentally sustainable mining in quarries to reduce waste production and loss of resources using the developed optimization algorithm

The study focuses on enhancing the sustainable management of natural resources, specifically dimension stones, within the earth sciences. Quarrying dimension stones involves challenges such as significant waste production and resource loss, primarily due to discontinuities and fractures in the rock mass. To optimize quarrying operations, it's crucial to devise strategies that increase the extraction of larger blocks while minimizing operational costs, especially energy consumption. Traditionally, quarry optimization algorithms have primarily emphasized the number of blocks extracted, often disregarding other critical factors like energy usage in block cutting. Recognizing this limitation, a novel algorithm was developed in this study. This new algorithm aims to optimize the quarrying process by considering the impact of discontinuities on waste production and cutting surfaces. It analyses these parameters to provide an optimal cutting pattern for the quarry face. The primary objective of this algorithm is to offer a comprehensive approach to quarry optimization. Incorporating the analysis of discontinuities and their effects on waste production and cutting surfaces, can provide valuable insights for decision-making in dimension stone quarries. The algorithm's optimization of the cutting pattern not only enhances block extraction but also minimizes resource waste and operational costs, particularly energy consumption. Implementing this algorithm in dimension stone quarries could yield several significant benefits. It has the potential to substantially reduce production costs, energy and water consumption, cutting tools usage, and waste production. Ultimately, this optimized approach can significantly increase quarry profitability while concurrently addressing environmental concerns related to quarrying activities. **In essence, the introduction of this algorithm represents a considerable advancement in quarrying practices. Its holistic approach to quarry optimization, considering multiple critical factors beyond block extraction, marks it as an efficient and valuable tool for improving operations in dimension stone quarries. Through its application, the industry can move towards greater sustainability, reduced environmental impact, and increased profitability**.

Courtesy: Mohammad Hossein Jalalian, Nature Scientific Reports, volume 13, Article number: 22183, 2023

3. Scientists drilled 500 metres beneath Greenland's ice

The longest core of rock ever extracted from beneath Greenland's thick ice could hold clues about how quickly the island's frozen covering will melt as the planet warms. Preliminary analysis of the rock and associated sediments suggests that at some time in the past three million years or so, the material in this core was exposed to air. That means the ice atop it had melted away, at least temporarily. **The work adds to a growing cadre of studies that use Greenland's bedrock to illuminate how unstable the overlying ice has been in the past. This core is particularly important because it is the first such material to be collected in decades, and because it contains much more bedrock material than has ever been gathered from beneath Greenland's ice**. This core holds a lot of information about past exposure," says Allie Balter-Kennedy, a glacial geologist at the Lamont–Doherty Earth Observatory in Palisades, New York. She presented initial findings from the drilling project, called Green Drill, on 11 December 2023 at a meeting of the American Geophysical Union in San Francisco, California.
Courtesy: Nature.com /news -Alexandra Witze.

4. Chandrayaan-3's measurements of sulphur open the doors for lunar science and exploration

The data from Chandrayaan-3's rover, named Pragyan, or "wisdom" in Sanskrit, showed the lunar soil contains expected elements such as iron, titanium, aluminum, and calcium. The measurement of sulphur is interesting to scientists for at least two reasons**. First, these findings indicate that the highland soils at the lunar poles could have fundamentally different compositions, compared with highland soils at the lunar equatorial regions. This compositional difference likely comes from the different environmental conditions between the two regions and the poles get less direct sunlight. Secondly, these results suggest that there is somehow more sulphur in the polar regions**. Sulphur concentrated here could have formed from the exceedingly thin lunar atmosphere. The polar regions of the Moon receive less direct sunlight and, as a result, experience extremely low temperatures compared with the rest of the Moon. These have originated from ancient volcanic eruptions **If the surface temperature falls, below -73 degrees C (-99 degrees F), then sulphur from the lunar atmosphere could be collected on the surface in solid form like frost on a window** or from meteorites containing sulphur that struck the lunar surface and vaporized on impact.
Courtesy: Conversation.com, September 22, 2023

5. NASA's James Webb Space Telescope captures stunning images of the wreckage of two galaxies crashing into each other

The recently released image from NASA's James Webb Space Telescope (JWST) presents a remarkable view of the galaxy NGC 3256, showcasing evidence of an ancient cosmic event in an unprecedented manner. Despite its outward appearance resembling a typical spiral galaxy, NGC 3256 carries distinct marks from a dramatic collision that occurred roughly 500 million years ago. This galaxy, now visibly distorted, bears witness to a head-on collision between two spiral galaxies, which led to its current disrupted form. The aftermath of this collision is vividly captured in the image obtained by JWST's powerful infrared cameras. Located approximately 120 million light-years away, NGC 3256 exhibits a strikingly chaotic appearance, deviating from the typical expected structure of orderly spiral galaxies. What sets NGC 3256 apart are the visible tendrils emanating directly from its galactic center and luminous clouds of dust and stars shining brightly. These features, observed in infrared wavelengths by JWST, unveil the tumultuous history of this galaxy, shedding light on the aftermath of a cosmic collision that significantly altered its structure and appearance. The ability of JWST's infrared capabilities to peer deep into the heart of NGC 3256 has provided scientists and astronomers with a unique glimpse into the aftermath of this collision event, showcasing the complex and captivating dynamics of galaxies in the universe. This observation serves as a testament to the telescope's ability to capture and reveal the intricacies of celestial events, offering valuable insights into the evolution and nature of galaxies.
Courtesy: Marianne Guenot, July 05 2023

6. Sun Rips Hole in Earth's Magnetic Field Sparking Rare Red Auroras

Red auroras are rare, and even rarer still to see with the naked eye.

