NITIN SIR CLASSES

THE HINDU

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Syllabus : GS-II, Polity + Governance| Prelims

SC tasks CBI to tackle 'digital arrests'

- Court says every type of cyberscam that defrauds the public needs to be probed
- Court directly ordering CBI, overriding state consent, is an extraordinary step
- States directed to accord their consent for investigations in their jurisdictions

Krishnadas Rajagopal
NEW DELHI

The Supreme Court on Monday tasked the Central Bureau of Investigation with cracking down on 'digital arrest' scammers and their associates, giving the agency a "free hand" to launch an anti-corruption probe into bankers involved in the opening of mule accounts linked to cybercrimes.

A Bench of the Chief Justice of India Surya Kant and Justice Joymalya Bagchi found "enough was enough", and held that 'digital arrest' scams required the immediate attention of the CBI.

A note provided by the Centre in the court showed that ₹3,000 crore had already been scammed by fraudsters from victims, mostly drawn from the elderly population, through 'digital arrests'.

"There is no second opinion that every type of cyber scam defrauding victims, especially senior citizens, is required to be investigated. The CBI shall investigate first the digital arrest scams. Other types of cyber scams [fraudulent investments, promise of part-time jobs] can come in the second and third stages," the court observed in the order.

The court directly ordering the CBI, overriding state consent, to conduct a pan-India probe and hunt down scammers is an extraordinary step. It cannot order the CBI, except when compelled by exceptional circumstances.

Directive to States

Bihar, Tamil Nadu, Karnataka, Kerala, West Bengal, Madhya Pradesh, Uttarakhand, Rajasthan, Punjab, Maharashtra, Meghalaya, Jharkhand, and Tripura have been directed to accord consent to the CBI under Section 6 of the Delhi Special Police Establishment Act to investigate 'digital arrest' cases under the Information Technology Act, 2000 in their jurisdictions.

The court directed the CBI to identify police officers from different States, and domain experts, to aid the investigation. "We want the CBI to undertake a comprehensive investigation on identified cybercrimes on a pan-India basis," Chief Justice Kant observed.

Considering the magnitude of the 'digital arrest' scams and widespread tentacles of the fraudsters, the Supreme Court directed the CBI to coordinate with the Interpol to identify cybercrime havens abroad. The court impleaded and issued notice to the Reserve Bank of India to respond on the use of Artificial Intelligence and Machine Learning to trace 'layering' or the moving of the proceeds of crime through multiple bank accounts to escape detection.

Invoking the Information Technology (Intermediary Guidelines and Digital Media Ethics Code) Rules of 2021, the apex court directed online intermediaries to cooperate with the CBI, and provide the agency assistance with regard to data in connection with investigation into 'digital arrest' cases.

States and Union Territories have to ensure the establishment and operationalisation of regional cybercrime coordination centres to compile data on cybercrimes, and for initiating preventive measures against the offence, the court directed. They should be linked to the Indian Cybercrime Coordination Centre (I4C), which is designed to provide an ecosystem for law enforcement agencies to deal with cybercrime in a coordinated and comprehensive manner.

The court said telecom operators had been careless in issuing SIM cards.

"The records before this court show an alarming, negligent and irresponsible approach of the telecom service operators in issuing SIM cards, particularly multiple SIMs, in the same name," Chief Justice Kant noted.

The Telecom Department was ordered to submit a proposal for the consideration of the top court, which would be eventually complied with by telecom service operators to prevent the misuse of SIMs.

The court's *amicus curiae* in the case, advocate N.S. Nappinai, classified cyber frauds into three main categories – digital arrest, fraudulent investments, and the promise of part-time jobs.

All these frauds are meant to defraud innocent victims, particularly senior citizens, of their hard-earned money. Whatever the category, they need to be stopped, the CJI stressed.

Tough action

The Supreme Court has asked the Central Bureau of Investigation (CBI) to crack down on 'digital arrest' scammers

THREE CATEGORIES OF CYBER SCAMS IDENTIFIED BY SC

- **Digital arrests:** Victims are made to believe government authorities are entitled to their hard-earned money, and they are subjected to coercive acts of extortion
- **Investment scams:** Victims are lured by attractive investment schemes to deposit large amounts, but eventually are duped of the money. The fraudsters continue to coin different terminologies to dupe victims. In some of the cases, the money is sought in the name of 'advance tax'
- **Part-time jobs:** Victims are paid for 'free tasks' like positive reviews or watching YouTube. They are later made to pay huge amounts for 'premium tasks'

Supreme Court tasks CBI to crack down on 'Digital Arrest' Scams

Context

The Supreme Court of India has directed the **Central Bureau of Investigation (CBI)** to investigate the rapidly rising cases of *digital arrest* scams and related cyber frauds that have collectively defrauded citizens of over **₹3,000 crore**, particularly targeting senior citizens.

