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Page 01 : Prelims Facts

The U.S. dollar's dominance in global trade is being challenged by BRICS nations, which aim to reduce reliance on it.

- In response, Donald Trump has threatened 100% tariffs if these countries promote alternatives or develop a BRICS currency.

Trump's Tariff Threat Against BRICS

- S. President-elect Donald Trump has threatened 100% tariffs on nine BRICS alliance nations if they undermine the U.S. dollar.
- The BRICS alliance includes Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Iran, and the UAE.
- Trump demands these countries avoid creating a new BRICS currency or supporting alternatives to the U.S. dollar.

The Dollar's Global Dominance

- The U.S. dollar remains the dominant global currency, comprising 58% of global foreign exchange reserves (IMF data).
- Most global commodities, like oil, are primarily traded in dollars.
- However, BRICS nations aim to trade in non-dollar currencies, challenging the dollar's dominance.

Russia's Push for Alternatives

- Russian President Vladimir Putin criticized the U.S. for "weaponising" the dollar at a BRICS summit.
- Russia advocates for an alternative payment system to bypass SWIFT and counter Western sanctions.

Future of the Dollar

- Despite challenges, research suggests the U.S. dollar's role as the global reserve currency is secure in the near future.

UPSC Prelims PYQ : 2017

Ques : The term 'Digital Single Market Strategy' seen in the news refers to :

(a) ASEAN
(b) BRICS
(c) EU
(d) G20

Ans : c)

Trump threatens 100% tariffs on BRICS if dollar is undermined

'America first': A supporter wearing a mask of Donald Trump holds an American Flag near Trump's Mar-a-Lago estate on Friday. AP

Associated Press
WEST PALM BEACH

U.S. President-elect Donald Trump on Saturday threatened 100% tariffs against a bloc of nine nations if they act to undermine the U.S. dollar.

His threat was directed at countries in the so-called BRICS alliance, which consists of Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Iran, and the United Arab Emirates.

While the U.S. dollar is by far the most-used currency in global business and has survived past challenges to its preeminence, members of the alliance and other developing nations say they are tired of America's dominance of the global financial system.

The dollar represents roughly 58% of the world's foreign exchange reserves, according to the IMF and major commodities like oil are still primarily bought and sold using dollars. The dollar's dominance is threatened with BRICS's growing share of GDP and the alliance's intent to trade in non-dollar currencies.

Mr. Trump, in a Truth Social post, said: "We require a commitment from these Countries that they will neither create a new BRICS Currency, nor back any other Currency to replace the mighty U.S. Dollar or, they will face 100% Tariffs, and should expect to say goodbye to selling into the wonderful U.S. Economy."

Russia's stand

At a BRICS summit in October, Russian President Vladimir Putin accused the U.S. of "weaponising" the dollar and described it as a "big mistake".

"It's not us who refuse to use the dollar," he said. "But if they don't let us work, what can we do? We are forced to search for alternatives."

Russia has specifically pushed for the creation of a new payment system that would offer an alternative to the global bank messaging network, SWIFT, and allow Moscow to dodge Western sanctions.

Research shows that the U.S. dollar's role as the primary global reserve currency is not threatened in the near future.

Representatives from 170 countries convened in Busan, South Korea, for the fifth round of the Intergovernmental Negotiations Committee (INC) discussions aimed at eliminating plastic pollution.

- Despite a week of talks, the countries failed to agree on a framework due to stark divisions over critical issues.
- Negotiations will resume under the banner of INC-5.2, likely in the coming year.

Plastic treaty negotiations fail with countries split over production cuts

Jacob Koshy
NEW DELHI

Delegates from nearly 170 countries who gathered in Busan, South Korea, failed to agree on a framework agreement to eliminate plastic pollution, despite a week of negotiations.

While this was the fifth and officially final round of talks of the Intergovernmental Negotiations Committee that began in 2022, ultimately the chasm between the blocs of countries – those that saw cutting plastic production as necessary to eliminate plastic waste and those that didn't – proved too wide to overcome. Countries, however, have decided to resume negotiations, likely sometime next year, under the tentative banner of INC-5.2.

Delegates pose for a group photo at the end of a member state press briefing during the fifth meeting of the INC in Busan. AFP

As of Sunday evening, the assembly of countries in the final plenary expressed disappointment as well their reservations on several paragraphs in a text, which was synthesised by the Chair of the proceedings, Luis Vayas Valdivieso, following negotiations by countries in an attempt to cobble an agreement.

