UPSC Mains 2021 GS III

Year-wise PYQ pack · WRAP model answers with canonical links

Official UPSC stems in exam order. Each live answer sits on one WRAP URL; this PDF is the year pack, not a second copy of the article. Open the link under a question for the full page.

https://wrapexams.com/upsc/mains/gs-3/2021/

Q1 · 10 marks

Explain the difference between computing methodology of India's Gross Domestic Product (GDP) before the year 2015 and after the year 2015.

GS III · 2021 · Indian Economy

Revision summary

The 2015 revision moved the base from 2004-05 to 2011-12 and replaced GDP at factor cost with GVA at basic prices.

Headline GDP is at market prices, in line with SNA 2008.

MCA21 and wider financial and local-body coverage changed what enters the total.

New IIP and price deflators mean the series is not a relabelled old index.

Debate on comparability is fair; a conspiracy reading is not.

Introduction

In January 2015 India shifted the National Accounts to a 2011-12 base and to System of National Accounts 2008 ideas. The change was about what is counted, at which prices, and from which books, not a secret rewrite of real output.

Body

What changed in the headline

- Before 2015 the familiar production measure was **GDP at factor cost** on a **2004-05** base. After 2015 the production measure is **Gross Value Added (GVA) at basic prices** on a **2011-12** base.
- **Basic prices** add production taxes and subtract production subsidies from factor-cost GVA. They are not the same as factor cost.
- **Headline** GDP **is now stated at** market prices**:** GVA plus product taxes minus product subsidies. That matches how most countries quote GDP.
- New series numbers cannot be read as a simple markup of the old series. The basket, the base, and the books all moved together.

Data books and coverage

• The corporate sector moved toward **MCA21** company filings instead of relying mainly on the Index of Industrial Production and a thinner set of company accounts.

• Coverage widened for **financial corporations**, **local bodies**, and **autonomous institutions**, which the old series under-counted.

• Informal and unorganised activity still uses survey labour input and value added per worker, but with newer NSS and enterprise frames rather than a frozen 2004-05 picture.

• Deflators shifted with new **IIP**, **WPI**, and **CPI** series, so real growth is not the old volume index with a new label.

How to read the debate

• Growth rates jumped in some years because the new books captured more organised activity, not because output was invented in a back room.

• Comparability with 2004-05 is imperfect. That is a fair statistical complaint. It is not evidence of a political conspiracy.

• Users should quote **GVA at basic prices** and **GDP at market prices** correctly, and never say India still publishes GDP at factor cost as the main production total.

Flow diagram

Pre-2015 2004-05 -> GDP at factor cost

Post-2015 2011-12 -> GVA at basic prices

Post-2015 2011-12 -> GDP at market prices

Post-2015 2011-12 -> MCA21 wider coverage

GVA at basic prices -> Headline accounts

GDP at market prices -> Headline accounts

Conclusion

After 2015 India measures production as GVA at basic prices on a 2011-12 base, with MCA21 and wider coverage, and quotes GDP at market prices. The revision aligned books with SNA 2008. It changed the ruler; it did not secretly reprint the cloth.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/explain-the-difference-between-computing-methodology-of-indias-gross-domestic-product-gdp-before-the-year-2015-and-after-the-year-2015/

Q2 · 10 marks

Distinguish between Capital Budget and Revenue Budget. Explain the components of both these Budgets.

GS III · 2021 · Government Budgeting

Revision summary

Revenue Budget covers tax and non-tax receipts and spending that does not create assets.

Capital Budget covers borrowings, disinvestment, loan recoveries, and asset-creating outlays.

Salaries, interest, and subsidies sit on the revenue side; roads, equity, and loans sit on the capital side.

A revenue deficit means borrowing to consume, not only to invest.

FRBM reading needs both splits, not a single deficit number.

Introduction

The Union Budget's Annual Financial Statement splits government accounts into a Revenue Budget and a Capital Budget. The first is the cost of running the year. The second is borrowing, assets, and loans that change the government's balance sheet.

Body

The distinction

- The **Revenue Budget** records receipts that do not create a liability or reduce an asset, and spending that does not create an asset or reduce a liability.
- The **Capital Budget** records receipts that create a liability or reduce an asset, and spending that creates an asset or reduces a liability.
- A salary or subsidy is revenue expenditure. A highway, a defence capital store, or a loan to a State is capital expenditure.
- Tax collected is a revenue receipt. A market borrowing or a disinvestment receipt is a capital receipt.

Revenue Budget components

- **Revenue receipts** are tax revenue (income tax, corporation tax, GST, Union excise, customs) and non-tax revenue (dividends, interest, fees, spectrum in some years, external grants).
- **Revenue expenditure** is interest, salaries, pensions, subsidies, grants to States that are not for capital assets, and the running cost of schemes such as food and fertiliser support.
- A revenue deficit means the government is borrowing to run the household, not only to build assets.

Capital Budget components

- **Capital receipts** include market borrowings, other debt, recovery of loans, and non-debt receipts such as **disinvestment**.
- **Capital expenditure** includes creation of infrastructure and defence capital, equity in public firms, and loans and advances to States, Union Territories, and public enterprises.
- The **Fiscal Responsibility and Budget Management** debate watches whether capital spending is protected when revenue spending is sticky.

Why the split matters

- Mixing the two hides whether the deficit is buying a road or paying yesterday's interest.
- FRBM and Budget papers therefore print revenue deficit, fiscal deficit, and capital outlay as separate tests.

