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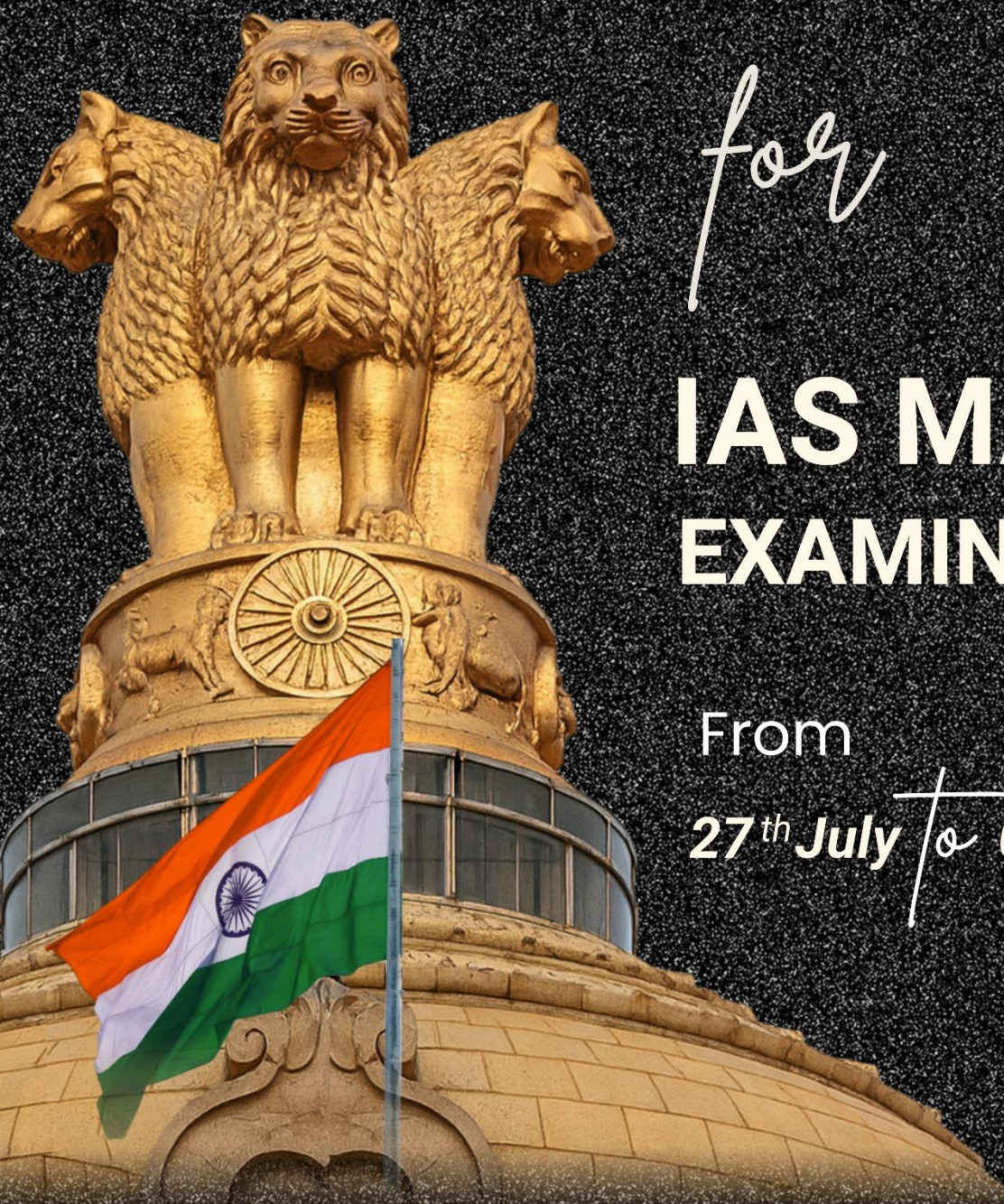
TEXT & CONTEXT / IE EXPLAINED

for

**IAS MAINS
EXAMINATION**

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GENERAL STUDIES 2

1.1. POLITY & GOVERNANCE

1.1.1. WHAT CAN BE DONE TO ADDRESS THE CBSE EVALUATION CONTROVERSY?

Context

The CBSE-OSM (On-Screen Marking) controversy highlights evaluation errors, limited script access and weak grievance redressal, raising broader concerns of transparency, equal opportunity, digital governance and institutional accountability.

Introduction

Examinations shape **education, employment and social mobility**. While CBSE's OSM aims to improve evaluation, **technical errors and major mark revisions** raise concerns over fairness, showing that digitalisation must ensure **transparency, accessibility and accountability**, not just efficiency.



Why is the CBSE-OSM Controversy Significant?

1. Examination Integrity and Equal Opportunity

- **Fair evaluation:** Errors in marking can directly affect students' academic and career opportunities.
- **Equality of opportunity:** Every student should have an equal opportunity to verify the accuracy of evaluation and seek correction of genuine errors.
- **Social mobility:** Board examination results influence admission to higher education and future career pathways.
- **Institutional credibility:** Repeated evaluation controversies can weaken public confidence in examination institutions.

2. Transparency as a Core Requirement of Digital Governance

- **Digital availability:** Since answer scripts are already digitised, students should have meaningful access to their evaluated scripts.
- **Transparency gap:** Digital records have limited value if procedural and technical barriers prevent students from accessing them.
- **Right to verify:** Students should be able to identify missing pages, blurred scans, mismatched scripts and other deficiencies.
- **Trust through openness:** Transparency strengthens institutional legitimacy and reduces suspicion of arbitrary evaluation.

3. Equal Access to Grievance Redressal

- **Procedural barriers:** Application fees, portal glitches, payment failures and limited timelines can restrict access to re-evaluation.
- **Unequal opportunity:** Students who overcome technical barriers may receive remedies while others remain unaware of possible errors.
- **Student-centric governance:** Grievance mechanisms should be simple, accessible and time-bound.

- **Substantive fairness:** A fair system must provide not only correct evaluation but also a meaningful opportunity to challenge incorrect evaluation.

4. Youth Welfare and Public Trust

- **High stakes:** Examination marks affect college admissions, scholarships and career prospects.
- **Mental stress:** Uncertainty and perceived injustice can intensify anxiety and frustration among young students.
- **Supreme Court concern:** The Court's reference to "frustrated young minds" highlights the human consequences of institutional failures.
- **Trust in institutions:** Fair examination systems are essential for maintaining young citizens' confidence in public institutions.

5. Digitalisation and Governance

- **Efficiency:** OSM can reduce dependence on physical answer-script movement and facilitate faster evaluation.
- **Standardisation:** Digital systems can support monitoring and administrative consistency.
- **New risks:** Digitisation can also generate scanning errors, data mismatches, technical failures and accessibility problems.
- **Human oversight:** Technology should assist evaluation rather than dilute institutional responsibility.