Key Highlights

1. Supreme Court Intervention

- A Bench led by **CJI Surya Kant** and Justice Joymalya Bagchi gave CBI a **"free hand"** to conduct a nationwide probe.
- The Court termed the situation *extraordinary*, justifying its decision to **override state consent** — a rare move under the DSPE Act.
- First focus: **Digital arrest scams**.
  Later stages:
    - Fraudulent investment scams
    - Part-time job scams

2. State Consent under DSPE Act

Fourteen States — including Bihar, Tamil Nadu, Karnataka, West Bengal, Maharashtra, Kerala, Rajasthan, Punjab, Madhya Pradesh, Jharkhand, Meghalaya, Tripura, Uttarakhand — have been **directed to grant consent** under **Section 6 of the Delhi Special Police Establishment Act** to allow CBI investigation within their jurisdictions.

3. Multi-Agency Coordination

The Court directed:

- CBI to collaborate with **Interpol** to track cybercrime networks operating abroad.
- RBI to explain how **AI/ML tools** can be used to track fraudulent "layering" of money through multiple accounts.
- Online intermediaries to comply under **IT Rules, 2021** and assist the CBI with required data.
- Telecom Department to propose corrective measures to prevent **misuse of SIM cards**, citing negligent issuance of multiple SIMs in the same name.

4. Institutional Strengthening

The Court ordered:

- States/UTs to operationalise **Regional Cybercrime Coordination Centres**.
- Integration of these centres with the national **Indian Cybercrime Coordination Centre (I4C)**.
- Use of domain experts and specialised police officers to support CBI's pan-India investigation.

5. Amicus Curiae Classification of Cyber Frauds

As per Advocate N.S. Nappinai, cyber frauds fall into three main categories:

1. **Digital Arrest Frauds**
2. **Fraudulent Investment Schemes**
3. **Part-time Job Scams**

All disproportionately affect elderly citizens and must be curbed urgently.

Significance for BPSC

- Reflects rising **cybersecurity challenges** in India.
- Highlights **Centre–State coordination issues**, federalism, and limits of CBI jurisdiction.
- Strengthens discussion on **digital governance, AI regulation, telecom accountability**, and **consumer protection**.
- Useful for **GS-2 (Governance, Role of Judiciary)** and **GS-3 (Cybersecurity, Internal Security)**.

BPSC Prelims Practice Question

Q. Consider the following statements regarding 'Digital Arrest' scams:

1. The Supreme Court has directed the CBI to investigate these scams even without obtaining state consent.
2. The CBI can normally take up investigations within a state only after consent under Section 6 of the DSPE Act, 1946.
3. The Supreme Court invoked the IT Rules, 2021 to direct online intermediaries to assist in investigation.

Which of the statements given above are correct?

A. 1 and 2 only
B. 2 and 3 only
C. 1, 2 and 3
D. 1 and 3 only

Answer: C

BPSC Mains Practice Question

Q. The rise of 'digital arrest' and other cyber scams poses a serious threat to India's internal security and digital economy. Critically examine the role of the Supreme Court and central agencies in addressing these challenges. Suggest measures to strengthen India's cybercrime investigation framework.

Page 01

Syllabus : GS-III,Indian Economics| Prelims

Centre moves Bills to raise pan masala cess, increase excise duties on tobacco products

The Hindu Bureau
NEW DELHI

The Centre on Monday introduced a Bill in Parliament seeking to raise the excise duty on tobacco products, and another legislation targeting the manufacture of pan masala.

Union Finance Minister Nirmala Sitharaman tabled the two Bills – The Health Security se National Security Cess Bill, 2025 and the Central Excise (Amendment) Bill, 2025 – amid Opposition sloganeering.

The Bills are aimed at replacing the revenue from the Goods and Services Tax (GST) compensation cess on tobacco products, which will be discontinued soon. The Health Security se National Security Cess proposes to augment funding for health and national security through levy of cess on "machines installed, or other processes undertaken in the manufacture of pan masala".

The GST compensation cess was introduced in 2017 during the launch of the GST system. The proceeds were to be used to compensate States for any losses they faced due to the implementation of GST for a period of five years. During the COVID-19 pandemic years of 2020-21 and 2021-22, the proceeds from this cess fell short of the compensation requirement, leading to the Centre borrowing money to compensate the States.

The compensation cess on tobacco products is to be discontinued once the government pays back interest on these loans. According to sources in the Finance Ministry, this repayment will be completed in the next few months.


Nirmala Sitharaman

However, with the removal of this cess, the effective tax rate on and revenues from tobacco products would fall significantly. To overcome this shortfall in revenue, the Central Excise (Amendment) Bill has been introduced "in order to give the government, the fiscal space to increase the rate of Central excise duty on tobacco and tobacco products so as to protect tax incidence".

The Health Security se National Security Cess Bill seeks to "augment the resources for meeting expenditure on national security and for public health" by levying a cess on the "machines installed, or other processes undertaken in the manufacture of pan masala". The Bill also allows for the imposition of this cess on "other goods which may be notified".

"It provides for taxable persons to self-declare all machines or processes for each factory or premises, and the cess would be calculated in the aggregate for each location," it added.

Amid uproar, Lok Sabha passes Manipur GST Bill

NEW DELHI
The Lok Sabha, on the first day of the Winter Session on Monday, passed a Bill to replace an Ordinance which implemented reforms in the Goods and Services Tax (GST) in Manipur, amid disruptions and protests by the Opposition parties. » PAGE 5

Centre introduces Bills to hike excise duty on tobacco; impose cess on pan masala machinery

Context

The Union Finance Minister Nirmala Sitharaman introduced two key Bills in Parliament aimed at increasing tax revenues from tobacco and regulating the pan masala sector:

1. **The Health Security se National Security Cess Bill, 2025**
2. **The Central Excise (Amendment) Bill, 2025**

These Bills aim to compensate for the revenue gap created by the discontinuation of GST compensation cess on tobacco products.