"We share the unhappiness we feel in this room with the limited amount of progress that we were able to make," said Hugo Schally, who spoke on behalf of the European Union at the closing plenary.

At the other end, other delegates saw proceedings as trying to reach "beyond" addressing plastic pollution. "Everyone is bringing their own lenses and turning it into a pretext for trade restrictions, economic agendas, and commercial competition disguised as environmental action," said Salman Al-Ajmi who spoke for Kuwait.

A long-standing sticking point, and vehemently opposed by countries such as Saudi Arabia whose economies are centred on petrochemicals and the production of plastic polymers, was the push to have countries set targets to cut virgin plastic polymer production. This position was also unacceptable to India.

"India would like to state its inability to support any measures to regulate the production of primary plastic polymers as it has larger implications in respect of the right to development of Member States," said Indian delegation leader Naresh Pal Gangwar of the Environment Ministry, at the plenary

Divisions on Reducing Plastic Production

- The talks highlighted disagreements between countries advocating for a reduction in virgin plastic polymer production and those opposing it.
- Some nations with petrochemical-dependent economies opposed setting production reduction targets, citing significant economic implications.
- Others argued that regulating plastic production impacts their developmental rights and economic growth prospects.

Limited Progress and Future Steps

- A synthesized text, intended to create a consensus, failed to address the concerns of all nations.
- Delegates expressed collective disappointment at the limited progress and the inability to reach a compromise.
- Countries remain committed to continuing negotiations in the future to address unresolved issues.

Concerns Over Broader Agendas

- Some countries like Qatar, criticized the discussions, alleging they served as a pretext for advancing trade restrictions, economic agendas, and commercial competition under the guise of environmental action.

UPSC Prelims PYQ

Q. In the context of Plastic pollution, consider the following statements:

1.The main environmental concern associated with plastic pollution is the soil erosion.

2.Montreal Protocol aims to reduce the production and use of single-use plastics.

3.Burning plastic waste can help reduce plastic pollution in the oceans.

How many of the statements given above are correct?

a) Only one
b) Only two
c) All three
d) None

Ans : d)

Page 07 : GS 3 : Environment – Climate change

The oceans, vital for moderating Earth's climate, have absorbed 25% of anthropogenic CO_2 emissions and 90% of excess heat. However, this comes at a cost, including acidification and ecological disruptions. Marine Carbon Dioxide Removal (mCDR) strategies, both biotic and abiotic, offer scalable solutions but face scientific, regulatory, and societal challenges.

In our fight against climate change, could the seas turn the tide?

The open seas offer an immense opportunity to slow climate change if we invest now and do it right. The ocean has absorbed 25% of anthropogenic carbon dioxide emissions and more than 90% of the excess heat generated by greenhouse gases. Investing in sequestration within the wide-open expanse of the ocean is logical and inevitable

Pranay Lal

The ocean, the earth's vast blue lung, has long played a critical but underappreciated role in moderating the planet's climate. It has absorbed 25% of anthropogenic carbon dioxide emissions and more than 90% of the excess heat generated by greenhouse gases, buying humankind precious time against the worsening effects of climate change.

However, this seemingly boundless capacity comes at a cost: ocean acidification, disrupted biogeochemical cycles, pollution, and profound harm to marine ecosystems. Acidification, for instance, threatens calcifying organisms like coral and shellfish, while warming alters ocean circulation and deoxygenates vital marine habitats. These disruptions cascade through ecosystems, undermining the services they provide – from fisheries to carbon sequestration. The ocean's natural carbon and heat absorption processes, though crucial, are slow and carry ecological consequences.

A different suite of options

As we grapple with the dual imperatives of decarbonisation and climate resilience, attention is increasingly turning to marine carbon dioxide removal (mCDR) to complement emissions reductions and address lingering carbon dioxide burdens. The ocean's immense surface area and unique chemistry make it a tempting venue for natural and carefully engineered solutions. So far, all our efforts to fight climate change have been land-biased. We have invested heavily on land but ignored oceans, seas, lakes, and rivers. Several studies tell us that the land is saturated because soils and rocks are so severely damaged that they no longer support efficient carbon capture.

Oceans, seas, rivers, and even lakes offer a different suite of options. Deep-water bodies retain the ability to remove excess carbon rapidly from the atmosphere. They also transport the carbon into depths where it mixes and binds with minerals. As on land, marine carbon capture strategies fall into two categories. (i) Biotic approaches take advantage of living systems like mangroves and macroalgae or of our rivers to carefully calibrate biomass burial at sea. (ii) Abiotic approaches manipulate physical or chemical properties, such as through ocean alkalinity enhancement (OAE), and are more complicated but are also becoming unavoidable. Both these methods promise to capture and store carbon for the long term and potentially transform countries' contributions to climate goals.