6. Accountability of Examination Institutions

- **CBSE responsibility:** CBSE must ensure reliable evaluation, transparent procedures and effective grievance redressal.
- **Ministry oversight:** The Ministry of Education must ensure appropriate policy supervision and institutional accountability.
- **Independent scrutiny:** External audits and institutional review can identify systemic weaknesses.
- **Beyond individual errors:** Accountability should examine the entire administrative chain rather than treating every mistake as an isolated incident.

Constitutional and Democratic Dimensions

1. Equality and Fairness

- **Article 14:** Equal treatment requires that similarly placed students receive comparable opportunities to seek remedies.
- **Article 16:** Fair examination systems are particularly important where examinations determine access to public employment.

2. Transparency and Right to Information

- **Transparency:** Students must have access to relevant information concerning their evaluation.
- **RTI framework:** Transparency mechanisms can strengthen institutional accountability.
- **SOP requirement:** Comprehensive and publicly available Standard Operating Procedures can clarify rights, timelines and remedies.
- **Public accountability:** Anonymised disclosure of evaluation errors and re-evaluation outcomes can improve institutional credibility.

3. Procedural Fairness and Natural Justice

- **Audi alteram partem:** Students should have a meaningful opportunity to present their grievance before an adverse academic outcome is treated as final.

- **Reasoned process:** Decisions regarding re-evaluation and correction should follow clear procedures.
- **Proportionality:** Procedural requirements should not become unreasonable barriers to legitimate grievance redressal.

Challenges in the CBSE Evaluation System

1. **Technical failures:** Portal glitches, payment failures, blurred scans and missing pages can undermine reliable evaluation.
2. **Limited access:** Not all students were able to access their evaluated answer scripts and seek review.
3. **Procedural complexity:** Multiple steps, fees and overlapping timelines can discourage legitimate grievances.
4. **Transparency deficit:** Lack of universal access to evaluated scripts weakens students' ability to verify marks.
5. **Weak grievance redressal:** Delays or inadequate mechanisms can leave students without effective remedies.
6. **Institutional accountability:** Difficulty in fixing responsibility for systemic failures can weaken public trust.
7. **Digital divide:** Unequal access to devices, internet connectivity and digital literacy can create new inequalities.
8. **Public confidence:** Substantial mark changes after re-evaluation can raise doubts about the reliability of the initial evaluation process.

Way Forward for Strengthening Examination Integrity

1. Implement a Seven-Day Transparency Framework

- Give students immediate access to evaluated answer scripts, followed by a short verification window for missing pages, blurred scans or mismatches.
- Genuine errors should then undergo time-bound re-evaluation, with anonymised outcomes publicly disclosed.

2. Establish Comprehensive SOPs

- Create a clear process covering access → verification → correction → re-evaluation → appeal with fixed timelines and transparent fees.
- Keep procedures simple, uniform and student-friendly, with periodic review and improvement.

3. Strengthen Independent Auditing

- Conduct regular independent audits of scanning, data integrity, evaluation and answer-sheet matching.
- Independent quality checks can identify systemic flaws early and improve confidence in the OSM system.

4. Ensure Student-Centric Grievance Redressal

- Establish accessible, time-bound and trackable mechanisms for students to report evaluation problems.
- Provide escalation and appropriate remedies when genuine or systemic errors are established.

5. Improve Transparency and Public Accountability

- Publish anonymised data on re-evaluation, errors detected and changes in marks.
- Public disclosure of SOPs and systemic deficiencies will strengthen institutional accountability and public trust.

6. Balance Digitalisation with Human Oversight

- Technology should improve efficiency while human authorities remain responsible for important evaluation decisions.
- Manual intervention and trained evaluators should be available whenever digital errors or anomalies arise.

7. Protect Students from the Digital Divide

- Provide assisted access and adequate time for students facing connectivity, disability or digital-literacy barriers.
- Technical problems should never deprive a student of the right to verify and challenge evaluation.

Conclusion

Digitalisation alone cannot ensure fairness in examinations. The CBSE-OSM system needs accurate evaluation, transparency, equal access and effective grievance redressal, with the seven-day framework offering a simple, time-bound solution to restore trust.

***Q.** Digitalisation of examination evaluation can improve efficiency, but without transparency, accountability and effective grievance redressal, it can undermine examination integrity and public trust. Discuss in the context of the CBSE On-Screen Marking controversy. 15 marks*

1.1.2. REGULATION OF SOPHISTICATED WEAPONS IN PROTEST MANAGEMENT

Context

The Siwan incident, in which a police constable allegedly fired four rounds from an AK-47 during a protest, raises concerns over the **deployment of sophisticated weapons, proportionality of police force, operational discretion and accountability**. It highlights the need to balance effective maintenance of public order with **Articles 19 and 21, human rights and democratic policing**.



Introduction

Police must maintain public order while using force **lawfully, necessarily and proportionately**. As Police and Public Order are State subjects, weapon use is governed by **State SOPs and police manuals**. Thus, modernisation must go hand in hand with **clear rules, de-escalation, human-rights safeguards and accountability**.

Why is the Use of Sophisticated Weapons During Protests Significant?

1. Protection of Fundamental Rights

- Articles **19 and 21** protect peaceful assembly, expression, life and personal liberty.

- Police action must maintain public order without disproportionately restricting **democratic dissent and civil liberties**.

2. Proportionality and Necessity

- State coercive power must follow **legality, necessity, proportionality and minimum-force principles**.
- Sophisticated weapons demand strict controls as their use can cause **disproportionate harm and escalation**.

3. Public Order and Police Safety

- Police may face **mob attacks, stone-pelting or imminent threats to life**, requiring effective protection.
- The challenge is to balance **citizen rights with the legitimate need to protect police personnel**.

4. State Subject and Need for Uniform Standards

- **Police and Public Order** are State subjects, making weapon deployment largely dependent on State SOPs and manuals.
- Variation across States highlights the need for **uniform minimum standards with operational flexibility**.

5. Professional and Accountable Policing

- Sophisticated weapons require **specialised training, clear rules of engagement, command protocols and weapon accountability**.
- Police modernisation must therefore focus on **professionalism and responsible use of force**, not merely better weapons.

6. Rule of Law and Public Trust

- Every instance of police firing should be assessed for **legality, authority, necessity, proportionality and accountability**.
- Independent investigation, due process and effective remedies can prevent **impunity and strengthen public trust in policing**.

Challenges in Regulating Police Use of Force During Protests

1. Lack of Uniform Standards

- Police being a State subject leads to variations in **SOPs, weapon deployment and crowd-control practices**.
- This creates inconsistencies in **rules of engagement and accountability** across States.

2. Difficulty in Assessing Crowd Threats

- A peaceful protest can quickly turn into **violence, rioting or a life-threatening attack**.
- Police must accurately distinguish between different threat levels to ensure a **proportionate response**.

3. Split-Second Decision-Making

- During an imminent attack, officers may have little time to **seek superior authorisation**.
- This creates a dilemma between **command control, operational discretion and emergency self-defence**.