Flow diagram

Annual Financial Statement -> Revenue Budget

Annual Financial Statement -> Capital Budget

Revenue Budget -> Tax and non-tax receipts

Revenue Budget -> Salaries interest subsidies

Capital Budget -> Borrowing disinvestment loan recovery

Capital Budget -> Assets and loans given

Conclusion

The Revenue Budget is recurring income and running cost. The Capital Budget is debt, disinvestment, assets, and loans. Good public finance keeps the first from eating the second.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/distinguish-between-capital-budget-and-revenue-budget-explain-the-components-of-both-these-budgets/

Q3 · 10 marks

How did land reforms in some parts of the country help to improve the socio-economic conditions of marginal and small farmers ?

GS III · 2021 · Crops, Irrigation and Marketing

Revision summary

Serious land reform meant title and recorded tenancy, not only ceiling statutes.

West Bengal's Operation Barga and Kerala's tenancy-homestead path lifted small-farmer security and credit.

Gains included investment, bargaining power, and a rural political voice.

Most States failed on ceilings and left benami holdings intact.

Title is a floor for welfare; markets and water still decide today's income.

Introduction

Land reform after Independence meant abolishing intermediaries, securing tenants, imposing ceilings, and consolidating holdings. Where States actually enforced those laws, small and marginal farmers gained title, credit, and a political voice. Where they did not, the same paper laws left the hierarchy standing.

Body

What worked in some regions

• **Abolition of zamindari and jagirs** in the 1950s cut absentee claims and made many occupancy tenants owners, which raised the incentive to invest in wells and seed.

• **Tenancy reform** in **West Bengal** (**Operation Barga** from 1978) recorded bargadars and shared the harvest by law, which reduced eviction and raised the tenant's share.

• **Kerala** combined tenancy abolition with homestead rights and a strong rural public sphere, which lifted security for small holders even on tiny plots.

• **Jammu and Kashmir**'s early ceiling and tenancy measures, and pockets of **Karnataka** tenancy reform, show the same pattern: recorded rights beat oral dependence.

Socio-economic gains for small and marginal farmers

• Title and recorded tenancy opened **cooperative and bank credit**, because land could be shown as security instead of a landlord's word.

• A more equal village share in some districts raised **wage bargaining** for landless neighbours and cut extra-economic caste levies on the field.

• Small farmers who were secure adopted **HYV seed and irrigation** more readily in the Green Revolution belts that also had reform, rather than remaining sharecroppers who would lose the gain to the malik.

• **Political inclusion followed economic title:** panchayat and party competition in Bengal and Kerala had a landed small-farmer base, not only a landlord vote.

Limits

• Ceiling surplus was small in most States because of benami, exemptions, and weak mutation. **Bihar**, large parts of **Uttar Pradesh**, and much of the **Hindi heartland** show paper reform without a land-to-the-tiller shift.

• Fragmentation, tenancy that went underground, and later reverse tenancy mean reform was a regional success, not a national completion.

• Today's small-farmer distress is also about markets, water, and climate; historic title is necessary, not sufficient.

Flow diagram

Land reform -> Intermediary abolition

Land reform -> Recorded tenancy

Land reform -> Ceilings where enforced

Intermediary abolition -> Title credit investment

Recorded tenancy -> Title credit investment

Ceilings where enforced -> Title credit investment

Title credit investment -> Better small-farmer conditions

Weak enforcement -> Gains stay local

Conclusion

Land reform improved small and marginal lives where tenants were recorded and intermediaries actually left, as in parts of Kerala, West Bengal, and a few other States. It did not, by itself, equalise agrarian India.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/how-did-land-reforms-in-some-parts-of-the-country-help-to-improve-the-socio-economic-conditions-of-marginal-and-small-farmers/

Q4 · 10 marks

How and to what extent would micro-irrigation help in solving India's water crisis ?

GS III · 2021 · Crops, Irrigation and Marketing

Revision summary

Drip and sprinkler cut evaporation and can save roughly a third to half of applied irrigation water, more on horticulture.

PMKSY Per Drop More Crop is the Union vehicle for subsidy and area expansion.

Gains die if free power and paddy MSP use the saved water to grow more of the same crop.

Small-farmer cost, clogging, and service quality still limit spread.

Recharge, diversification, and urban water reform must accompany micro-irrigation.

Introduction

India's water crisis is a crisis of over-extraction, flood irrigation, and thirsty cropping in dry districts. Micro-irrigation - drip and sprinkler - puts water at the root or as a fine spray. It can save a large share of farm water. It cannot, by itself, refill aquifers if policy still rewards paddy on a desert tube-well.

Body

How micro-irrigation helps

- **Drip** feeds the root zone and cuts evaporation and conveyance loss that flood channels waste.
- **Sprinkler** suits cereals, pulses, and fodder on undulating land where drip laterals are costly.
- Field studies and PMKSY literature commonly show **water saving of about 30 to 50 per cent**, and higher on horticulture, with better nutrient use when fertigation is added.
- Less pumping means **lower diesel and power demand**, which eases the farm-power-groundwater loop.
- Yield and quality gains in fruits, vegetables, sugarcane, and cotton raise income per drop, which is the economic case for **Per Drop More Crop** under **PMKSY**.

To what extent it solves the crisis

- Agriculture takes the bulk of freshwater. A wide shift from flood to micro systems would delay aquifer collapse in **Punjab, Haryana, western UP, Rajasthan, and Tamil Nadu** hard-rock and alluvial belts.
- Extent is limited while **free power, MSP-backed paddy-wheat, and flood canal warabandi** still make wasting water rational.
- Micro-irrigation does not create new rain. **Watershed works, aquifer recharge, crop diversification, and urban leak control** must sit beside it.
- High capital cost, clogging, and weak after-sales service keep adoption uneven among small holders unless subsidy, clustering, and solar pumps are well designed.
- If saved water is used to expand area under the same thirsty crop, the basin gains nothing. That is the **rebound** risk.

Policy that stretches the gain

- Pair **PDMC** subsidy with **crop shift**, metering or at least feeder separation, and **Atal Bhujal** style community groundwater rules.