Biotic, or nature-based, solutions rely on the inherent potential of ecosystems to sequester carbon while supporting biodiversity conservation and coastal protection. They are also relatively well-established, with some already integrated into national climate plans. However, their carbon sequestration potential is modest – typically capped at less than one billion tonnes of carbon dioxide every year – and storage durations are limited to hundreds or at best thousands of years.

Abiotic techniques, by contrast, offer greater scalability and permanence. For example, biomass burial at sea, if done right, can sequester seven to 22 billion tonnes of carbon dioxide per year. Reducing the acidic nature of the seas through OAE is another option. Here, alkaline materials are added to sea water to neutralise its carbon dioxide content, locking the carbon away for tens of thousands of years in the form of dissolved inorganic molecules. This method could potentially sequester one to 15 billion tonnes of carbon dioxide per year, an order of magnitude higher than biotic methods.

To put this in perspective, if we wish to keep global warming below 1.5 C , all our efforts must collectively cap emissions at 570 billion tonnes of carbon dioxide and reach net zero by 2050. But at today's relentless pace, this carbon budget will vanish by 2031. Yet abiotic approaches face hurdles, including public scepticism, regulatory challenges, and the need for extensive energy inputs – particularly in cases involving mineral mining or electrochemical processes.

If we wish to keep global warming below 1.5C, all our efforts must collectively cap emissions at 570 billion tonnes of carbon dioxide and reach net zero by 2050. But at today's relentless pace, this carbon budget will vanish by 2031

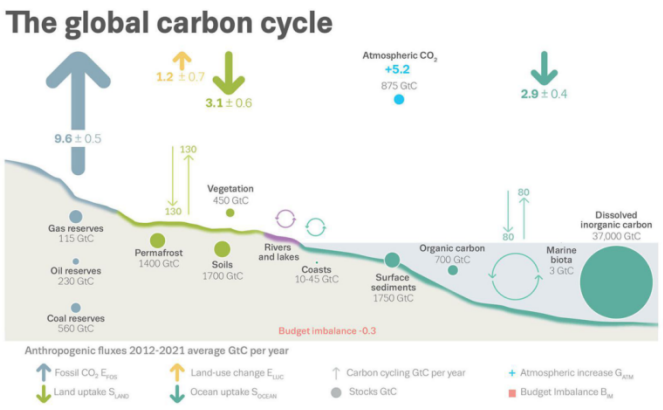
Promise for deep carbon burial

Despite its promise, mCDR is fraught with uncertainties and potential side effects as well. Techniques like ocean iron fertilisation, which claims to stimulate phytoplankton blooms to capture carbon dioxide, can disrupt other ecosystems and lower the oxygen content of deeper waters. Macroalgae cultivation, another proposed solution, carries similar risks when decaying biomass alters the local chemistry. Even OAE, which experts have touted for its scalability, raises concern about its consequences for marine biodiversity and the energy-intensive processes it may require.

Public perception further complicates deployment. Measuring how much carbon is captured and stays buried also remains a challenge since the seas are expensive to monitor. Many people view abiotic techniques as unnatural or harmful and favour biotic approaches instead, like direct air capture. Overcoming this scepticism will require communication, rigorous assessments, and stakeholder engagement. Critically, mCDR is not a substitute for reducing emissions. It cannot offset the current scale of fossil fuel combustion. However, as the world transitions toward net-zero emissions, leveraging the oceans and the seas becomes indispensable.

The careful study of geological and ecological methods offers a chance to harness their power and vastness of oceans. Success hinges on rigorous science, robust governance, and societal trust. The Indian Ocean, with its vast arms holds untapped promise for deep carbon burial, potentially capturing 25-40% of the marine carbon dioxide. Harnessing these natural systems could provide a critical edge, turning the tide on runaway warming.