The occurrence of red auroras is a fascinating phenomenon resulting from highly energized solar particles interacting with oxygen

high in the Earth's atmosphere. In September 2023, an unusual and intense disturbance in the Earth's magnetic field led to a rare display of red auroras that could be observed across Europe and North America. This striking red hue in the auroras was caused by a massive release of plasma known as a coronal mass ejection (CME) from the Sun. This CME, hitting the Earth on September 24, created a breach in the planet's magnetic field, allowing charged particles to penetrate and trigger a G2-class geomagnetic storm. As these charged particles from the Sun interacted with the Earth's atmosphere, particularly with gas atoms and molecules, they excited these elements. The subsequent calming process of these excited particles released photons, resulting in the mesmerizing light displays of the aurora borealis (Northern Lights) and aurora australis (Southern Lights). While such events may seem alarming, these disturbances are usually transient and pose no threat to life on Earth. However, what made this particular geomagnetic storm unique was that the solar particles reached higher altitudes, between 300 and 400 kilometers (180 to 240 miles), in the Earth's atmosphere. At these heights, oxygen is less concentrated and requires greater energy to become excited. This higher energy interaction produced a stunning red light, rather than the usual green, as the oxygen atoms emitted red photons. Observing red auroras is rare because they are more fragile and can only be seen if the oxygen atoms remain undisturbed long enough to emit red light. Additionally, the human eye is less sensitive to red light compared to green, further contributing to the infrequency of observing red auroras. During periods of heightened solar activity leading up to the Solar Maximum in July 2025 (or earlier), we may expect more of these awe-inspiring sky spectacles as the Sun continues to exhibit increased activity, offering opportunities for more stunning auroral displays.
Courtesy: IFL Science,26 Sept 2023

7. Chandrayaan-3: The Indian Space Odessy
Chandrayaan-3, launched on July 14, 2023, marks the third mission in ISRO's Chandrayaan program aimed at lunar exploration. The mission comprised a lunar lander named Vikram and a rover called Pragyan. Notably, it successfully landed near the lunar south pole on August 23, 2023, making India the fourth country to achieve a lunar landing and the first to do so in the lunar south pole region. **Key mission objectives included engineering a safe lunar landing, demonstrating rover capabilities, and conducting experiments to analyze lunar surface materials**. The spacecraft, comprising a propulsion module, lander, and rover, was designed with specific features tailored for its intended functions. The Vikram lander was equipped with four variable-thrust engines, improved structural rigidity, enhanced instrumentation, and advanced attitude control mechanisms compared to its predecessor, Chandrayaan-2. The Pragyan rover, weighing 26 kilograms and measuring 917 by 750 by 397 millimeters, was deployed to explore the lunar surface, analyze its composition, investigate the presence of water ice, study lunar impacts, and assess the evolution of the Moon's atmosphere. After landing near the Moon's south pole, the rover began its operations, sending back videos and data**. It completed its assignments within the planned timeframe of one lunar daylight period (equivalent to 14 Earth days), with successful deployments and data transmissions back to Earth. ISRO reported various scientific findings, including data from Chandra's Surface Thermophysical Experiment (ChaSTE) showing significant temperature variations between the lunar surface and subsurface. This experiment unveiled the insulating properties of the lunar topsoil, suggesting a drastic drop in temperature just below the surface. Furthermore, the Pragyan rover's laser-induced breakdown spectroscope (LIBS) confirmed the presence of sulfur on the Moon's surface near the south pole, a significant discovery facilitated by in-situ measurements. Data released by ISRO regarding plasma density and seismic measurements aimed to explore the near-surface environment and understand lunar seismic activity, contributing to the broader understanding of the Moon's dynamics. Regarding the detection of lunar water, initial assessments suggested the unlikeliness of finding liquid water near the surface due to the Moon's low pressure, but deeper layers might support it. Chandrayaan-3's successful mission not only showcased India's technological prowess but also contributed crucial findings to lunar science, advancing our understanding of the Moon's composition and characteristics**.
Courtesy: www.wikiwand.com > Chandrayaan-3

Epilogue

We have observed and experienced breathtaking and amazing research and development in different branches of science and technology for the community and individual benefits. At the same time, we have to think and act seriously for the irreversible ecosystem to make it a pollution and climate risk free environment for the sustainable existence of the human race.

Compilation and analysis

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