• Use micro-irrigation first on **horticulture, sugarcane, and cotton**, then on cereals where sprinkler is proven.

Flow diagram

Drip and sprinkler -> Less evaporation and conveyance loss

Less evaporation and conveyance loss -> Yield and fertigation

Less evaporation and conveyance loss -> Lower pumping

Rebound thirsty crops -> No basin gain

Drip and sprinkler -> Partial solution

Crop shift recharge pricing -> Larger water-crisis relief

Conclusion

Micro-irrigation is one of the few farm tools that can cut water use and raise yield together. It will ease India's crisis only as far as cropping, power, and groundwater rules stop putting the saved litre back into paddy.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/how-and-to-what-extent-would-micro-irrigation-help-in-solving-indias-water-crisis/

Q5 · 10 marks

How is S-400 air defence system technically superior to any other system presently available in the world?

GS III · 2021 · Indian Economy

Revision summary

S-400's advertised 40N6 reach of about 400 km and a mix of shorter missiles give a layered anti-aircraft umbrella.

High simultaneous-engagement capacity and mobile TELs are real design edges.

Patriot and THAAD are built for different range and ballistic jobs; they are not failed S-400s.

No system is magically superior on every metric, including stealth, saturation, and C2 fusion.

India's value in the system is long-range area defence plugged into national sensors, not a world-title slogan.

Introduction

The S-400 Triumf is a Russian long-range surface-to-air system that India contracted in 2018. It is often advertised as the best SAM in the world. That slogan is too large. Its real edges are a long-range missile mix, high engagement capacity, and mobility. Other systems beat it on some jobs, especially specialised ballistic-missile defence.

Body

Claimed technical edges

• The **40N6** interceptor is advertised at about **400 km**, which is a longer anti-aircraft reach than typical **Patriot** batteries field in the same role.

• A regiment can mix **40N6**, **48N6** (about 250 km class), and **9M96** shorter-range missiles, so one radar-and-launcher family covers aircraft, cruise missiles, and some ballistic profiles at different ranges.

• The battery is built to **track and engage many targets at once**, with a high advertised simultaneous-engagement count compared with older one-target-at-a-time SAMs.

• Launchers are **road-mobile**, which helps shoot-and-scoot survivability against enemy location of fixed sites.

• A 360-degree engagement picture and stacked missiles give a **layered** umbrella rather than a single short fence.

Careful comparison, not a world title

• **Patriot PAC-3** is a hit-to-kill system tightly integrated in NATO command-and-control. It is strong against some ballistic and aircraft threats at shorter ranges. It is not trying to be a 400 km area SAM, so "S-400 beats Patriot at everything" is a category error.

• **THAAD** is a high-altitude endo-atmospheric ballistic-missile defender. It is not a general-purpose long-range anti-aircraft grid. S-400 is not "better than THAAD" at THAAD's job.

• Western **Aegis / SM-6**, Israeli **David's Sling**, and Chinese **HQ-9** families compete on sensors, networking, and specific interceptors. No open source can honestly rank one winner on every metric.

• Limits of S-400 include **electronic warfare**, **stealth and low-observable aircraft**, **saturation raids**, and the need to **plug into IAF and civilian radar networks**. Hardware without fusion is only a battery.

• Export geopolitics (CAATSA, spares, software) is not a radar fact, but it is an operational limit on how "available" the system stays in a long war.

How to answer the paper's wording

• State the 400 km-class reach, multi-missile mix, multi-target load, and mobility as **claimed edges**.

• Refuse the phrase **superior to any other system in the world** as a total ranking.

Flow diagram

S-400-400 -> 40N6 about 400 km

S-400 -> Mixed 48N6 and 9M96

S-400 -> Multi-target mobile

Patriot -> Shorter-range NATO BMD mix

THAAD -> High-altitude ballistic job

S-400 -> Not best at every job

Conclusion

S-400's technical case is a long-range layered mix and a large engagement book on mobile launchers. That is a serious area-defence edge, not a proof that Patriot, THAAD, or naval Aegis are inferior at their own designed tasks.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/how-is-s-400-air-defence-system-technically-superior-to-any-other-system-presently-available-in-the-world/

Q6 · 10 marks

Explain the purpose of the Green Grid Initiative launched at World Leaders Summit of the COP26 UN Climate Change Conference in Glasgow in November, 2021. When was this idea first floated in the International Solar Alliance (ISA) ?

GS III · 2021 · Environment and Conservation

Revision summary

The Green Grids Initiative at COP26 is an India-UK launch of a transnational renewable power grid.

Its purpose is to share solar and wind across time zones so surplus is not dumped and peaks need less coal.

OSOWOG was first floated at the ISA First Assembly in 2018, after ISA's Paris 2015 origin.

COP26 scaled the ISA idea; it did not invent it.

Domestic storage and national grids remain necessary; GGI is not a finished world wire.

Introduction

At the World Leaders Summit of COP26 in Glasgow in November 2021, India and the United Kingdom launched the Green Grids Initiative - One Sun One World One Grid. The purpose is to connect solar-rich and demand-rich regions so that the sun that has set in one country can still light another. The political idea was first floated in the International Solar Alliance.

Body

Purpose of the Green Grid Initiative

- **GGI-OSOWOG** aims at a transnational grid that moves **renewable electricity** across time zones and borders, so solar and wind are not wasted when local demand is low.
- It seeks **technical standards, investment, and political clubs** for interconnectors, not a single overnight world wire.
- For developing countries it is a bid to cut **coal peak** by importing daytime solar and exporting surplus, which is cheaper than every nation over-building storage alone.
- India-UK co-leadership at COP26 was meant to pull **ISA members, G20 grids, and development banks** into one diplomatic product rather than scattered bilateral lines.
- Purpose also includes **skills, planning tools, and green finance** so poor solar-rich States are not only raw-generation colonies.