4. Risk of Excessive Force

- Sophisticated firearms can cause **fatalities, collateral casualties and escalation of violence**.
- Their disproportionate use can also undermine **public confidence in law enforcement**.

5. Inadequate Training

- Limited training in **de-escalation, negotiation, crowd psychology and non-lethal methods** can increase risks.
- Effective policing requires **professional judgement and calibrated use of force**, not merely weapon capability.

6. Weak Post-Incident Accountability

- Delayed or non-independent investigations can create perceptions of **impunity and arbitrary use of power**.
- Strong post-incident scrutiny is essential to protect **citizens' rights and institutional credibility**.

Prakash Singh Recommendations Relevant to Police Use of Force

- **State Security Commission:** Insulate police from **arbitrary political interference** and ensure professional, impartial policing during protests.
- **Fixed Tenure:** Provide security of tenure to key police officers to enable **independent, professional and accountable decision-making** during law-and-order situations.
- **Police Complaints Authority:** Establish independent mechanisms to investigate **excessive force, custodial abuse and other police misconduct**, strengthening public accountability.
- **Police Establishment Board:** Ensure transparent decisions on **transfers, postings and promotions**, reducing external influence and promoting professional policing.

What Can Be Done to Strengthen Police Accountability?

1. Establish Uniform Minimum Standards

- Develop common national standards for **use of force, authorisation, warnings and post-firing review**.
- States can retain flexibility while ensuring **consistency and accountability** in policing.

2. Adopt a Graduated Response

- Follow **dialogue → warning → containment → non-lethal measures → firearms as the last resort**.
- Lethal force should be used only against an **imminent and serious threat to life**, as permitted by law.

3. Define Clear Rules of Engagement

- Clearly specify when sophisticated weapons may be **carried, drawn or fired**, including emergency exceptions.
- Differentiate **ordinary protests from armed or life-threatening situations** to guide police discretion.

4. Strengthen De-escalation Training

- Train personnel in **negotiation, communication, crowd psychology, threat assessment and non-lethal methods**.
- This promotes **calibrated responses** and reduces unnecessary escalation during protests.

5. Leverage Technology for Accountability

- **Body-worn cameras and digital records** can document warnings, crowd behaviour and use of force.
- Such evidence improves **transparency, accountability and protection against false allegations**.

6. Ensure Independent Post-Firing Investigation

- Fatal police firing should invite **independent investigation, magisterial scrutiny and preservation of evidence**.
- Violations must attract appropriate **departmental and legal action**, strengthening public trust.

7. Implement Police Reforms

- Strengthen **professionalisation, operational autonomy and accountability**, in line with Supreme Court-directed police reforms.
- Insulating policing from arbitrary external influence can improve **neutrality, effectiveness and public confidence**.

8. Ensure Weapon Accountability

- Maintain **weapon registers, ammunition records, periodic audits and training certification** for sophisticated firearms.
- This ensures that **police modernisation strengthens security without weakening accountability**.

Conclusion

Democratic policing requires a balance between authority and restraint. Sophisticated weapons must be used only when necessary, proportionate and accountable, ensuring public order without compromising constitutional freedoms.

Q. The use of force by police during protests must balance public order with constitutional rights, proportionality and accountability. Discuss in the context of the use of sophisticated weapons during civilian protests. 15 Marks

1.2. HEALTH

1.2.1. SHOULD INDIA IMPOSE A HEALTH TAX ON FOODS HIGH IN FAT, SUGAR AND SALT (HFSS)?

Context

The **Parliamentary Standing Committee on Consumer Affairs** has recommended **mandatory front-of-pack nutrition labelling** for packaged foods, while an expert consortium led by the **ICMR-National Institute of Nutrition (ICMR-NIN)** has proposed a **health tax on High Fat, Sugar and Salt (HFSS) foods** to curb rising obesity and non-communicable diseases (NCDs).



Introduction

India is facing a **double burden of malnutrition**, where persistent undernutrition coexists with rapidly increasing obesity and diet-related diseases. Addressing unhealthy diets through taxation,

nutrition labelling and stronger food regulations is essential to promote preventive healthcare and improve public health outcomes.

What are High Fat, Sugar and Salt (HFSS) Foods?

- **HFSS foods** are processed or packaged foods containing excessive amounts of **fat, sugar and salt**, while offering low nutritional value.
- Regular consumption increases the risk of **obesity, diabetes, hypertension, cardiovascular diseases and other non-communicable diseases (NCDs)**.

Examples

- **Soft Drinks:** Sugar-sweetened beverages with little or no nutritional value.
- **Packaged Snacks:** Processed ready-to-eat foods that are typically high in salt and unhealthy fats.
- **Chips:** Deep-fried or processed potato snacks rich in fat, salt and calories.
- **Chocolates:** Confectionery products often containing high amounts of added sugar and saturated fats.
- **Sugary Breakfast Cereals:** Processed cereals with excessive added sugars despite being marketed as healthy.
- **Instant Noodles:** Highly processed foods containing refined flour, sodium and unhealthy fats.
- **Fast Food:** Commercially prepared meals that are generally high in calories, fat, sugar and salt.
- **Sweetened Beverages:** Drinks with added sugars, such as fruit drinks and energy drinks, contributing to excessive calorie intake.

Why is Regulating HFSS Foods Significant?

1. Rising Burden of Obesity

- India is witnessing a rapid increase in overweight and obesity among both adults and children.
- According to **ICMR-NIN**, over **17 million children and adolescents** are affected by obesity, which may exceed **27 million by 2030**.

2. Preventing Non-Communicable Diseases (NCDs)

- Excessive consumption of HFSS foods is a major risk factor for diabetes, hypertension, cardiovascular diseases and certain cancers.
- Preventive regulation can reduce the long-term healthcare burden and improve population health.

3. Promoting Healthy Consumer Choices

- Mandatory **Front-of-Pack Nutrition Labelling (FOPNL)** helps consumers identify unhealthy products at the time of purchase.
- Better information encourages healthier dietary behaviour and informed decision-making.

4. Protecting Children and Adolescents

- Children are highly vulnerable to aggressive marketing of junk food through television and digital platforms.

- Restricting advertisements and improving school food environments can promote healthier eating habits from an early age.

5. Reducing Economic Burden

- Rising obesity and NCDs increase healthcare expenditure, productivity losses and economic costs.
- Preventive measures such as health taxes can reduce long-term fiscal pressure on the health system.

6. Aligning with Global Best Practices

- Many countries have introduced **health taxes** and stricter food regulations to discourage unhealthy consumption.
- International experiences show that taxation, combined with awareness and labelling, can improve dietary patterns.

Challenges in Regulating HFSS Foods

1. Industry Resistance

- Food manufacturers may oppose higher taxes and stricter labelling due to increased compliance costs.
- Strong lobbying can delay or dilute public health reforms.

2. Consumer Affordability Concerns

- Higher prices may disproportionately affect lower-income households if healthier alternatives remain expensive.
- Policy should therefore improve access to affordable nutritious foods.