Key Details

1. Background: Withdrawal of GST Compensation Cess

- **GST Compensation Cess (introduced in 2017) was levied on demerit goods including tobacco.**
- **Used to compensate States for revenue loss during GST implementation (for 5 years).**
- **During COVID-19 (2020-22), cess revenues fell short; the Centre borrowed money to compensate States.**
- **The compensation cess on tobacco will be discontinued once loan interest is fully repaid — expected within a few months.**

2. Why New Bills?

Once the compensation cess ends, the tax incidence on tobacco would drop sharply, reducing government revenue.

To avoid this shortfall, the Centre proposes:

A. Central Excise (Amendment) Bill, 2025

- **Gives the government power to increase Central excise duty on:**
  - **Tobacco**
  - **Cigarettes**
  - **Other tobacco products**
- **Aim: Protect tax incidence and maintain revenue stability.**

B. Health Security se National Security Cess Bill, 2025

A new cess will be levied on:

- **Machines installed in pan masala manufacturing units**
- **Processes undertaken for such manufacture**
- **Provision to extend cess to other notified goods**

Purpose:

- **“Augment resources” for:**
  - **National security**
  - **Public health expenditure**

Compliance mechanism:

- **Factories must self-declare machines or production processes.**
- **Cess will be charged per manufacturing location.**

3. Why target pan masala and tobacco?

- **Both are demerit goods with high public health impact.**
- **High taxation discourages consumption while generating revenue.**
- **Helps bridge fiscal gaps without burdening essential sectors.**

4. UPSC Relevance

- **GS-3: Fiscal policy, taxation, health economics**
- **GS-2: Centre–State fiscal relations; GST design; cooperative federalism**
- **GS-1/GS-3 (Ethics): Public health and social costs of tobacco/pan masala**
- **Important for Prelims (GST, excise, cess concepts)**

BPSC Prelims Practice Question

Q. With reference to the fiscal measures introduced by the Union Government in 2025, consider the following statements:

1. **The Health Security se National Security Cess is levied directly on the retail sale of pan masala products.**
2. **The Central Excise (Amendment) Bill, 2025 seeks to provide fiscal space to increase excise duties on tobacco products after the withdrawal of the GST compensation cess.**
3. **GST compensation cess on tobacco will continue until 2030.**

Which of the statements given above is/are correct?

A. 2 only
B. 1 and 2 only
C. 2 and 3 only
D. 1 and 3 only

Answer: A

BPSC Mains Practice Question

Q. The withdrawal of GST compensation cess has led the government to introduce new cess mechanisms and amend excise duties. Discuss the fiscal implications of these

changes. How do such measures balance the objectives of revenue generation, public health, and cooperative federalism?

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Syllabus : GS-II, Polity + Governance| Prelims

Masala bond controversy reignites in Kerala

EXPLAINER

Tiki Rajwi
THIRUVANANTHAPURAM

Once again, the battle over the 'Masala Bond' issued by the Kerala Infrastructure Investment Fund Board (KIIFB) – the Kerala government's principal funding arm for large infrastructure projects – is hotting up on the southern State's political scene.

In the latest instance, the Enforcement Directorate (ED) issued show-cause notices to Chief Minister Pinarayi Vijayan, former Finance Minister T.M. Thomas Isaac and KIIFB chief executive officer K.M. Abraham citing violation of the Foreign Exchange Management Act (FEMA) and the directions of the Reserve Bank of India (RBI).

With the 2025 local body polls just days away, the issue is expected to gather political steam.

What is masala bond?

In a nutshell, a masala bond is an instrument for raising rupee-denominated resources internationally.

For funding infrastructure projects, KIIFB had raised ₹2,150 crore through the bond issued in March 2019 when Mr. Isaac was Finance Minister in the 2016-2021 Left Democratic Front (LDF) government. The bonds were listed in the London Stock Exchange and the Singapore Stock Exchange. In July 2024, the current Finance Minister, K.N. Balagopal informed the Legislative Assembly that KIIFB had repaid the amount in full in March 2024.

ED probe

The ED probe has centred around the alleged contravention of FEMA regulations and RBI directions and the end-use of the funds raised through the bonds.

The Comptroller and Auditor General (CAG), in its State Finances Audit Report for the year ending March 2019, had observed that the RBI nod for the masala bond was questionable and "appear to be in violation of the Constitution and encroachment on the powers of the Centre."

The row over masala bonds is part of a broader debate over 'off-budget' borrowings by KIIFB and its consequences for the State's overall borrowing limit. The KIIFB borrowings have been a matter of contention with the Centre treating them as direct liabilities of the State, much to the Kerala government's dismay. Repeated requests to treat them as contingent liabilities have yielded no result.

Masala Bond Controversy Reignites in Kerala

Context

The controversy around the Masala Bond issued by the Kerala Infrastructure Investment Fund Board (KIIFB) has resurfaced after the Enforcement Directorate (ED) issued show-cause notices to the Kerala Chief Minister, former Finance Minister T.M. Thomas Isaac and KIIFB officials.