When the idea was first floated in the ISA

- The **International Solar Alliance** was launched by India and France at **COP21 Paris in 2015** and given a founding conference in New Delhi.
- **One Sun One World One Grid** was first floated by India at the **First Assembly of the ISA in 2018**.
- COP26 did not invent the slogan. It **scaled** an ISA idea into a UK-partnered Green Grids Initiative at a UN climate summit.

What it is not

- It is not a completed global grid in 2021. It is a political and engineering programme.

- It does not replace domestic **storage, demand response, and national transmission** such as India's Green Energy Corridor.

Flow diagram

ISA 2018 First Assembly -> OSOWOG idea

OSOWOG idea -> COP26 Nov 2021

India and India and UK -> Green Grids Initiative

COP26 Nov 2021 -> Green Grids Initiative

Green Grids Initiative -> Cross-border renewable electricity

Conclusion

GGI-OSOWOG, launched by India and the UK at COP26 in November 2021, exists to interconnect renewable power across borders and time zones. The OSOWOG idea was first floated in the ISA in 2018.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/explain-the-purpose-of-the-green-grid-initiative-launched-at-world-leaders-summit-of-the-cop26-un-climate-change-conference-in-glasgow-in-november-2021-when-was-this-idea-first-floated-in-the-international-solar-alliance/

Q7 · 10 marks

Describe the key points of the revised Global Air Quality Guidelines (AQGs) recently released by the World Health Organisation (WHO). How are these different from its last update in 2005? What changes in India's National Clean Air Programme are required to achieve these revised standards ?

GS III · 2021 · Indian Economy

Revision summary

WHO 2021 AQGs set PM2.5 annual at 5 µg/m³ against 10 in 2005, with tighter 24-hour PM and a much lower NO2 annual guideline.

Interim targets exist because few countries are at 5 today.

India's NAAQS and NCAP still work from a far higher PM2.5 ceiling and a limited city list.

Required NCAP shifts are stricter standards, wider monitoring, and regional airshed policy.

City dust plans alone cannot meet WHO 2021.

Introduction

WHO released new Global Air Quality Guidelines in 2021, replacing the 2005 update. The new numbers are much tighter, especially for PM2.5. India's National Clean Air Programme still aims at a modest cut from a high domestic standard. Meeting WHO 2021 would need stricter cities, denser monitoring, and an airshed approach, not only city action plans.

Body

Key points of WHO AQG 2021

- **PM2.5** annual mean is **5 µg/m³**; 24-hour mean is **15 µg/m³**.
- **PM10** annual mean is **15 µg/m³**; 24-hour mean is **45 µg/m³**.
- **NO2** annual mean falls to **10 µg/m³**, with a tighter 24-hour value.
- Ozone, SO2, and CO also get health-based guideline levels, with an ozone peak-season number added.
- WHO presents **interim targets** so countries can climb down from dirty baselines instead of pretending 5 µg/m³ is next year's law.

Difference from 2005

- 2005 set **PM2.5 annual at 10 µg/m³** and 24-hour at 25. 2021 **halves** the annual PM2.5 guideline to **5** and cuts the 24-hour number to 15.
- PM10 annual moves from **20 to 15**; 24-hour from **50 to 45**.
- NO2 annual was **40 µg/m³** in 2005 and is **10** in 2021, which is a large tightening for traffic and power-plant NOx.
- The 2021 package is based on a larger health-evidence base linking even "moderate" South Asian air to premature death.

NCAP changes required

- India's **NAAQS** still allow **PM2.5 annual 40 µg/m³**, eight times the new WHO annual guideline. NCAP must **tighten national standards** in stages toward WHO interims, not stop at a 20-30 per cent cut from 2017 in a few cities.

- **NCAP's city list must** expand and harden**:** more than the original non-attainment set, with real-time **monitoring** in smaller towns, not only State capitals.
- Pollution is an **airshed** problem (Indo-Gangetic plain, brick kilns, stubble, industry). City plans without **regional power, transport, and agriculture** rules cannot hit WHO numbers.
- Need **cleaner fuels, industrial emission norms, fleet electrification, waste burning control, and construction dust law** with penalties that bite.
- Health surveillance and public AQI communication should use WHO risk language so 40 µg/m³ is not sold as safe air.

Flow diagram

WHO 2005 PM2.5 annual 10 -> WHO 2021 PM2.5 annual 5

NCAP city 20-30 percent cut -> Gap to WHO

Stricter NAAQS -> Airshed action

More cities and monitors -> Airshed action

Airshed action -> Health-closer air

Conclusion

WHO 2021 made PM2.5 annual 5 µg/m³ against 10 in 2005, and tightened NO2 sharply. NCAP can approach that path only if India tightens standards, monitors more places, and governs air as a regional airshed rather than a municipal project.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/describe-the-key-points-of-the-revised-global-air-quality-guidelines-aqgs-recently-released-by-the-world-health-organisation-who-how-are-these-different-from-its-last-update-in-2005-what-changes-in-indias-national-clean/

Q8 · 10 marks

Discuss about the vulnerability of India to earthquake related hazards. Give examples including the salient features of major disasters caused by earthquakes in different parts of India during the last three decades.

GS III · 2021 · Disaster Management

Revision summary

Himalayan collision and the north-east put large populations in Zones IV and V; alluvium can amplify shaking in the plains.

The peninsula is not risk-free, as Latur 1993 showed.

Bhuj 2001 was a great urban disaster of failed multi-storeys on Republic Day.

The 2004 tsunami made Andaman and Tamil Nadu earthquake-coast disasters.