3. Weak Consumer Awareness

- Nutrition labels may have limited impact unless supported by sustained public awareness campaigns.
- Low nutritional literacy can reduce the effectiveness of regulatory measures.

4. Implementation and Monitoring

- Effective regulation requires clear standards, regular inspections and strong enforcement mechanisms.
- Inadequate monitoring may lead to non-compliance by food manufacturers.

5. Balancing Public Health and Business Interests

- Policymakers must balance public health objectives with the interests of the food processing industry and employment.
- Regulations should encourage product reformulation rather than merely increasing compliance costs.

Recommendations by the Parliamentary Committee & ICMR-NIN Consortium

- **Mandatory Front-of-Pack Nutrition Labelling (FOPNL):** Introduce easy-to-understand nutrition labels to help consumers make informed food choices.
- **Display High Sugar, Fat and Salt Content:** Clearly indicate excessive levels of sugar, fat and salt on packaged foods through warning labels.

- **Display Sugar Content in Baby Foods:** Mandate disclosure of sugar content in infant and baby food products to protect child health.
- **Levy a Health Tax on HFSS Foods:** Impose higher taxes on unhealthy foods to discourage consumption and promote healthier diets.
- **Regulate Advertisements Targeting Children:** Restrict the marketing of HFSS foods to children across television, digital media and other platforms.
- **Promote Healthy School Food Environments:** Encourage nutritious food options and limit the availability of HFSS foods in and around schools.

What Can Be Done to Promote Healthy Diets?

1. Introduce a Health Tax on HFSS Foods

- Levy differential taxes on foods high in fat, sugar and salt to discourage excessive consumption.
- Revenue generated can support nutrition and preventive healthcare programmes.

2. Mandate Front-of-Pack Nutrition Labelling

- Introduce simple, easy-to-understand warning labels indicating high sugar, fat or salt content.
- This empowers consumers to make healthier food choices.

3. Regulate Advertising of Junk Food

- Restrict advertisements targeting children across television, digital platforms and schools.
- Promote responsible marketing practices by food companies.

4. Create Healthy School Food Environments

- Ban the sale of HFSS foods in and around schools.
- Encourage nutritious mid-day meals and healthy food options.

5. Promote Nutrition Awareness

- Conduct nationwide campaigns on balanced diets, food labels and healthy lifestyles.
- Integrate nutrition education into school curricula.

6. Encourage Food Reformulation

- Incentivise food manufacturers to reduce sugar, salt and trans-fat content in processed foods.
- Promote healthier product innovation through regulatory support.

Conclusion

India's growing burden of obesity and diet-related diseases demands a shift from curative to preventive healthcare. A combination of **health taxes, mandatory nutrition labelling, responsible food marketing and public awareness** can promote healthier dietary choices while reducing the long-term burden of non-communicable diseases.

***Q.** India is witnessing a dual burden of malnutrition, where undernutrition coexists with rising obesity and diet-related diseases. Discuss the need for regulating High Fat, Sugar and Salt (HFSS) foods through taxation, labelling and other policy measures. 15 Marks*

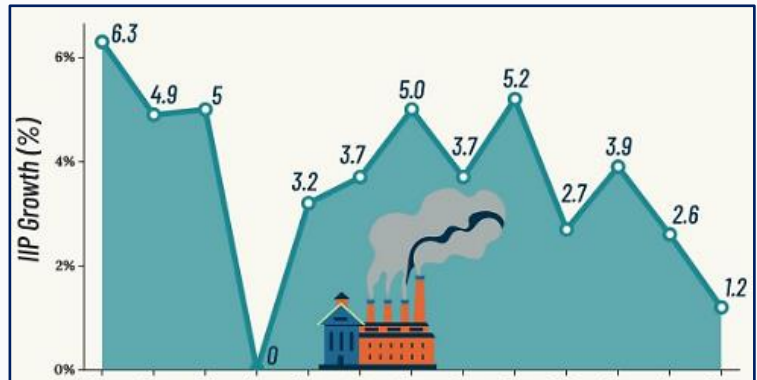
GENERAL STUDIES 3

2.1. ECONOMY

2.1.1. WHAT DOES THE LATEST IIP DATA REVEAL ABOUT THE INDIAN ECONOMY?

Context

The **Ministry of Statistics and Programme Implementation (MoSPI)** reported that India's **Index of Industrial Production (IIP)** grew by **7.3% (YoY) in June 2026**, the highest in nearly two years. While industrial growth remains strong, it is largely driven by **public investment and infrastructure**, with **consumer demand continuing to remain weak**.



Introduction

The **Index of Industrial Production (IIP)** is a monthly indicator of industrial output in the **manufacturing, mining and electricity** sectors. The latest data indicates **strong investment-led industrial growth**, driven by infrastructure and capital expenditure, even as **consumer demand remains subdued**, pointing to structural imbalances in the economy.

What is the Index of Industrial Production (IIP)?

- IIP is a monthly indicator published by **MoSPI**.
- Measures changes in industrial production compared to a base year.
- Covers:
 - Manufacturing
 - Mining
 - Electricity
- Acts as an important leading indicator of GDP and industrial performance.

Why is the Latest IIP Data Significant?

1. Indicates Strong Industrial Recovery

- India's **IIP grew by 7.3% (YoY) in June 2026**, marking the **highest growth in 23 months** and the **third consecutive month of accelerating industrial output**.
- This reflects improving industrial momentum and resilience despite global economic uncertainties.

2. Investment-Led Growth

- Strong growth in **Capital Goods, Infrastructure Goods and Intermediate Goods** indicates rising investment in productive assets and infrastructure.
- It reflects higher government capital expenditure, capacity expansion and improved long-term growth potential.

3. Weak Consumer Demand

- Growth in **Consumer Durables and Consumer Non-Durables** remained subdued, signalling weak household demand despite higher industrial production.
- Persistent inflation, sluggish rural incomes and moderating urban consumption continue to weigh on private consumption.

4. Infrastructure Push Driving Manufacturing

- Increased public spending on infrastructure has boosted demand for **steel, cement, machinery and engineering products**, supporting industrial activity.
- This demonstrates that infrastructure investment is acting as a key driver of manufacturing growth and employment generation.

5. Global Factors Continue to Influence Industry

- Production of **Primary Goods** remained weak due to supply disruptions and elevated energy prices arising from geopolitical tensions in **West Asia**.
- This highlights India's continued dependence on global commodity markets and vulnerability to external economic shocks.

6. Reflects Structural Transformation

- Recent IIP trends show consistently stronger growth in **Capital Goods, Intermediate Goods and Infrastructure Goods**, while **Consumer Goods** remain relatively weak.
- This suggests that India's economic growth is increasingly **investment-led**, with public expenditure driving industrial expansion more than private consumption.