The accusation: violation of FEMA regulations and RBI directions related to external borrowings.

This issue gains political significance with the upcoming 2025 local body polls.

What is a Masala Bond?

A Masala Bond is a rupee-denominated bond issued in international markets.
Key features:

- **Borrowing done in Indian Rupees, not foreign currency.**
- **Issuer bears no foreign exchange risk; investors bear the risk.**
- **Used for raising funds for infrastructure and developmental projects.**
- **Permitted under RBI's framework for External Commercial Borrowings (ECBs).**

KIIFB issued ₹2,150 crore worth of Masala Bonds in March 2019, listed on:

- **London Stock Exchange**
- **Singapore Stock Exchange**

The amount was reportedly fully repaid in March 2024.

Why is the ED Investigating?

The ED probe focuses on:

1. **Alleged FEMA violations**
2. **Non-compliance with RBI directions**
3. **End-use of funds raised through the bond**

Key questions under ED scrutiny:

- **Was RBI approval properly obtained?**
- **Was the borrowing consistent with FEMA's rules for external commercial borrowing?**
- **Were the funds used strictly for the stated purpose (Kerala infrastructure projects)?**

CAG's Objection

In the State Finances Audit Report (2019), the Comptroller and Auditor General (CAG) stated:

- **RBI's permission for the KIIFB Masala Bond was questionable.**
- **It appeared to violate the Constitution.**
- **It could be seen as an encroachment on the Union government's fiscal powers.**

This created institutional friction and triggered deeper scrutiny.

The Larger Issue: Off-Budget Borrowing

The Masala Bond dispute is part of a bigger debate over off-budget borrowings by KIIFB.

What is off-budget borrowing?

- **Loans raised by agencies outside the State budget, but used for government expenditure.**
- **These do NOT appear in the State's fiscal deficit numbers.**
- **KIIFB used this mechanism extensively for infrastructure financing.**

Why the conflict with the Centre?

- **The Union government counts KIIFB borrowings as direct liabilities of Kerala.**
- **Kerala argues they are contingent liabilities, not part of the State's debt.**
- **This affects the State's overall borrowing limit under the FRBM framework.**

Repeated requests by Kerala to treat KIIFB's liabilities as contingent have been rejected.

BPSC Prelims Practice Question

Q. Consider the following statements regarding Masala Bonds:

1. **They are rupee-denominated bonds issued in foreign markets.**
2. **The foreign exchange risk is borne by the investor, not the issuer.**
3. **Masala Bonds require RBI approval under the External Commercial Borrowing framework.**

Which of the statements given above are correct?

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. 1, 2 and 3

Answer: D

BPSC Mains Practice Question

Q. The KIIFB Masala Bond controversy highlights deeper issues surrounding off-budget borrowings and Centre–State fiscal relations. Examine the constitutional, economic, and regulatory dimensions of this dispute. Suggest measures to ensure transparent and sustainable borrowing practices by State governments.

NITIN SIR CLASSES

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Syllabus : GS-II/III Polity + Governance| Prelims

Sanchar Saathi app must be pre-installed on phones: DoT

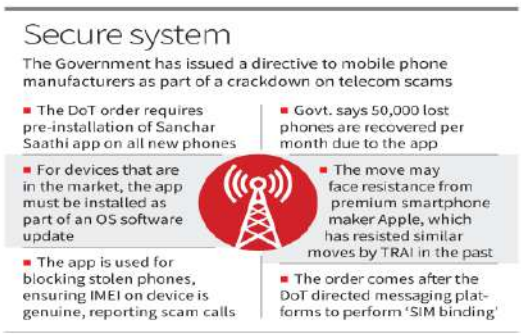
It must be installed on devices sold from March, govt. tells phone makers; move will help safeguard people from buying non-genuine handsets and enable easy reporting of telecom resource misuse

Aroon Deep
NEW DELHI

The Department of Telecommunications (DoT) on Monday ordered smartphone manufacturers to pre-install the Sanchar Saathi app on new devices sold from March 2026, and to make sure "that [the app's] functionalities are not disabled or restricted".

The Hindu has viewed a copy of the directions. The Sanchar Saathi app will be used to "verify authenticity of IMEIs used in mobile devices," the order said. It is unclear if the app will have access to the IMEI number of devices it is pre-installed on, or if users will have to input the hardware identifier on their own.

In a statement, the DoT said the move was meant to "safeguard the citizens from buying the non-genuine handsets, enabling easy reporting of suspected misuse of telecom resources and to increase effectiveness of the Sanchar Saathi initiative". The Sanchar Saathi app, first introduced as a portal in 2023, has been used to report scam calls, enable users to identify SIM cards registered in their name, and remotely disable phones if they are stolen. It is much like the Telecom Regulatory Authority of India's (TRAI) DND app, the commercial spam equivalent.



2.48 lakh complaints

The government has promoted the app, with 2.48 lakh complaints received so far on the platform, according to a dashboard on the site. Almost 2.9 crore requests to see mobile connections associated with a certain user have been made, the site says.

"Spoofed/Tampered IMEIs in telecom network leads to situation where same IMEI is working in different devices at different places simultaneously and pose challenges in action against such IMEIs," the DoT said.