Kashmir 2005, Sikkim 2011, and Nepal 2015 extended the Himalayan lesson into the 2010s.

Introduction

India sits where the Indian plate drives under Eurasia. That collision makes the Himalaya and the north-east highly seismic, while the peninsula is not immune to intraplate shocks. Vulnerability is the product of that geology plus dense towns, poor masonry, and long hospital-to-fault distances.

Body

Why India is vulnerable

- The **Himalayan arc**, **Kashmir**, **Uttarakhand**, **Nepal border**, **Sikkim**, and the **north-east** lie in **BIS seismic Zones IV and V**.
- The **Indo-Gangetic plains** can shake from Himalayan ruptures and from soft alluvium that amplifies motion under mega-cities.
- The **peninsula** is stable relative to the arc, yet **Killari 1993** and **Bhuj 2001** showed intraplate and failed-rift earthquakes can devastate unprepared Deccan and Kachchh towns.
- **Andaman-Nicobar** and the east coast are exposed to **tsunami** when a great submarine earthquake occurs, as in 2004.
- **Risk is social:** unreinforced brick, hillside cutting, and lifeline failure (power, water, hospitals) kill after the wave has passed. **NDMA** and **NDMF** exist because geology will not pause.

Major disasters of the last three decades (from 2021)

- **Uttarkashi 1991** and **Chamoli 1999:** Garhwal Himalayan shocks that flattened hill masonry and showed the central seismic gap is not a comfort.
- **Latur / Killari, Maharashtra, 1993:** about magnitude 6.2 intraplate earthquake before dawn; roughly **8,000-10,000** dead in poorly built village houses on the Deccan plateau, a region once sold as "safe".
- **Bhuj, Gujarat, 26 January 2001:** about magnitude **7.6-7.7**; on the order of **13,000-20,000** dead, Ahmedabad multi-storeys failed far from the epicentre, and Republic Day gatherings raised the human toll. Salient feature: urban RC-frame failure plus a long Kachchh rupture.

• **Indian Ocean earthquake and tsunami, 26 December 2004:** Sumatra megathrust; **Andaman and Nicobar** and the **Tamil Nadu** coast took the Indian death toll. Salient feature: the hazard was water, not only shaking.

• **Muzaffarabad / Kashmir, 2005:** a great Himalayan earthquake that killed tens of thousands in Pakistan-administered Kashmir and hundreds on the Indian side; landslides cut valleys.

• **Sikkim 2011** (about 6.9) and the **2015 Gorkha, Nepal** earthquake: Himalayan events that killed in Sikkim, Bihar, and Uttar Pradesh through shaking, landslides, and collapsed brick. Salient feature: trans-boundary rupture and hill-road failure.

What the record teaches

• Intraplate "surprise" and Himalayan "expected" events both kill when codes are not built.

• Tsunami warning, **seismic microzonation**, and retrofit of hospitals are as much the answer as a new map colour.

Flow diagram

Indian plate collision -> Himalaya NE Zone IV-High vulnerability

Indian plate collision -> Intraplate peninsula

Indian plate collision -> Andaman tsunami

Himalaya NE Zone IV-High vulnerability -> Disasters 1991-2015

Intraplate peninsula -> Disasters 1991-2015

Andaman tsunami -> Disasters 1991-2015

Weak masonry cities -> High vulnerability

Conclusion

India's earthquake hazard is Himalayan collision, a live north-east, a tsunami coast, and a peninsula that can still break. The last three decades - Latur, Bhuj, the 2004 tsunami, Kashmir 2005, Sikkim 2011 - show that vulnerability is bad buildings on a live plate.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/discuss-about-the-vulnerability-of-india-to-earthquake-related-hazards-give-examples-including-the-salient-features-of-major-disasters-caused-by-earthquakes-in-different-parts-of-india-during-the-last-three-decades/

Q9 · 10 marks

Discuss how emerging technologies and globalisation contribute to money laundering. Elaborate measures to tackle the problem of money laundering both at national and international levels.

GS III · 2021 · Cyber Security and Money Laundering

Revision summary

Global trade, hawala, shells, and now crypto and mule rails turn criminal cash into apparently clean assets.

PMLA, FIU-IND, and regulator KYC are the core national tools.

FATF, Egmont, and UN conventions organise the international chase and asset return.

Technology also helps investigators if travel rules and chain analysis are funded.

Beneficial ownership and virtual assets remain the soft spots.

Introduction

Money laundering is the cleaning of criminal proceeds so they look like lawful income. Globalisation multiplied the pipes. New technology multiplied the speed. India now fights the old hawala pipe and the new crypto pipe with the same legal idea: follow the money, freeze it, and take it.

Body

How technology and globalisation feed laundering

- **Cross-border trade and finance** let criminals over-invoice, under-invoice, and park profit in shell companies in secrecy jurisdictions.
- **Hawala and informal value transfer** ride migrant corridors and trade cover, which global labour markets expanded.
- **Cryptocurrencies, mixers, and nested exchanges** move value without a classic bank KYC trail, though the chain is often still traceable with skill.
- **Online gaming, prepaid cards, mule accounts, and instant UPI-like rails** (and their foreign cousins) split placement into thousands of small hops.
- **Trade-based money laundering** uses global supply chains: gold, gems, scrap, and phantom shipments.
- Professional enablers - accountants, company-formation agents, and real-estate channels - sit in global cities, including Indian metros.

National measures

- **Prevention of Money Laundering Act, 2002**, with ED investigation, attachment, and special courts; **KYC** and **reporting entities** under the Act.
- **Financial Intelligence Unit-India** receives and analyses **Suspicious Transaction Reports** and shares them with police and ED.
- **RBI, SEBI, and IRDAI** rules on banks, markets, and insurers; **Benami** and **Black Money** Acts as cousins; **Companies Act** beneficial-ownership filing.
- **Demonetisation** was a one-time cash shock, not a standing AML system. Standing tools are KYC, STR, and confiscation.