Challenges Highlighted by the IIP Data

1. Weak Private Consumption

- High inflation has eroded household purchasing power, limiting spending on consumer goods.
- Rural demand remains weak due to slower income growth, while urban discretionary spending has also moderated.
- As private consumption contributes nearly **60% of India's GDP**, its sluggishness poses a challenge to sustained economic growth.

2. Dependence on Government Capital Expenditure

- The recent industrial growth is largely driven by **government-led infrastructure and capital expenditure** rather than private sector investment.
- While public investment has supported manufacturing, private investment recovery remains uneven due to demand uncertainty.
- Excessive reliance on government spending may not be sustainable in the long run without stronger private sector participation.

3. External Vulnerabilities

- Global tariff uncertainties and geopolitical tensions, particularly in **West Asia**, continue to disrupt supply chains and trade.
- Rising energy and commodity prices increase production costs and reduce industrial competitiveness.
- These external shocks expose India's industrial sector to global economic and geopolitical risks.

4. Uneven Industrial Growth

- Growth has been concentrated in **capital goods, infrastructure and intermediate goods**, while consumer-oriented industries continue to lag.
- This indicates that industrial expansion is not broad-based across all sectors of the economy.
- A balanced recovery requires stronger growth in both investment and consumption-driven industries.

5. Slow Recovery in Consumer Industries

- Sectors such as **pharmaceuticals, electronics, apparel and leather** have recorded relatively weak production growth.
- Subdued domestic demand, global trade uncertainties and export-related challenges have constrained their performance.
- Reviving these labour-intensive industries is essential for boosting employment, exports and inclusive industrial growth.

What Can Be Done to Achieve Broad-Based Industrial Growth?

1. Strengthen Domestic Consumption

- Boost rural incomes through higher agricultural productivity, better wage opportunities and targeted welfare measures to stimulate demand.
- Generate quality employment and maintain price stability to improve household purchasing power.
- Stronger domestic consumption will support sustainable industrial growth and reduce overdependence on public investment.

2. Encourage Private Investment

- Improve the ease of doing business by simplifying regulations, reducing compliance costs and ensuring policy certainty.
- Facilitate faster project approvals and create a stable investment climate to boost business confidence.
- Greater private investment will expand industrial capacity, enhance productivity and complement government capital expenditure.

3. Support MSMEs

- Improve MSMEs' access to affordable finance, technology and digital infrastructure to enhance their competitiveness.
- Strengthen their integration with domestic and global supply chains through skill development and market linkages.
- A vibrant MSME sector will promote innovation, employment generation and balanced industrial growth.

4. Sustain Infrastructure Investment

- Continue public capital expenditure on transport, energy, logistics and urban infrastructure to strengthen industrial ecosystems.
- Encourage **Public-Private Partnerships (PPP)** to mobilise private capital for infrastructure development.

- Better infrastructure reduces logistics costs, improves competitiveness and attracts long-term investment.

5. Diversify Export Markets

- Expand trade with emerging markets and reduce dependence on a limited number of export destinations.
- Strengthen India's participation in **Global Value Chains (GVCs)** by improving quality standards and export competitiveness.
- A diversified export base will enhance industrial resilience and reduce vulnerability to external shocks.

6. Promote Labour-Intensive Manufacturing

- Encourage sectors such as **textiles, food processing, leather and electronics** through targeted incentives and skill development.
- Strengthen labour-intensive industries to create large-scale employment while boosting manufacturing output.
- This will support inclusive growth by linking industrial expansion with higher incomes and job creation.

Conclusion

The latest IIP data indicates that India's industrial sector is witnessing strong investment-driven growth supported by infrastructure spending. However, weak consumer demand highlights that the recovery remains uneven. Sustaining high economic growth will require complementing public investment with stronger private consumption, private investment and employment generation to ensure inclusive and durable industrial development.

Q. *The latest Index of Industrial Production (IIP) data indicates strong industrial growth despite weak consumer demand. Examine the trends reflected in the IIP and discuss what they reveal about the changing nature of India's economic growth. 15 Marks*

2.2. ENVIRONMENT

2.2.1. ASSAM'S FLOOD CRISIS

Why is in news?

Within a short span, Assam experienced one of its **worst flood disasters in recent years**, affecting **over 16 lakh people**, inundating thousands of villages, damaging infrastructure, and triggering landslides across northeastern states. Experts attribute the severity to an interaction between **climate change-induced extreme rainfall events** and **local ecological degradation**.



Introduction

- Floods are a recurring natural phenomenon in Assam due to the Brahmaputra and Barak river systems. However, the floods witnessed in **2026** are unprecedented because of the **combined**

effects of extreme rainfall, climate change, geographical vulnerability, and increasing human-induced environmental degradation.

- The disaster demonstrates how climate change is intensifying hydro-meteorological disasters, making traditional flood management strategies inadequate.

Reason behind Assam's frequent occurrence of unprecedented flooding?

1. Climate Change-Induced Extreme Rainfall (Primary Factor)

- Rising global temperatures have increased the atmosphere's moisture-holding capacity (approximately **7% more moisture per 1°C warming** according to the Clausius-Clapeyron relationship).
- This results in:
 - Short-duration, high-intensity rainfall.
 - Cloudburst-like events.
 - More frequent extreme precipitation.
- Instead of gradual rainfall, Assam is receiving **very heavy rain within a few hours**, overwhelming rivers and drainage systems.

2. Climate Change Intensifying the Indian Monsoon

Climate change has made the **Southwest Monsoon** increasingly erratic.

Features include:

- Delayed onset, long dry spells
- Sudden intense rainfall and localized extreme weather events

Such rainfall rapidly increases river discharge, leading to flash floods.

3. Geographic Vulnerability of Assam

Assam's physical geography naturally makes it flood-prone.

a) Brahmaputra River System

- One of the world's largest braided rivers.
- Receives enormous discharge from Tibet, Arunachal Pradesh, Meghalaya, Bhutan
- Heavy rainfall across the entire basin causes sudden rise in water level.

b) Low-Lying Floodplains

Much of Assam lies within the floodplains of the Brahmaputra, making settlements highly vulnerable.

c) High Sediment Load

- The Brahmaputra carries one of the world's highest sediment loads due to Young Himalayan geology, Soil erosion, Landslides
- Sediment deposition raises riverbeds and reduces water-carrying capacity.

4. Cloudburst and Orographic Rainfall

- Moisture-laden monsoon winds strike the hills of Meghalaya, Arunachal Pradesh, Nagaland.
- This causes Orographic lifting, Cloudbursts, Extremely intense localized rainfall the runoff eventually enters Assam's river system.

5. Simultaneous Rainfall Across Entire River Basin

- Experts note that rainfall occurred simultaneously in Assam, Arunachal Pradesh, Meghalaya and Bhutan

- This synchronized rainfall caused all tributaries to swell together, dramatically increasing the Brahmaputra's discharge.

6. Deforestation and Forest Degradation

- Loss of forests has reduced the land's capacity to absorb rainwater consequences include increased surface runoff, soil erosion, landslides and rapid river swelling
- Forests act as natural sponges that delay runoff.