"India has a big second-hand mobile device market. "Cases have also been observed where stolen or blacklisted devices are being re-sold. It makes the purchaser abettor in crime and causes financial loss to them. The blocked/blacklisted IMEIs can be checked using Sanchar Saathi App." In a Google Play listing for the app, the DoT declared that the app does not collect any user data. In a separate statement, the DoT also defended its order to messaging platforms.

The "DoT's SIM-binding directions are essential to plug a concrete security gap that cybercriminals are exploiting to run large-scale, often cross-border, digital frauds," the DoT said.

"Accounts on instant messaging and calling apps continue to work even after the associated SIM is removed, deactivated or moved abroad, enabling anonymous scams, remote "digital arrest" frauds and government-impersonation calls using Indian numbers."

Some smartphone makers have resisted government mandates to pre-install apps around the world. Apple, for instance, resisted the TRAI's draft regulations to install a spam-reporting app, after the firm balked at the TRAI app's permissions requirements, which included access to SMS messages and call logs.

Sanchar Saathi helped recover 50,000 lost or stolen devices in October, the DoT said.

Sanchar Saathi App Made Mandatory on All Smartphones — DoT Directive

Context

The Department of Telecommunications (DoT) has directed all smartphone manufacturers to pre-install the Sanchar Saathi app on every new device sold from March 2026.

Manufacturers must ensure that the app's features cannot be disabled or restricted.

What is the Sanchar Saathi App?

Launched in 2023, Sanchar Saathi is a citizen-centric digital platform designed to:

- **Verify authenticity of IMEI numbers**
- **Identify mobile connections linked to a person**
- **Report misuse of telecom resources**
- **Block/disable stolen phones remotely**
- **Report scam calls and telecom frauds**

The initiative includes modules such as:

- **CEIR (Central Equipment Identity Register): Tracks lost/stolen phones using IMEI**
- **TAFCOP: Shows number of SIMs registered against your name**

Why is the App Being Made Mandatory?

1. Curb sale of fake or tampered IMEI devices

- **Spoofed/tampered IMEIs allow multiple devices to operate on the same IMEI.**
- **This obstructs law enforcement and aids cybercrime.**

2. Growing second-hand mobile market

- **Stolen and blacklisted devices often re-enter the market.**
- **Buyers face financial loss and may unknowingly become abettors in crime.**

3. Address surge in digital fraud

DoT highlighted a serious issue:

- **Messaging and calling apps continue functioning even after SIM removal or deactivation, enabling anonymous cybercrimes like:**
    - **International scam calls**
    - **Digital arrest frauds**
    - **Government-impersonation scams**

4. Citizen security and telecom transparency

The app aims to:

- **Improve traceability**
- **Prevent misuse of telecom infrastructure**
- **Strengthen national cyber hygiene**

Current Performance of Sanchar Saathi

According to the official dashboard:

- **2.48 lakh complaints registered**
- **2.9 crore requests to check SIMs linked to users**
- **50,000 phones recovered in October alone**

Concerns & Industry Pushback

- **Some companies may resist mandatory pre-installed apps ("bloatware")**
- **Apple previously resisted TRAI's spam-reporting app due to privacy concerns**
- **Questions remain:**
    - **Will the app automatically access IMEI?**
    - **Will it raise privacy issues despite DoT's claim of "no data collection"?**

Significance

For GS-2 / Governance

- **Strengthens citizen protection**
- **Enhances State capacity to fight cybercrime**
- **Raises debates over regulatory overreach vs. public safety**

For GS-3 / Cybersecurity

- **Tackles digital frauds, fake IMEIs, cross-border scams**
- **Improves traceability of telecom devices**

For Prelims

- **IMEI, CEIR, TAFCOP**
- **DoT regulatory powers**
- **Consumer protection**

BPSC Prelims Practice Question

Q. Which of the following statements about the Sanchar Saathi initiative are correct?

1. **It allows users to check all mobile connections registered with their name.**
2. **It can remotely block or disable lost mobile phones through the CEIR system.**
3. **The app collects user data to verify identity.**

Select the correct answer using the code below:

A. 1 and 2 only
B. 2 and 3 only
C. 1 and 3 only
D. 1, 2 and 3

Answer: A
(DoT has stated that the app does not collect user data.)

BPSC Mains Practice Question

Q. The DoT's directive to mandate the Sanchar Saathi app on all smartphones reflects India's response to rising telecom fraud and digital security challenges. Examine the implications of this move on cybersecurity, consumer protection, and regulatory accountability.

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Syllabus : GS-III, Environment| Prelims

Why does India need bioremediation?

What are the two different types of bioremediation? How is traditional microbiology combined with cutting-edge biotechnology? Has the government initiated schemes to further bioremediation programmes? What are some of the challenges the country faces with respect to adoption of such technologies?

EXPLAINER

Shambhavi Naik

The story so far:

Human waste is leading to a world where access to clean air, water and soil is becoming increasingly difficult. The solution is two-pronged – reduce waste and clean up the waste already made.

What is bioremediation?