• Domestic coordination with **NIA, CBI, and State police** on predicate offences (drugs, corruption, fraud, terror finance).

International measures

• **FATF** standards, mutual evaluations, and grey-listing pressure; India has used the FATF process on neighbours as well as on itself.

• **Egmont Group** of FIUs for secure information exchange; **UNTOC (Palermo)** and the **Vienna** drug convention's laundering articles; **UNCAC**.

• Bilateral MLAT, extradition, and **asset-return** cases; SWIFT and correspondent-bank de-risking as private-sector enforcement.

• Need for **crypto travel-rule** cooperation and beneficial-ownership registries that actually talk across borders.

Flow diagram

Global trade hawala -> Laundering

Crypto mules gaming -> Laundering

PMLA FIU KYC -> Attachment and STR

FATF Egmont UNTOC -> Attachment and STR

Conclusion

Globalisation and new rails made laundering faster and more split. India's answer is PMLA, FIU-IND, and sector KYC at home, and FATF-Egmont-UNTOC pipes abroad. The weak joint is still beneficial ownership and virtual-asset supervision, not the absence of a statute.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/discuss-how-emerging-technologies-and-globalisation-contribute-to-money-laundering-elaborate-measures-to-tackle-the-problem-of-money-laundering-both-at-national-and-international-levels/

Q10 · 10 marks

Keeping in view India's internal security, analyse the impact of cross-border cyber attacks. Also discuss defensive measures against these sophisticated attacks.

GS III · 2021 · Cyber Security and Money Laundering

Revision summary

Cross-border cyber operations can stall critical infrastructure, rob finance, and steal state data without a kinetic raid.

Attribution problems let states and proxies hide behind criminal malware.

CERT-In, NCIIPC, Defence Cyber Agency, sector CERTs, and the IT Act are the Indian defensive core.

Segmentation, backups, vendor control, and phishing defence are the practical layer.

Resilience and international CERT cooperation matter more than a claim of perfect security.

Introduction

Cross-border cyber attacks are a cheap way for a rival state, a proxy, or a criminal gang abroad to hit Indian banks, power, railways, and public trust without a visible soldier. For internal security they sit beside terrorism and subversion: the border is a router, not only a fence.

Body

Impact on internal security

- **Critical infrastructure** - power grids, ports, railways, oil, and telecom - can be slowed or blinded, which creates urban disorder without an explosion.
- **Banks, UPI rails, and markets** face theft, ransomware, and loss of confidence, which is a domestic stability problem as much as a cyber-crime problem.
- **Attribution is slow.** A server in a third country can mask a state or a non-state actor, which complicates response under international law.
- **Espionage and influence:** theft of defence and ministry data, and information operations that inflame communal or separatist fault lines.
- **Terror and insurgent use:** encrypted command, funding, and targeting of police databases. The 2020s pattern is mixed criminal-state toolkits (supply-chain malware, zero-days).
- Examples in the public domain include probes and incidents around **Kudankulam** (2019 reporting), **Mumbai power** disturbance debates in 2020, and repeated **Chinese and Pakistan-linked** campaign reporting by CERT-In and private firms. Exact operational detail is often classified; the strategic fact is persistent targeting.

Defensive measures

- **CERT-In** as the national incident response node; **NCIIPC** for designated critical information infrastructure under the IT Act.
- **Network monitoring, segmentation, backups, and air-gapping** of the most sensitive control systems; no internet-facing SCADA by default.
- **Defence Cyber Agency** and service cyber commands for military networks; **NATGRID** and police cyber cells for the criminal layer.

• **IT Act** offences, data-protection rules as they evolve, **sector CERT** (finance, power), and mandatory incident reporting.

• **Supply-chain hygiene:** trusted telecom gear, software bills of materials, and audits of vendors.

• **International:** Budapest Convention cooperation even without full membership politics, bilateral CERT MoUs, and UN norms on not attacking critical civilian infra.

• **People:** phishing is still the main door. Training, zero-trust identity, and public-private drills matter more than a new logo.

Limits

• **Perfect defence is false. The aim is** resilience**:** detect, isolate, restore, and attribute well enough to deter.

Flow diagram

Cross-border actor -> Banks grid data

Banks grid data -> Internal security shock

CERT-In NCIIPC -> Detect isolate restore

Segmentation drills KYC of vendors -> Detect isolate restore

Conclusion

Cross-border cyber attacks threaten Indian internal security by hitting money, power, data, and social trust from outside the fence. Defence is CERT-In, NCIIPC, segmented critical systems, cyber commands, and drills - resilience, not an unbreakable wall.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/keeping-in-view-indias-internal-security-analyse-the-impact-of-cross-border-cyber-attacks-also-discuss-defensive-measures-against-these-sophisticated-attacks/

Q11 · 15 marks

Do you agree that the Indian economy has recently experienced V- shapes recovery? Give reasons in support of your answer.

GS III · 2021 · Indian Economy

Revision summary

Headline GDP and several high-frequency indicators bounced in a V from the 2020-21 contraction into 2021-22.

The shock was a lockdown stop more than a 1930s financial freeze, so restart was possible.

Agriculture, public capex, and transfers cushioned the floor.

Informal firms, casual labour, and contact services lagged - a K-shape under the V.

Do not read one strong growth print as proof that lost jobs, schooling, and MSME capacity fully returned.

Introduction

• **After the 2020 COVID contraction, several official charts looked like a V:** a sharp fall, then a sharp rise in GDP and in high-frequency indicators. A V is a fair description of the headline bounce into 2021-22. It is not a fair description of every household. Informal work, contact services, and small firms recovered later and less evenly - a K more than a clean V.