7. Wetland and Floodplain Encroachment

- Important wetlands have been degraded due to Urban expansion, Illegal settlements, Infrastructure development
- Loss of wetlands has reduced the natural storage capacity for excess floodwater.

8. Unplanned Urbanisation

- Cities such as Guwahati face severe urban flooding because of Encroached drainage channels, Concretization, Blocked storm-water drains, Poor land-use planning.

9. Riverbank Erosion

- The Brahmaputra experiences severe bank erosion every year. Effects include Widening of river channels, Loss of agricultural land, Displacement of communities, Increased sediment deposition

Challenges of Extreme Weather Events

1. Increasing Frequency and Intensity

- Events like Heatwaves Floods, Cyclones, Cloudbursts, Landslides, Glacial Lake Outburst Floods (glofs) are becoming more frequent.

2. Forecasting Challenges

- Highly localized rainfall is difficult to predict.
- Existing forecasting models have limitations in mountainous terrain.

3. Inadequate Urban Infrastructure

- Because of Poor drainage, Encroachment, Weak disaster-resilient infrastructure increase vulnerability.

4. Ecological Degradation

- Deforestation, Wetland destruction, River pollution, Sand mining reduce ecosystem resilience.

5. Disaster Preparedness Gap

- Many vulnerable regions still lack Early warning dissemination, Community awareness, Evacuation infrastructure, Disaster-resilient housing.

6. Climate Adaptation Deficit

Development planning has not fully integrated climate risk assessments.

Impact of the Floods

A. Environmental Impact

- Massive soil erosion Riverbank collapse, Wetland degradation, Biodiversity loss, Habitat destruction in Kaziranga and other protected areas, Increased landslides, Water contamination.

B. Social Impact

- Large-scale displacement and Loss of human lives
- Food insecurity due to crop loss.
- Health emergencies and Spread of water-borne diseases.

C. Economic Impact

- Crop destruction and Livestock losses
- Damage to roads and bridges, Railway disruption cause infrastructural issues.

D. Governance Challenges

- Difficult rescue operations, Relief distribution in inaccessible areas, Rehabilitation of displaced populations and Coordination among multiple agencies

Government Initiatives

1. National Disaster Management Authority (NDMA)

- National Guidelines on Flood Management
- Capacity building programme
- Community-based disaster management

2. National Disaster Response Force (NDRF)

- Search and rescue and Medical assistance during disaster response operation.
- Relief operations and Evacuation during floods and precautions for after effects

3. India Meteorological Department (IMD)

- Impact-based weather forecasting
- Doppler Weather Radars incorporation for heavy rainfall warnings
- Lightning alerts awareness

4. Central Water Commission (CWC)

- Flood forecasting stations, River-level monitoring in regular basis
- Reservoir management support, Real-time flood alerts

5. Flood Management and Border Areas Programme (FMBAP)

- Embankments, Anti-erosion measures
- Drainage improvement, River training works

6. National Hydrology Project

- Real-time hydrological data, Improved flood forecasting
- Basin-level water management

7. National Action Plan on Climate Change (NAPCC)

Relevant missions include:

- National Water Mission, Green India Mission
- Sustainable Agriculture Mission

These enhance climate resilience and ecosystem restoration.

8. Sendai Framework for Disaster Risk Reduction (2015–2030)

India aligns its disaster management strategy with the **Sendai Framework**, focusing on:

- Risk reduction, Preparedness, Build Back Better and Resilience

9. State-Level Measures in Assam

- SDRF deployment and setting up Evacuation camps
- Boat rescue operations
- Relief distribution
- Early warning dissemination
- Embankment strengthening

Way Forward

1. Shift from Flood Control to Flood Risk Management

- Adopt **Integrated River Basin Management (IRBM)** for the Brahmaputra basin involving India, Bhutan, and China for coordinated data sharing and basin planning.

2. Nature-Based Solutions

- Restore wetlands and floodplains as natural water buffers.
- Large-scale afforestation in upstream catchments.
- Protect riparian vegetation to reduce erosion.

3. Climate-Resilient Infrastructure

- Build elevated roads, bridges, schools, and health centres.
- Develop flood-resilient housing in vulnerable districts.

4. Strengthen Early Warning Systems

- Expand Doppler Weather Radar coverage.
- Use AI, satellite imagery, GIS, and IoT-based river monitoring.
- Improve last-mile dissemination through mobile alerts and community volunteers.

5. Scientific Land-Use Planning

- Restrict construction in floodplains.
- Enforce zoning regulations and prevent encroachment on wetlands and drainage channels.

6. Improve Urban Flood Management

- Upgrade storm-water drainage.
- Promote permeable surfaces and rainwater harvesting.
- Restore urban water bodies.

7. Ecosystem Restoration

- Conserve forests in the Eastern Himalayas.
- Control illegal sand mining.
- Implement catchment area treatment programmes.

8. Community-Based Disaster Risk Reduction

- Train local communities in evacuation and first response.
- Strengthen village disaster management committees.
- Promote flood insurance and resilient livelihoods.

Conclusion

- The unprecedented floods in Assam underscore the growing reality of **climate-induced hydro-meteorological disasters**, where natural vulnerabilities are amplified by environmental degradation and unsustainable development.

- Addressing this challenge requires a paradigm shift from reactive relief to **anticipatory, ecosystem-based, and climate-resilient disaster management**.
- By integrating scientific forecasting, sustainable river basin management, nature-based solutions, resilient infrastructure, and community participation, India can significantly reduce disaster risk while advancing the goals of **disaster resilience, climate adaptation, and sustainable development**—a necessity for achieving the vision of **Viksit Bharat 2047**.

Q. "Climate change has transformed floods in Assam from seasonal events into recurrent extreme disasters." Discuss the causes, impacts and suggest measures to enhance flood resilience. 10 marks

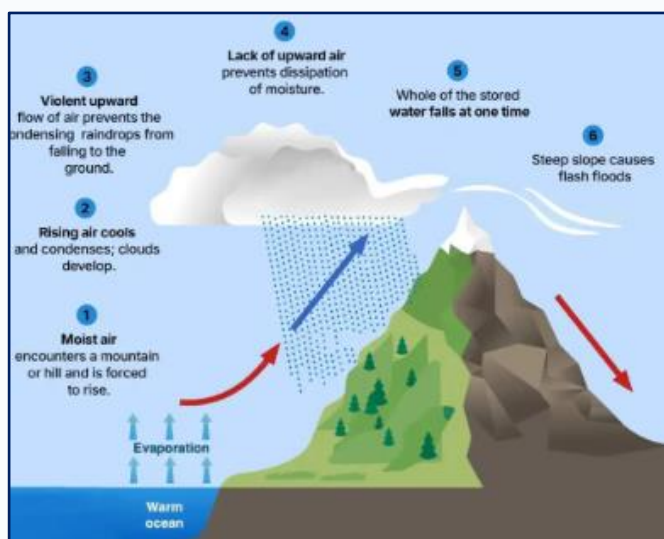
2.2.2. IMPROVING CLOUDBURST FORECASTING & DISASTER MANAGEMENT IN INDIA

Context

Recent cloudburst-like events in the Himalayas highlight the risks of **extreme rainfall, fragile ecology and weak infrastructure**. While cloudbursts are natural hazards, **unplanned construction, deforestation, poor drainage and weak early warnings** amplify their impacts, requiring better forecasting, risk-sensitive planning and resilient infrastructure.