Bioremediation literally means "restoring life through biology." It harnesses microorganisms such as bacteria, fungi, algae and plants to sequester or transform toxic substances such as oil, pesticides, plastics, or heavy metals. These organisms metabolise these pollutants as food, breaking them down into harmless by-products such as water, carbon dioxide, or organic acids. In some cases, they can convert toxic metals into less dangerous forms that no longer leach into the soil or groundwater.

There are two broad types of bioremediation – in situ bioremediation, where treatment happens directly at the contaminated site such as when oil eating bacteria is sprayed on an ocean spill; or ex situ bioremediation, where contaminated soil or water is removed, treated in a controlled facility, and returned once cleaned.

Modern bioremediation combines traditional microbiology with cutting-edge biotechnology. New biotechnologies are enabling humans to gain unprecedented insight into biology, allowing them to identify biomolecules with useful characteristics. These technologies also allow humans to replicate biomolecules under desired conditions of use, such as in sewage plants or agricultural lands. For example, genetically modified (GM) microbes are designed to degrade tough chemicals like plastics or oil residues that natural species struggle with.

Why does India need it?

India's rapid industrialisation has come at a heavy environmental cost. Although pollution has been reducing, rivers such as the Ganga and Yamuna receive untreated sewage and industrial effluents daily. Oil leaks, pesticide residues, and heavy-metal contamination threaten both ecosystems and public health.

Traditional clean-up technologies are expensive, energy-intensive, and often create secondary pollution. Bioremediation offers a cheaper, scalable, and sustainable alternative, especially in a country where vast stretches of land and water are affected but resources for remediation are limited. Moreover, India's diverse biodiversity is a huge advantage. Indigenous microbes adapted to local conditions, such as high temperatures or salinity, can outperform imported strains.

Where does India stand today?

Bioremediation is gaining traction in India, though still largely in pilot phases. The Department of Biotechnology (DBT) has supported several projects through its Clean Technology Programme, encouraging partnerships between universities, public research institutions, and industries.

The CSIR-National Environmental Engineering Research Institute has a mandate to propose and implement programmes related to bioremediation. Researchers at the Indian Institute of Technology have experimented with a nanocomposite material synthesised from cotton that can be used to mop up oil spills and others have identified bacteria that can consume toxic pollutants in soils.

Startups are also entering the space. Firms like Biotech Consortium India Limited (BCIL) and Ecoinnvat Biotech offer microbial formulations for soil and wastewater treatment.

However, widespread adoption faces challenges such as a lack of site-specific knowledge and the complex nature of pollutants, and a lack of unified bioremediation standards.

What are other countries doing?

Japan integrates microbial and plant-based cleanup systems into its urban waste strategy. The European Union funds cross-country projects that use microbes to tackle oil spills and restore mining sites. China has made bioremediation a priority under its soil pollution control framework, using genetically improved bacteria to restore industrial wastelands.

The opportunities for India are immense. Bioremediation can help restore rivers, reclaim land, and clean industrial sites, while creating jobs in biotechnology, environmental consulting, and waste management. It can also integrate with the government's Swachh Bharat Mission, Namami Gange, and other green technology initiatives.

What are the risks?

The introduction of genetically modified organisms into open environments need to be strictly monitored to prevent unintended ecological effects. Inadequate testing or poor containment can create fresh problems while solving old ones. Public engagement will be necessary to allow the smooth adoption of new technologies. India will need new biosafety guidelines, certification systems, and trained personnel to scale this technology responsibly.

What next?

First, there is a need to develop national standards for bioremediation protocols and microbial applications. Second, building regional bioremediation hubs linking universities, industries, and local governments would enable better understanding of local issues and identifying appropriate technologies for their resolution. Finally, public engagement would raise awareness that microbes can be allies, not threats, in environmental restoration.

Shambhavi Naik is chairperson, TaraSharda Institution's Health & Life Sciences Policy.

New methods: Garbage being dumped in the Mittaganahalli landfill in Bengaluru in 2024. FILE PHOTO

THE GIST

- India's rapid industrialisation has come at a heavy environmental cost. Although pollution has been reducing, rivers such as the Ganga and Yamuna receive untreated sewage and industrial effluents daily.
- Bioremediation can help restore rivers, reclaim land, and clean industrial sites, while creating jobs in biotechnology, environmental consulting, and waste management.
- The introduction of genetically modified organisms into open environments need to be strictly monitored to prevent unintended ecological effects.

Why does India need bioremediation?

What is bioremediation?

Bioremediation means using living organisms — microbes, fungi, algae, or plants — to remove, degrade, or neutralise pollutants.
These organisms metabolise pollutants such as oil, plastics, pesticides, heavy metals, converting them into harmless by-products like CO_2 , water and organic acids.

Two major types of bioremediation

1. **In situ bioremediation**
    - **Treatment at the contamination site itself**
    - **Example: oil-eating bacteria sprayed on an ocean oil spill.**
2. **Ex situ bioremediation**
    - **Polluted material is removed, treated externally, and returned after cleanup.**

Why does India need bioremediation?