Body

What a V-shaped recovery means

• A **V** is a deep drop followed by a return toward the old path without a long **L** stagnation or a **W** double dip.

• India's real GDP contracted sharply in **2020-21** (official prints around **7 per cent** contraction in early estimates) as lockdowns froze contact activity.

• **2021-22** then printed a strong rebound as mobility, vaccination, and base effects lifted industry and many services. That arithmetic is a V on the GDP line.

• High-frequency signs used in 2021 - **GST e-way bills, power consumption, rail freight, digital payments, and PMI** - also sprang back faster than in a typical demand-depression.

Reasons that support a V on the headline

• The shock was largely a **health-and-lockdown stop**, not a 1930s balance-sheet collapse of the whole banking system. When the stop lifted, factories and logistics could restart.

• **Agriculture** held up in 2020, which cushioned rural demand relative to a pure industrial crash.

• **Public capex**, rural guarantees (**MGNREGA**), food transfers, and later **PLI** and infrastructure pushes put a floor under demand.

• A **favourable base** after a collapse automatically raises the next year's growth rate. That is still a recovery, but it is not the same as a new productivity boom.

Reasons not to overclaim a full V

• **A** K-shape **appeared across people:** listed firms, IT, and formal wage earners recovered faster than **informal services, MSMEs, and urban casual labour**.

• **Contact-intensive** trade, tourism, and hospitality lagged while software and some manufacturing led.

• **Employment quality often worsened:** more **self-employment and unpaid family work**, fewer regular wage jobs, especially for women.

• **Health and education scars**, migrant distress, and school closure are not visible in a quarterly GDP V.

• Inflation in some later months ate real wages even as output indices looked healthy.

• If the comparison is with the **pre-pandemic trend path**, India did not instantly recapture every lost year of income. A V on the annual bar chart can still leave a **permanent output gap**.

A balanced verdict

• Agree that **aggregate GDP in 2021-22 showed a V-type bounce** from the 2020-21 hole.

• Disagree that this proved **uniform, job-rich, informal-inclusive** recovery.

• Policy should treat the V as a chance to rebuild **MSMEs, skilling, and health**, not as a claim that the K never happened.

Flow diagram

2020-21 contraction -> 2021-22 GDP bounce

2021-22 GDP bounce -> GST power freight PMI

Formal and IT -> Up arm of Formal and IT

Informal MSME contact labour -> Lagging arm

2021-22 GDP bounce -> Headline 2021-22 GDP bounce

Lagging arm -> Not a full social 2021-22 GDP bounce

Conclusion

Yes, India's headline economy showed a V-shaped bounce into 2021-22 after the COVID contraction. No, that V did not lift every worker equally. The honest picture is a GDP V sitting on a K-shaped social recovery.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/do-you-agree-that-the-indian-economy-has-recently-experienced-v-shapes-recovery-give-reasons-in-support-of-your-answer/

Q12 · 15 marks

"Investment in infrastructure is essential for more rapid and inclusive economic growth. "Discuss in the light of India's experience.

GS III · 2021 · Infrastructure

Revision summary

Infrastructure cuts logistics and power costs and crowds in private investment when last-mile links exist.

India's Golden Quadrilateral, PMGSY, ports, and digital public infrastructure supported growth and some inclusion.

A highway that bypasses the poor, or a project that displaces without R&R, is not inclusive.

Gati Shakti is the 2021 attempt to treat assets as a network.

Maintenance, DISCOM health, and eastern connectivity decide whether the next rupee of capex really raises broad-based growth.

Introduction

Roads, rails, power, ports, digital pipes, and irrigation lower the cost of moving goods and people. In India they have also been a way to pull lagging districts into the market. Infrastructure is essential for rapid and inclusive growth. It is not sufficient if land, skills, and last-mile public services stay broken.

Body

Why infrastructure raises growth

- Lower **logistics cost** raises tradable manufacturing. India has long paid a growth tax in slow ports, mixed-gauge delays, and truck time on poor roads.
- **Power and logistics** are complementary capital: a factory without both is a shed.
- Public infrastructure crowds in private investment when the State completes **last-mile links** and a predictable tariff.
- Multiplier effects in **construction employment** matter in a labour-surplus economy, if the asset then actually works.

India's experience of faster growth

- **Golden Quadrilateral**, **NHDP**, and later **Bharatmala** cut inter-city time and supported the 2000s growth burst in auto, durables, and organised retail.
- **PMGSY** village roads expanded market access for produce and non-farm work, which is inclusion as well as GDP.
- **Ports, airports, and dedicated freight corridor** logic (and **PM Gati Shakti**, 2021) aim to treat infrastructure as a **network**, not a ribbon-cutting list.
- **Telecom liberalisation, Aadhaar, UPI, and BharatNet** are digital infrastructure. They cut transaction costs for the poor more than a new steel mill sometimes does.
- **Irrigation and rural electrification** (including later **Saubhagya**) raised farm and household capability, though quality of power remains uneven.

Inclusion is not automatic

- A highway can **bypass** a poor block if there is no feeder, bus, or skill to use the new market.

• **Large dams and urban metro** can displace the weak unless rehabilitation is real. Inclusion needs **R&R and local hiring**, not only a GDP multiplier slide.

• **Public-private partnerships** (airports, some ports, HAM highways) brought capital. They also brought toll and land conflicts. The State must still specify **universal access**.

• **Regional imbalance:** coastal and metro corridors absorbed more private infra than the eastern and hill States, which is why **public capex** still has an equalising job.

• Debt-financed infra that does not earn or save cash becomes a **macro risk** (power DISCOM dues, stalled projects). Bad infrastructure investment can slow growth.