Introduction

According to the **IMD**, a cloudburst is **10 cm (100 mm) or more rainfall in an hour over about 20–30 sq. km**. In mountainous regions, **orographic lifting and rugged terrain** can trigger flash floods, landslides and debris flows. Thus, the challenge is not only **forecasting cloudbursts but also reducing vulnerability and exposure**.



Why Are Cloudbursts a Growing Concern for India?

1. Highly Destructive Extreme Rainfall

- Cloudbursts involve an extraordinary concentration of rainfall within a short period and over a small area. The ground cannot absorb such large volumes of water quickly, resulting in **rapid runoff, flash floods and landslides**.

2. Greater Risk in Mountainous Regions

- Himalayan states such as **Uttarakhand, Himachal Pradesh and Jammu & Kashmir** are particularly vulnerable. Steep slopes, fragile geology and narrow valleys amplify the impact of intense rainfall.

3. Climate Change Dimension

- A warmer atmosphere can hold more moisture, potentially increasing the intensity of extreme precipitation events.
- Climate change therefore adds uncertainty and may increase the risk of **short-duration, high-intensity rainfall**.

4. Disaster Risk Beyond Rainfall

- A cloudburst itself is a **hazard**, but disaster losses depend on exposure and vulnerability.
- Construction on floodplains, deforestation, poor drainage and unplanned infrastructure can significantly magnify damage.

5. Challenge to Weather Forecasting

- Cloudbursts occur over a very small geographical area and develop rapidly.
- Conventional weather models may forecast heavy rainfall for a broad region but struggle to identify the exact location and timing of a cloudburst.

6. Governance and Accountability

- Describing every extreme rainfall disaster as a “cloudburst” can sometimes obscure the role of **poor planning, weak infrastructure and inadequate preparedness**.
- Scientific attribution is therefore important for ensuring accountability and improving disaster management.

How Does a Cloudburst Form?

1. **Moist Air Rises:** Moist monsoon winds are forced upward over steep mountains through **orographic lifting**.
2. **Cloud Formation:** Rising air cools and condenses, producing **towering cumulonimbus clouds** through intense convection.
3. **Droplet Accumulation:** Strong updrafts hold water droplets until they become too heavy or the updraft weakens.
4. **Sudden Downpour:** Large volumes of water fall rapidly over a small area, triggering **flash floods, landslides and debris flows**.

Challenges Associated with Cloudbursts & Their Management

1. **Hyperlocal & Rapid Events** – Cloudbursts are highly localised and develop quickly, making precise **location- and time-specific forecasting** difficult and leaving limited time for evacuation.
2. **Difficult Himalayan Terrain** – Rugged mountains obstruct radar signals, create **blind spots** and make installation of weather stations and communication networks challenging.
3. **Sparse Data & Technology Gaps** – Remote areas have fewer rain gauges and automatic weather stations, while accurate hyperlocal forecasting requires **high-resolution models, dense data and greater computing capacity**.
4. **Weak Last-Mile Early Warning** – Even when alerts are generated, poor connectivity and communication gaps may prevent warnings from reaching **remote communities, tourists and pilgrims** in time.
5. **Fragile Ecology & Unplanned Development** – **Deforestation, hill cutting, riverbed construction, poor drainage and unplanned tourism** increase runoff, landslides, flash floods and overall disaster vulnerability.
6. **Inadequate Disaster-Resilient Infrastructure** – Weak slope stabilisation, drainage, building standards and hazard-sensitive infrastructure can amplify the damage caused by extreme rainfall.
7. **Accountability & Risk Management Gap** – Treating every disaster as a “cloudburst” can obscure human negligence; hence, disaster management must move from **hazard identification to reducing exposure, vulnerability and poor planning**.

What Is India Doing to Improve Forecasting and Early Warning?

- **Strengthening Nowcasting** – IMD is developing short-term forecasting systems to detect **rapidly developing thunderstorms, intense rainfall and extreme weather**.
- **Mission Mausam** – Strengthens **weather observation, modelling, forecasting and radar networks**, with greater use of advanced technologies and AI.
- **Expanding Doppler Weather Radars** – Wider radar coverage will improve detection of **intense rainfall and convective systems**, including efforts to reduce Himalayan observation gaps.
- **AI & Data Integration** – Combining **satellite, radar, ground-sensor and numerical-model data** can improve hyperlocal forecasting and nowcasting.
- **Strengthening Last-Mile Warnings** – Alerts should reach vulnerable communities quickly through **SMS, mobile alerts, sirens, local administration, community networks and disaster-response agencies**.

What Can Be Done to Strengthen Cloudburst Forecasting and Disaster Management?

1. **Dense Observation & Hyperlocal Forecasting** – Expand weather stations and rain gauges; integrate **AI, satellite, radar, ground sensors and high-resolution models** for location-specific, impact-based warnings.
2. **Improve Radar & Technology Coverage** – Expand Doppler radar networks and adopt complementary technologies to overcome **mountainous radar blind spots**.
3. **Strengthen Last-Mile Early Warning** – Ensure **timely, simple and actionable alerts** through mobile messages, sirens, local authorities and trained community volunteers.
4. **Risk-Sensitive Land-Use Planning** – Restrict construction in **floodplains, riverbeds, landslide-prone slopes and high-risk valleys**, using hazard maps in planning.
5. **Climate-Resilient & Ecosystem-Based Infrastructure** – Improve drainage and slope protection while protecting **forests, wetlands and natural drainage channels**; avoid unscientific hill cutting and excessive concretisation.
6. **Scientific Attribution & Accountability** – Verify whether rainfall meets the cloudburst threshold and assess the role of **poor planning, infrastructure and preparedness**, ensuring natural hazards do not mask governance failures.
7. **Community Resilience & Build Back Better** – Train communities in **evacuation, first aid and emergency response**, while rebuilding damaged infrastructure through safer locations, resilient designs and ecosystem-sensitive planning.

Conclusion

Cloudbursts reflect the rising risk of localised extreme rainfall in a warming climate. India must shift from a hazard-centric to risk-centric approach through better forecasting, early warnings, resilient infrastructure, scientific land-use planning and ecosystem protection.

Q. What is the phenomenon of cloudbursts? Explain. 10 marks

2.3. SCIENCE & TECHNOLOGY

2.3.1. THE MAKING OF MODERN INDIAN SCIENCE AND IACS

Why in News?