1. High pollution load

- **Rapid industrialisation = contaminated rivers, soil and groundwater.**
- **Ganga, Yamuna, and several urban rivers receive untreated sewage + industrial effluents every day.**
- **Pesticide and metal pollution is widespread in agricultural belts.**

2. Limitations of traditional clean-up

Conventional physical/chemical cleanup technologies are:

- **Expensive**
- **Energy-intensive**
- **Often cause secondary pollution**

3. Cost-effective and scalable

Bioremediation is:

- **Cheaper**
- **Suitable for large, polluted areas**
- **Requires less energy**
- **Sustainable for long-term use**

4. India’s biodiversity advantage

India hosts rich indigenous microbial ecosystems adapted to:

- **High temperature**
- **Salinity**
- **Local soil conditions**
  These microbes often outperform imported strains.

How does modern biotechnology improve bioremediation?

Traditional microbiology is now combined with cutting-edge biotechnology, enabling:

1. Identification of specialised microbes

Using genomics and proteomics to find organisms that:

- **Degrade oil**
- **Break down plastics**
- **Consume industrial toxins**

2. Genetically Modified (GM) microbes

Scientists design microbes to degrade tough chemicals that natural species struggle with — e.g., plastics or oil residues.

3. Replication and deployment at scale

Biotechnology allows:

- **Large-scale cultivation**
- **Integration into sewage treatment plants**
- **Use in agricultural lands and industrial sites**

Bioremediation is now moving from trial-and-error to precision-driven biotechnology.

Government Initiatives for Bioremediation

1. Department of Biotechnology (DBT)

- **Supports projects under the Clean Technology Programme**
- **Funds collaborations between IITs, NEERI, universities, and industries**

2. CSIR-NEERI

- **Mandated to design and implement bioremediation technologies**
- **Works on microbial and plant-based solutions**

3. Startups and industry

- **BCIL, Econirmal Biotech, and others sell microbial formulations for:**
  - **Wastewater treatment**
  - **Soil bioremediation**
  - **Oil spill cleanup**

4. Integration with national missions

Bioremediation aligns with:

- **Swachh Bharat Mission**
- **Namami Gange**
- **Green Technology Initiatives**
- **Urban waste management programmes**

Where does India lag? Challenges

1. Lack of site-specific data

Different pollutants need different microbes. India lacks a national database of:

- **Contaminated sites**
- **Suitable microbial strains**
- **Soil/water compositions**

2. Complex nature of pollutants

Mixed waste (plastics + metals + chemicals together) is harder to treat biologically.

3. No unified standards

India lacks:

- **Standard operating procedures (SOPs)**
- **Certification norms**
- **National guidelines for bioremediation practices**

4. Biosafety concerns

Especially with genetically modified microbes:

- **Risk of ecological disruption**
- **Possible uncontrolled spread**
- **Public suspicion towards GM organisms**

5. Limited skilled manpower

Bioremediation requires:

- **Microbiologists**
- **Environmental engineers**
- **Biosafety experts**
  These are not widely available at municipal or district levels.

What can India learn from other countries?

Japan

- **Integrates microbial + plant-based remediation in urban waste systems**

European Union

- Funds cross-border microbial projects
- Focus on mining site restoration and oil spill cleanup

China

- Uses genetically improved bacteria in large-scale soil remediation
- Pollution control embedded in national planning

The Way Forward for India

1. Create national bioremediation standards

- Protocols
- Safety guidelines
- Certification for microbial products

2. Build regional bioremediation hubs

- Collaboration of universities, industries, local bodies
- Region-specific solutions for rivers, soils and industrial sites

3. Strengthen biosafety regulation

- Monitor GM organisms
- Build containment systems
- Ensure evaluations before large-scale deployment

4. Public awareness

Educating people that microbes are useful allies in environmental restoration.

NITIN SIR CLASSES

Can India become self-reliant in REE production?

How is China using its dominance over rare earth elements as a geopolitical strategy?

V. Nivedita

The story so far:

The Union Cabinet has approved a ₹7,280-crore scheme to manufacture rare earth permanent magnets domestically. The scheme would facilitate the creation of integrated Rare Earth Permanent Magnet (REPM) manufacturing facilities, involving the conversion of rare earth oxides to metals, metals to alloys, and alloys to finished REPMs. This announcement comes at a time when China's export controls are squeezing global supply chains.

What is extent of China's dominance?

Rare earth elements (REEs), a group of 17 minerals, are crucial for their high density, melting point and conductivity. They are moderately abundant, but hard to extract economically and sustainably. China built global supremacy in this sector by controlling 90% of global REE processing and 70% of production, despite holding only 30% of global reserves. In April, China imposed export restrictions on seven rare earth elements and finished magnets, in a bid to counter the trade war. This hit many sectors, especially the automobile sector. "EV makers are the worst hit," said Pranay Kotasthane, deputy director of Takshashila Institution.

Though China's controls come amid a broader reshaping of global trade due to U.S. President Donald Trump's tariffs, they are not new. In 2009, Beijing imposed export quotas on REEs which was scrapped after it lost a World Trade Organisation case brought by the U.S. and others in 2015. "China realised that this is something which it can play in order to achieve its geopolitical, geostrategic and geoeconomic objectives. They played the same playbook in 2020 while restricting the export of graphite. In 2021, they started an export licensing plan in which they started restricting the supplies to certain industries," Dr. Ram Singh, Professor (IB), Head (CDOE), Indian Institute of Foreign Trade, explained.

Why is India focusing on REEs?