(Pranay Lal is a biochemist, a natural history writer, and the co-founder of the climate group Deep Carbon. pranaylal@gmail.com)



Schematic representation of the overall perturbation of the global carbon cycle caused by anthropogenic activities, averaged globally for the decade 2012-2021. The uncertainty in the atmospheric CO2 growth rate is very small (±0.02 billion tonnes per year) and is neglected for the figure. GLOBAL CARBON PROJECT

THE GIST

The capacity of oceans to absorb carbon comes at a cost: acidification, pollution, and harm to marine ecosystems. It causes disruptions that cascade through ecosystems

The ocean's immense surface area makes it a tempting venue for carefully engineered solutions. So far, efforts to fight climate change have been land-biased, but studies tell us that the land is saturated and can no longer support carbon capture

Marine carbon sequestration is not a substitute for reducing emissions. It cannot offset fossil fuel combustion. However, as the world transitions toward net-zero, leveraging the oceans becomes indispensable

Role of Oceans in Climate Moderation

- Oceans have absorbed 25% of anthropogenic carbon dioxide emissions and more than 90% of excess heat from greenhouse gases.
- This process has bought humanity critical time to combat climate change.
- However, it comes with consequences, including ocean acidification, disrupted biogeochemical cycles, and harm to marine ecosystems.

- Acidification threatens calcifying organisms, while warming disrupts ocean circulation and deoxygenates habitats, undermining vital ecosystem services like fisheries and carbon sequestration.

Marine Carbon Dioxide Removal (mCDR): An Emerging Focus

- Oceans offer immense potential for carbon removal due to their large surface area and unique chemistry.
- Unlike land, which has reached a saturation point for carbon capture, oceans present untapped opportunities for sequestration.

Marine carbon capture strategies fall into two categories:

- **Biotic Approaches:** Leverage living systems like mangroves and macroalgae for carbon sequestration.
- **Abiotic Approaches:** Use chemical and physical processes, such as ocean alkalinity enhancement (OAE).

Biotic Solutions: Nature-Based Approaches

- These approaches rely on ecosystems to sequester carbon while promoting biodiversity and coastal protection.
- They are modest in capacity, sequestering less than one billion tonnes of CO_2 annually with storage lasting hundreds to thousands of years.
- Some biotic methods are already integrated into national climate plans.

Abiotic Solutions: Technological Approaches

- Abiotic methods offer greater scalability and permanence:
- Biomass burial can sequester 7-22 billion tonnes of CO_2 per year.
- OAE can neutralize seawater's CO_2, potentially capturing 1-15 billion tonnes annually and storing it for tens of thousands of years.
- These methods face challenges, including public scepticism, regulatory hurdles, and energy-intensive processes.

Challenges and Risks

- Techniques like ocean iron fertilization and macroalgae cultivation can disrupt ecosystems and alter water chemistry.
- Measuring and monitoring carbon burial in oceans is expensive and complex.
- Public perception often favors biotic over abiotic solutions, further complicating deployment.

The Path Forward

- mCDR is not a replacement for emissions reduction but complements efforts toward net-zero emissions.
- Robust governance, societal trust, and rigorous science are crucial for success.
- The Indian Ocean holds significant promise for deep carbon burial, potentially capturing 25-40% of marine CO_2, providing a critical edge against global warming.

UPSC Mains PYQ : 2014

Ques : Bring out the relationship between the shrinking Himalayan glaciers and the symptoms of climate change in the Indian sub-conSnent. **(250 Words /15 marks)**

Shock diamonds, or Mach diamonds, are bright and dark patterns in the exhaust plume of supersonic rockets or jets, formed due to pressure differences between exhaust and atmospheric pressure.

- These patterns result from repeated compression and expansion cycles.

WHAT IS IT?

Shock diamonds: supersonic heat nuggets

Sometimes when a rocket or a jet takes off, its exhaust has an alternating pattern of light and dark patches (see image). The bright patches in this formation are called shock diamonds, a.k.a. Mach diamonds. Shock diamonds are formed when an engine releases its exhaust into the atmosphere at a supersonic speed.

Just as it leaves the engine, the exhaust can be at a lower pressure than atmospheric pressure at the same altitude. As the exhaust flows out, the atmosphere compresses it until the two pressures are equal. It's also possible that the exhaust becomes over-compressed, at which point it will expand outward again to drop its pressure. This seesawing process may repeat itself multiple times until the exhaust pressure is close to the atmospheric pressure. This entire process generates waves in the exhaust plume, leading to the formation of shock diamonds.

When the atmospheric pressure bears down on the plume, it causes exhaust that's diverging outward to bend inward instead, before its pressure causes the exhaust to bend outward again and so on. When it flows inward, the pressure in that portion increases, hiking the temperature there and causing any fuel passing through that area to burn. The combustion creates a bright spot at that location, i.e., a shock diamond. The bending of the exhaust outward and inward produces shock waves that flow through the plume, creating the shock diamond pattern throughout.