The **Indian Association for the Cultivation of Science (IACS)** completes **150 years**, highlighting its historic role in the development of scientific research in India and Mahendralal Sircar's vision of **scientific self-reliance**.

Background: Bengal Renaissance and Scientific Awakening

The **Bengal Renaissance** was a major intellectual, social and cultural awakening during the 18th and 19th centuries.

- **Scientific Temper & Rational Thinking:** Encouraged questioning, observation, and evidence-based reasoning over superstition and blind beliefs.
- **Modern Education:** Promoted Western scientific knowledge, modern schools, colleges, and new approaches to learning.
- **Social & Religious Reform:** Challenged practices such as caste discrimination, sati, child marriage, and religious orthodoxy.
- **Literature, Arts & Philosophy:** Stimulated new forms of literature, journalism, painting, philosophy, and intellectual debate.
- **Institutional Development:** Led to the creation of modern educational, cultural, and scientific institutions that strengthened India's intellectual foundations.

This growing spirit of rational inquiry and scientific awakening created the intellectual foundation for **Mahendralal Sircar's vision of scientific self-reliance**.

Mahendralal Sircar: Vision of Scientific Self-Reliance

- **Scientific Self-Reliance:** Advocated that Indians should not merely learn science but undertake original scientific research.
- **Institutional Support:** Highlighted the lack of research opportunities and called for indigenous scientific institutions.
- **IACS Initiative:** Proposed IACS in **1869**, and it was established in **1876** in Calcutta.
- **National Development:** Linked scientific education and research with **intellectual progress, social development and national self-confidence**.

IACS: A Landmark in Indian Scientific History

- **Colonial Constraint:** Limited opportunities and institutional support for Indians to pursue scientific research under colonial rule.
- **Scientific Aspiration:** Created a growing desire among Indians to develop scientific knowledge through independent inquiry and experimentation.
- **Indian Institution:** Provided an indigenous platform where Indians could conduct scientific research using their own initiative and resources.



- **Original Research:** Encouraged Indians to move beyond learning existing scientific knowledge towards experimentation and new discoveries.
- **Global Recognition:** Demonstrated India's scientific capabilities through landmark achievements such as C.V. Raman's discovery of the Raman Effect.

Thus, IACS was not merely a laboratory but an **institutional expression of scientific nationalism**.

C.V. Raman and the Raman Effect

- **Association with IACS:** C.V. Raman used the IACS laboratory for research alongside his government job and continued his association after joining the University of Calcutta in 1917.
- **Raman Effect:** Through experiments on light scattering, he discovered that a small fraction of scattered light changes its **wavelength and frequency** when passing through a transparent material.
- **Global Recognition:** Announced on **28 February 1928**, the discovery earned Raman the **Nobel Prize in Physics in 1930**, making him the first Asian scientist to win a Nobel Prize in the sciences.
- **Symbol of Scientific Self-Reliance:** Raman's achievement demonstrated that **Indian institutions and scientists could produce globally significant original research**, fulfilling Mahendralal Sircar's vision.

Significance of IACS in Modern India

- **Institutionalising Scientific Research:** Created an indigenous platform for systematic research and strengthened India's culture of scientific inquiry.
- **Promoting Scientific Temper:** Encouraged **observation, experimentation, rational inquiry and evidence-based thinking**.
- **Building Scientific Human Capital:** Nurtured scientists and demonstrated India's capacity to produce **globally significant scientific discoveries**.
- **Scientific Nationalism:** Linked scientific and technological advancement with **national development, intellectual independence and self-confidence**.
- **Foundation for Scientific Self-Reliance:** Strengthened the pursuit of **indigenous research, technological capabilities and innovation**, while promoting global collaboration.
- **Relevance to Modern India:** Its legacy supports India's ambitions in **AI, semiconductors, space, biotechnology, quantum technology, clean energy and advanced materials**, enabling the shift from **knowledge consumption to knowledge creation**.

Challenges to Scientific Self-Reliance

- **Low R&D Investment:** Limited and uneven investment in research constrains India's ability to undertake cutting-edge scientific work.
- **Weak Industry-Academia Linkages:** Limited collaboration between universities, research institutions and industries reduces the translation of research into practical applications.
- **Brain Drain:** Migration of highly skilled researchers and challenges in retaining scientific talent weaken India's research capacity.
- **Unequal Infrastructure:** Research facilities and advanced laboratories remain concentrated in select institutions and regions, creating disparities in scientific opportunities.

- **Weak Commercialisation:** Limited conversion of research outcomes into **patents, products and market-ready technologies** reduces the economic impact of innovation.
- **Basic Research Constraints:** Inadequate funding for **high-risk, long-term and interdisciplinary research** can limit breakthrough discoveries.

Way Forward

- **Strengthen Basic Research:** Increase sustained funding for **fundamental, curiosity-driven and long-term scientific research**.
- **Empower Young Scientists:** Provide better **fellowships, research opportunities and institutional autonomy** while reducing administrative hurdles.
- **Strengthen Industry-Academia Linkages:** Promote collaboration between academia and industry to improve **technology transfer, innovation and commercialisation**.
- **Expand Research Infrastructure:** Develop **world-class laboratories and research facilities** across regions, beyond major metropolitan centres.
- **Promote Scientific Temper:** Embed **rational, evidence-based and scientific thinking** in education from the school level onwards.
- **Build a Global Innovation Ecosystem:** Combine **indigenous capabilities with international collaboration** and connect universities, laboratories, startups, industry and government.

Conclusion

The legacy of **IACS reflects India's journey from a knowledge recipient to a knowledge creator**. Mahendralal Sircar and C.V. Raman demonstrated the power of indigenous scientific capability. Its enduring message is: **scientific self-reliance means creating, adapting and applying knowledge while remaining globally connected**.

Q. The legacy of the Indian Association for the Cultivation of Science (IACS) reflects India's transition from a knowledge recipient to a knowledge creator. Discuss the role of IACS in promoting scientific self-reliance and shaping modern Indian science. 15 Marks (GS-3, Science & Tech.)

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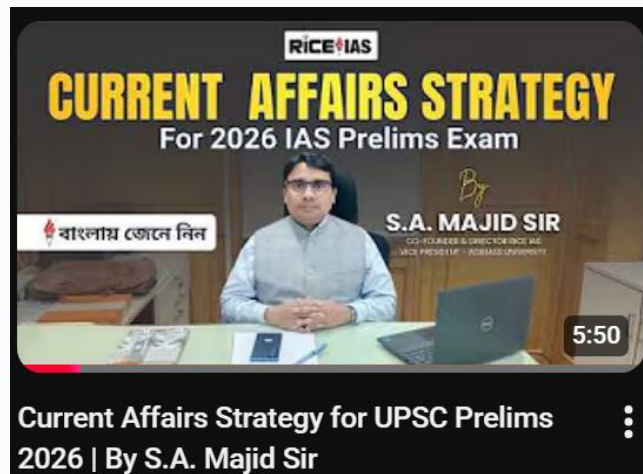
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