India's focus on REEs is driven by its ambitions in electric mobility, renewable energy, electronics manufacturing and defence. These industries depend heavily on rare earth magnets and components.

The country imported over 53,000 metric tonnes of REE magnets in FY 2024-25, despite having 8% of the world's REE reserves – mainly in monazite sands across Andhra Pradesh, Odisha, Tamil Nadu and Kerala. Yet, India produces less than 1% of global output. To fix this, the government launched the ₹16,300 crore National Critical Mineral Mission in January, with a total outlay of ₹34,300 crore spread over seven years, to achieve self-reliance. The mission focuses on exploration, processing, and recycling minerals like lithium, cobalt, and rare earths. To boost domestic production, the government has auctioned new mining blocks and is inviting private companies to participate in exploration and processing. "This sector was closed to the private sector until August 2023 and hence this is a new domain. China's restrictions will help generate interest among private players," Mr. Kotasthane said. However, he points out that only a handful of exploration licences were handed out. "The stumbling block is government regulations and control. Deregulating all segments of this supply chain, fast-tracking environmental regulations, and funding exploration projects to reduce information asymmetry is crucial," he said.

Dr. Singh cautioned that India still lacks refining infrastructure, skilled labour and innovation capacity. He also pointed out that domestic manufacturing would take years to take off given the long gestation period.

"The good thing is that India isn't in a particularly bad position," Mr. Kotasthane said, pointing out that India's monazite sands have several light rare earths, including Neodymium, which are used in magnets. "Several companies have plans to substantially increase capacity in the rare earth magnet recycling space from end-of-life electronic devices and appliances," he added.

THE GIST

- Rare earth elements (REEs), a group of 17 minerals, are crucial for their high density, melting point and conductivity.
- India's focus on REEs is driven by its ambitions in electric mobility, renewable energy, electronics manufacturing and defence. These industries depend heavily on rare earth magnets and components.
- To boost domestic production, the government has auctioned new mining blocks and is inviting private companies to participate in exploration and processing.

Can India become self-reliant in Rare Earth Elements (REE) production?

Current Status

- India holds **~8% of global REE reserves**, mainly in **monazite sands** (AP, Odisha, Tamil Nadu, Kerala).
- But it produces **less than 1%** of global REEs.
- India imported **53,000+ MT of REE magnets in FY 2024-25**, showing high dependence.

Steps India is Taking

1. **₹7,280-crore scheme for Rare Earth Permanent Magnets (REPM)**
   – Supports full value chain: *oxide → metal → alloy → finished magnets*.

2. **National Critical Mineral Mission (₹34,300 crore over 7 years)**
   – Focus on exploration, processing & recycling of REEs, lithium, cobalt, etc.

3. **Private sector entry allowed (since August 2023)**
   – Mining blocks are being auctioned to attract private and foreign players.

4. **Expansion of recycling**
   – Plans to recover REEs from *e-waste, EV motors, appliances*.

Challenges for India

- **Weak processing & refining capacity**
  (China controls 90% of global REE processing).
- **Lack of skilled workforce and technology** for high-purity separation.
- **Long gestation period**—REE mining to magnet production takes years.
- **Complex environmental clearances**.
- **Low private sector presence** due to earlier government monopoly.

Can India become self-reliant?

Yes, partially — over time (10–15 years).
India has:

- Large reserves
- Government support
- Growing domestic demand (EVs, wind turbines, electronics, defence)

But:

- Processing infrastructure is still primitive.
- China's ecosystem advantage is decades ahead.

Conclusion:
India can significantly reduce dependence but *complete* self-reliance will require:

- fast-tracking exploration
- deregulating the entire supply chain
- building refining technology
- developing skilled manpower
- sustained R&D and public-private partnerships

How is China using its dominance over REEs as a geopolitical strategy?

China controls:

- **70% of REE production**
- **90% of REE processing**
- Holds only **30% of REE reserves** but dominates the entire value chain.

This dominance has become a **strategic weapon**.

1. Export controls for geopolitical pressure

- **2009:** Export quotas on REEs → global prices shot up.
- **2020–21:** Restrictions on graphite and licensing rules.
- **2024:** Export limits on 7 REEs and finished magnets.

These were used especially when relations with:

- the **U.S.**,
- **Japan**,
- **Europe**
  were tense.

2. Controlling global EV and electronics supply chains

- China's curbs hit industries like:
  - Electric vehicles (EV makers "worst hit")
  - Wind turbines
  - Defence equipment
  - Smartphones

This helps China influence global manufacturing decisions.

3. Using REEs as a bargaining tool in trade wars

- The U.S.–China trade war saw China repeatedly **signal** its ability to choke REE supply.

4. Expanding global influence through processing contracts

- Even if minerals are mined in Africa or Australia, **processing is mostly done in China**.
- This makes other countries dependent on Chinese technology and facilities.

5. Economic statecraft

China uses REE leverage to:

- gain better diplomatic deals
- pressure rival states
- drive industries to shift manufacturing to China to secure supply

THE GIST (Exam-friendly)

- China uses REEs as a **strategic choke point**, controlling production, processing and export.
- India is pushing for **self-reliance** through new missions, private sector participation, and recycling.
- Self-reliance is possible only in the **medium to long term**, due to huge gaps in refining, technology, and skilled manpower.

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