An SR-71 Blackbird takes off from the Dryden Flight Research Centre, California, on March 9, 1993. Shock diamonds are visible in its exhaust. NASA

- Vasudevan Mukunth

For feedback and suggestions for 'Science', please write to **science@thehindu.co.in** with the subject 'Daily page'

Shock Diamonds Explained

- **Definition**

- Shock diamonds, also known as Mach diamonds, are alternating light and dark patterns visible in the exhaust plume of a rocket or jet engine operating at supersonic speeds.

Formation

- Occurs when the exhaust pressure differs from the surrounding atmospheric pressure.
- Exhaust undergoes compression and expansion cycles as it equalizes with atmospheric pressure.
- These cycles create waves in the exhaust plume.

Bright Spots

- Atmospheric compression increases exhaust pressure, causing temperature to rise.
- Fuel burns in these high-pressure regions, creating bright spots called shock diamonds.

Process

- Exhaust bends inward under atmospheric pressure and outward due to over-compression.
- Repeated cycles form a visible shock diamond pattern in the plume.

UPSC Prelims PYQ : 2023

Ques : Consider the following statements:

1. Ballistic missiles are jet-propelled at subsonic speeds throughout their flights, while cruise missiles are rocket-powered only in the initial phase of flight.
2. Agni-V is a medium-range supersonic cruise missile, while BrahmMos is a solid-fuelled intercontinental ballistic missile.

Which of the statements given above is/are correct?

a) 1 only
b) 2 only
c) Both 1 and 2
d) Neither 1 nor 2

Ans : d)

Page 09: GS 2 & 3 – Governance & Science and Technology

India's Ministry of Electronics and Information Technology is planning to establish an AI Safety Institute to address risks associated with artificial intelligence.

- The initiative aligns with international AI governance efforts like the Global Digital Compact and Bletchley Process. India's leadership can advocate for inclusive, evidence-based AI policy, benefiting both domestic and global ecosystems.

What India's AI Safety Institute could do

Sidharth Deb

Manager, Public Policy at The Quantum Hub, a public policy firm based in Delhi

India's AI Safety Institute should tap into parallel international initiatives

In October, the Ministry of Electronics and Information Technology (MeitY) convened meetings with industry and experts to discuss setting up an AI Safety Institute under the IndiaAI Mission. Curiously, this came on the heels of Prime Minister Narendra Modi's visit to the U.S., the Quad Leaders' Summit, and the United Nations Summit of the Future. AI appeared high on the agenda in the run up to the Summit of the Future, with a high-level UN advisory panel producing a report on Governing AI for Humanity.

Policymakers should build on India's recent leadership at the G20 and the GPAI, and position it as a unifying voice for the global majority in AI governance. The design of the Safety Institute should prioritise raising domestic capacity, capitalising on India's comparative advantages, and plugging into international initiatives.

Notably, the Summit of the Future yielded the Global Digital Compact that identifies multi-stakeholder collaboration, human-centric oversight, and inclusive participation of developing countries as essential pillars of AI governance and safety. As a follow up, the UN will now commence a Global Dialogue on AI. It would be timely for India to establish an AI Safety Institute which engages with the Bletchley Process on AI Safety. If executed correctly, India can deepen the global dialogue on AI safety and bring global majority perspectives on human centric safety to the forefront of discussions.

Institutional reform

In designing the institute, India should learn from concerns stemming from MeitY's AI Advisory in March 2024, which proposed that there be government approvals before the public roll-out of experimental AI systems. Some asked what kind of institutional capability the Indian government had to suitably determine the safety of novel AI deployments. Other provisions on bias, discrimination, and the one-size-fits-all treatment of all AI deployments indicated that the advisory was not based on technical evidence.

Similarly, India should be cautious and avoid prescriptive regulatory controls which have been proposed in the European Union (EU) and China. The threat of regulatory sanction in a rapidly evolving technological ecosystem quells proactive information sharing between businesses, governments, and the wider ecosystem. It nudges labs to only undertake the minimum steps towards compliance. Yet each jurisdiction demonstrates a recurring recognition of establishing specialised agencies – for example, China's Algorithm Registry and the EU's AI Office. However, to maximise the promise of institutional reform, India should decouple institution building from regulation making.

The Bletchley process is underscored by the U.K. Safety Summit in November 2023 and the South Korea Safety Summit in May 2024. The next summit is set for France and this process is yielding an international network of AI Safety Institutes.

The U.S. and the U.K. were the first two to set up these institutes and have already signed an MoU to exchange knowledge, resources, and expertise. Both institutions are also signing MoUs with AI labs and receiving early access to large foundation models. They have installed mechanisms to share technical inputs with the AI labs before their public roll outs. These Safety Institutes facilitate proactive information sharing without being regulators. They are positioned as technical government institutions that leverage multi-stakeholder consortiums and partnerships to assess the risk of frontier AI models to public safety. However, they largely consider AI safety through the lens of cybersecurity, infrastructure security, safety of the biosphere, and other national security threats.

These safety institutes aim to improve government capacity and mainstream the idea of external third-party testing and risk mitigations and assessments. Government-led AI safety institutes aim to deliver insights which can transform AI governance into an evidence-based discipline. The Bletchley process presents India with an opportunity to collaborate with governments and stakeholders from across the world. Shared expertise will be essential to keep up with AI's rapid innovation trajectories.

Charting India's approach

India should establish an AI Safety Institute which integrates into the Bletchley network of safety institutes. For now, it should be independent from rulemaking and enforcement authorities and, instead, operate exclusively as a technical research, testing, and standardisation agency. It would allow India's domestic institutions to tap into the expertise of other governments, local multi-stakeholder communities, and international businesses. While upscaling its AI oversight capabilities, India can also use the Bletchley network to advance the global majority's concerns with AI's individual centric risks.

The institute could champion perspectives on risks relating to bias, discrimination, social exclusion, gendered risks, labour markets, data collection and individual privacy. Consequently, it could deepen the global dialogue around harm identification, big picture AI risks, mitigations, red-teaming, and standardisation. If done right, India may become a global steward for forward-thinking AI governance which embraces many stakeholders and government collaboration. The AI Safety Institute can demonstrate India's scientific temper and willingness to implement globally compatible, evidence-based and proportionate policy solutions.

Background of AI Safety Initiative in India

- The Ministry of Electronics and Information Technology (MeitY) initiated discussions in October on establishing an AI Safety Institute under the IndiaAI Mission.
- This move follows global dialogues on AI governance, including the Quad Leaders' Summit and the United Nations Summit of the Future.
- The Global Digital Compact, adopted at the Summit of the Future, highlights multi-stakeholder collaboration, human-centric oversight, and inclusive participation as key principles for AI governance.
- India's leadership at the G20 and the Global Partnership on AI (GPAI) positions it to play a unifying role in global AI governance.

Designing the AI Safety Institute

- The proposed AI Safety Institute should focus on building domestic capacity and aligning with international AI safety initiatives like the Bletchley Process.
- The institute should prioritize research, testing, and standardization while avoiding prescriptive regulatory controls, as seen in the European Union (EU) and China.
- Regulatory sanctions in evolving ecosystems could discourage proactive information sharing and limit innovation.
- Instead, India should separate institution building from regulation-making to maximize the institute's effectiveness.

Global Precedents for AI Safety Institutes

- The U.K., U.S., and other nations have established AI Safety Institutes focused on assessing frontier AI risks related to cybersecurity, biosphere safety, and national security.
- These institutes foster collaboration between governments, AI labs, and multi-stakeholder groups for third-party risk assessments and proactive information sharing.
- They aim to mainstream risk mitigation practices and provide evidence-based insights for AI governance.
- The Bletchley network of safety institutes offers India an opportunity for global collaboration on AI safety.

India's Approach to AI Safety

- India should establish its AI Safety Institute as a technical research and testing body, independent of rulemaking and enforcement.
- The institute can tap into international expertise through the Bletchley network while addressing domestic AI governance needs.
- It should focus on risks like bias, discrimination, social exclusion, gendered impacts, labor markets, privacy, and data collection.
- The institute could contribute to global dialogues on AI harm mitigation, standardization, and forward-thinking governance.

Potential Benefits

- India's AI Safety Institute could enhance global collaboration, improve domestic oversight, and advocate for developing countries' perspectives in AI governance.

- By adopting a scientific, evidence-based approach, India can position itself as a global leader in inclusive and proportionate AI policy solutions.
- Practice Question: Discuss the significance of establishing an AI Safety Institute in India in the context of global AI governance. Highlight how such an institute can address domestic challenges and contribute to international collaborations. (150 Words /10 marks)

UPSC Prelims PYQ : 2020

Ques : With the present state of development, Artificial Intelligence can effectively do which of the following?

1. Bring down electricity consumption in industrial units
2. Create meaningful short stories and songs
3. Disease diagnosis
4. Text-to-Speech Conversion
5. Wireless transmission of electrical energy

Select the correct answer using the code given below:

(a) 1, 2, 3 and 5 only
(b) 1, 3 and 4 only
(c) 2, 4 and 5 only
(d) 1, 2, 3, 4 and 5

Ans: b)

Research security should be a national priority

Suryesh Kumar Namdeo

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As India aims to achieve its development objectives by 2047, the government has laid an emphasis on the role of science and technology in strategic and emerging sectors. Investment in cutting-edge technologies is essential to stay globally competitive, address societal challenges and unlock economic opportunities. Like in many nations, India is building an innovation ecosystem to harness the transformative power of these technologies. However, along with this intensification of research and development (R&D) arises a new challenge – research security.

While collaboration and the free exchange of knowledge are fundamental to scientific progress, there are new risks in the rapidly evolving geopolitical landscape. Foreign interference, intellectual property theft, insider threats, cyberattacks, and unauthorised access to sensitive information are concerns for countries investing in advanced technologies. If left unaddressed, they could undermine India's progress in strategic sectors. Research security, in this context, refers to safeguarding scientific research from threats to confidentiality, economic value, or national interest. India is ramping up investments in strategic technologies which include space, defence, semiconductors, nuclear technology, cybersecurity, biotechnology, clean energy, artificial intelligence, and quantum technology. So, ensuring strategic research outputs remain protected is critical. Any breach of security could compromise national interests, delay technological advancements, and expose sensitive data to exploitation by foreign actors.

Policymakers must focus on strengthening research security as a part of India's broader science and technology strategy. This involves a concerted effort to protect sensitive data, intellectual property, research infrastructure, and personnel. Preventing espionage, sabotage, and adversarial foreign influence are essential to safeguard India's R&D investment.

The global landscape, China factor

The issue of research security is not far-fetched, as there have been several cases of research security breaches around the world with serious consequences.

In a famous case, a senior professor at Harvard University and his two Chinese students were arrested for not-disclosing their links to Chinese funding, while also receiving funding from the U.S. Department of Defense. In another case, COVID-19 vaccine research facilities were subject to cyber attacks in 2020 to steal sensitive vaccine research and development data. The European Space Agency (ESA) has also suffered several cyberattacks to sabotage or steal sensitive information, prompting ESA to develop a partnership with the European Defence Agency on cybersecurity.

Policymakers must focus on strengthening research security as a part of the broader science and technology strategy in India

Such incidents have prompted several countries to develop policies and guidelines to strengthen research security. The US CHIPS and Science Act has several provisions on research security, which are complemented by other guidelines; these include the research security framework of the National Institute of Standards and Technology. Canada has come up with National Security Guidelines for Research Partnerships and a Policy on Sensitive Technology Research and Affiliations of Concern, along with a list of sensitive technologies.

Moreover, the country has identified research institutions – primarily from China, Iran, and Russia – with which collaborations should be avoided. The European Council's recommendation is taking a different approach based on the principles of self-governance by the sector, a risk-based and proportionate response, and country-agonistic regulations. It underlines the need to establish a centre of expertise on research security and highlights research security-related guidelines for Horizon Europe, the primary research funding programme of the EU. Several of these initiatives are partially driven as responses to the military-civil fusion strategy of the Chinese Communist Party, which promotes the use of dual-use technology, technology transfer, funding and foreign collaborations; there is a close nexus between China's defence industry, universities and research institutions to develop and share strategic research and technologies between the civilian and military sectors.

Promoting research security in India

Unfortunately, the concept of research security has received little attention in academic circles and government policymaking, leading to vulnerabilities that adversarial actors could exploit. The first step would be to systematically map the security vulnerabilities in our research ecosystem. This would involve understanding the nature of foreign influence in our universities, assessing the vulnerabilities of key research labs and sensitive research infrastructure, analysing foreign collaborations and funding in strategic technologies, and reviewing the personnel hiring and access control practices to comprehend possible insider threats in the crucial research facilities. For this, government agencies and research institutions need to deliberate on possible steps to make strategic research more secure while avoiding over-regulation. Further, engagement with trusted international partners could be explored for the initial capacity building and awareness-raising in this area.

Concrete steps would require security and intelligence agencies to engage with researchers and develop an understanding of the sensitive research areas. This would also necessitate the classification of research in different categories based on strategic value, possible economic impact and the national security implications. Thus, a research security framework could be developed providing research security guidelines. Here, a risk-based and proportionate response approach similar to the one recommended by the European Council could be considered as it seeks to avoid over-regulation while reducing security risks. There would be a requirement to develop a research security surveillance mechanism to keep tabs on emerging risks.

Observe these cautions

There are several in-principle and practical challenges for research security. For instance, science is inherently international and collaborative in nature and international collaborations are crucial drivers of scientific progress. Research security seeks to restrict certain funding and collaborations, which would be opposed by researchers for infringing on academic freedom and hindering scientific progress. Similarly, research security would also have to find a balance with open science, which includes sharing of research infrastructure, open data, and involving the general public in the scientific research via citizen science. Rightfully, open science is promoted by governments, funding agencies, science academies, and individual researchers.

Another major challenge would be the additional administrative and regulatory burden that research security would bring to research institutions and individual researchers, already strangled by the overly bureaucratic nature of our institutions and funding agencies. It is crucial that research security is implemented in close collaboration with the technical experts rather than security and intelligence agencies making decisions without full understanding of the matter. It is important that research security should not become an instrument of political interference in academic institutions.

Research security would require significant funding, effective communication, engagement, and capacity building to create a cadre of professionals who could design, develop, implement and lead research security efforts in India. A dedicated office similar to one at the U.S. National Science Foundation could be created for research security in the newly established Anusandhan National Research Foundation (ANRF). Such an office could become a focal point for coordinating and synergising efforts for research security among security agencies and academic institutions. Finally, researchers should be engaged at all levels of decision-making to find the right balance of security issues with open science, regulatory burden and scientific progress. Here, the spirit of 'as open as possible and as closed as necessary' could help guide decision-making.

GS Paper 02 : Governance

GS Paper 03 : Science and Technology

PYQ: (UPSC CSE (M) GS-3 2014): Scientific research in Indian universities is declining, because a career in science is not as attractive as our business operations, engineering or administration, and the universities are becoming consumer oriented. Critically comment. (200 words/12.5m)

UPSC Mains Practice Question: Examine the importance of research security in safeguarding India's strategic technological advancements. Discuss the challenges of implementing research security while ensuring academic freedom and international collaboration. (250 Words /15 marks)

Context :

- The article discusses the critical role of science and technology in India's strategic development goals by 2047 and highlights the emerging risks to research security.
- Issues like foreign interference, cyberattacks, and intellectual property theft threaten national interests.
- It emphasizes the need for a balanced framework to secure sensitive research while fostering innovation.

Importance of Science and Technology for India's Development

- By 2047, India aims to achieve its developmental objectives through strategic investments in science and technology.
- Cutting-edge technologies like space, semiconductors, artificial intelligence (AI), and quantum technology are vital for economic growth and societal challenges.
- Research security is critical to safeguarding strategic research from breaches that may compromise national interest and technological advancements.

Emerging Threats to Research Security

- Challenges include foreign interference, intellectual property theft, cyberattacks, and insider threats.
- Notable global incidents highlight these risks:
  - Harvard University professor's undisclosed Chinese funding links.
  - Cyberattacks on COVID-19 vaccine research facilities in 2020.
  - Cyber intrusions at the European Space Agency (ESA) to steal sensitive data.

Global Response to Research Security

- **United States:**

- CHIPS and Science Act addresses research security.
- Frameworks by the National Institute of Standards and Technology (NIST) guide protection efforts.

- **Canada:**
  - Policies like National Security Guidelines for Research Partnerships safeguard sensitive technologies.
  - European Union:
  - Recommendations emphasize risk-based, proportionate regulations.
  - Horizon Europe program includes research security measures.
- **China:**
  - Military-civil fusion policy links defense, universities, and research institutions to exploit dual-use technologies.

Need for Research Security in India

- India's research ecosystem faces vulnerabilities in foreign influence, personnel access, and sensitive research infrastructure.
- Collaboration with trusted international partners could build capacity and awareness.
- Strategic research categorization is necessary based on national security, economic value, and potential risks.

Steps to Enhance Research Security

- Systematically map vulnerabilities in research labs and universities.
- Develop a research security framework with proportionate risk responses.
- Create surveillance mechanisms to monitor emerging threats.
- Engage intelligence agencies with researchers to classify and secure sensitive areas.

Challenges in Implementing Research Security

- Restrictive policies might infringe academic freedom and international collaboration.
- Balancing research security with open science initiatives is critical.
- Administrative burdens may stifle researchers and institutions.
- Political interference in academic institutions must be avoided.

Policy Recommendations

- Establish a dedicated office for research security within the Anusandhan National Research Foundation (ANRF).
- Build a cadre of professionals for research security implementation.
- Prioritize inclusive decision-making with researchers.
- Follow the principle of "as open as possible and as closed as necessary."

Conclusion

- Research security in India requires a holistic approach balancing open science with security needs.

- Adequate funding, effective communication, and international partnerships are essential for safeguarding strategic research while fostering innovation.