What India should keep doing

• Coordinate ministries on one map (**Gati Shakti**), finish stalled assets, and pair hard infra with **schools, primary health, and skilling**.

• Target **logistics cost** and **eastern freight**, not only more kilometres of the same corridor class.

• Maintain assets. An unmaintained PMGSY road is not inclusion.

Flow diagram

Infra investment -> Lower logistics and power cost

Lower logistics and power cost -> Faster growth

Infra investment -> PMGSY digital rural access

PMGSY digital rural access -> Inclusion if feeders and skills

Bypass displacement debt -> Growth without inclusion

Conclusion

India's highways, village roads, ports, power, and digital rails show that infrastructure is essential for speed and for widening the market. Inclusion follows when feeders, skills, and fair displacement rules travel with the concrete. Kilometres alone do not.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/investment-in-infrastructure-is-essential-for-more-rapid-and-inclusive-economic-growth-discuss-in-the-light-of-indias-experience/

Q13 · 15 marks

What are the salient features of the National Food Security Act, 2013 ? How has the Food Security Bill helped in eliminating hunger and malnutrition in India?

GS III · 2021 · Farm Subsidies and PDS

Revision summary

NFSA covers up to 75 per cent of rural and 50 per cent of urban population through TPDS.

Priority persons get 5 kg a month at Rs 3/2/1; AAY gets 35 kg per household.

Maternity benefit, ICDS, and mid-day meals are statutory, with a food security allowance if grain fails.

The Act reduced starvation risk and proved its pipeline in COVID years.

Malnutrition persists because the entitlement is cereal-heavy and care, WASH, and diet diversity sit outside the ration shop.

Introduction

The National Food Security Act, 2013 turned cheap grain from a scheme into a **legal entitlement**. It covers up to **75 per cent of the rural** and **50 per cent of the urban** population through the Targeted Public Distribution System, and it links maternity and child feeding to statute. It has reduced starvation risk for millions. It has not eliminated hunger or malnutrition.

Body

Salient features of NFSA 2013

• **Coverage ceiling:** up to **75 per cent rural** and **50 per cent urban** population as eligible households.

• **Priority households** receive **5 kg per person per month** of grain at **Rs 3/2/1** per kg for rice, wheat, and coarse cereals.

• **Antyodaya Anna Yojana** households retain **35 kg per household per month**.

• Identification of eligible households is left to States within the ceiling, with **women as heads** of ration cards where possible.

• **Pregnant women and lactating mothers** are entitled to a maternity benefit of not less than **Rs 6,000**, besides nutritious food through **ICDS**.

• Children get age-wise meals through **ICDS** and the **mid-day meal** (now PM-POSHAN) as **legal rights**, not only administrative schemes.

• **Food Security Allowance** is due if entitled grain is not supplied.

• Grievance redress, transparency, and a role for local bodies are written into the Act. **TPDS** remains the delivery spine.

How the Act has helped

• A rights-based PDS expanded and regularised cheap calories, which **cuts starvation deaths** and distress grain prices in poor districts when it works.

• **Aadhaar and portability** (One Nation One Ration Card) later made the same entitlement more usable for migrants, which the 2013 text anticipated as reform of TPDS.

• ICDS and school meals as statute made it harder to quietly close feeding centres. That supports **child calorie access** even when it does not by itself fix diets.

• During **COVID**, NFSA plus extra Pradhan Mantri Garib Kalyan grain showed the value of an existing legal pipeline.

Why hunger and malnutrition are not eliminated

• NFSA is largely a **cereal entitlement**. Hidden hunger is about **protein, fat, iron, and diet diversity**. Cheap rice does not end anaemia.

• Leakage, exclusion errors, and quality complaints persist even after digitisation, especially where State capacity is thin.

• **Maternity benefit** in practice has often been narrower than the Act's Rs 6,000 vision (PMMVY design and budgets).

• NFHS rounds still show high **stunting, wasting, and anaemia**. That is malnutrition with a full PDS in many States.

• Open-market price spikes, WASH, women's education, and care time decide nutrition as much as the ration shop.

• Global Hunger Index methods are debated, but domestic anthropometry is enough to reject a claim of elimination.

What would complete the Bill's promise

• Fortification where safe, **pulses and millets** in PDS, ICDS quality, and **POSHAN** convergence.

• Keep the legal grain floor; add diet quality rather than declaring victory.

Flow diagram

NFSA 2013 -> TPDS 75 percent rural 50 percent urban

NFSA 2013 -> Maternity ICDS MDM rights

TPDS 75 percent rural 50 percent urban -> Less starvation risk

Maternity ICDS MDM rights -> Less starvation risk

Cereal-only leakage care gaps -> Hunger and malnutrition remain

Conclusion

NFSA 2013 made cheap grain, maternity feeding, ICDS, and mid-day meals justiciable for a large covered population. It has helped against hunger as starvation. It has not eliminated malnutrition, because calories at Rs 3 are not a complete diet or a complete care system.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/what-are-the-salient-features-of-the-national-food-security-act-2013-how-has-the-food-security-bill-helped-in-eliminating-hunger-and-malnutrition-in-india/

Q14 · 15 marks

What are the present challenges before crop diversification? How do emerging technologies provide an opportunity for crop diversification?

GS III · 2021 · Crops, Irrigation and Marketing

Revision summary

Rice-wheat MSP, free power, and thin alternative markets are the core barriers to crop diversification.

Fragmented land, credit, and perishability add to the lock-in.

Soil maps, drip, stress-tolerant seed, e-NAM, drones, and cold-chain tech lower the risk of switching.

Technology without a buyer and a water rule will still lose to paddy.

Pair gadgets with FPO processing and targeted incentives in dark zones.

Introduction

Crop diversification means moving land, water, and support away from a narrow rice-wheat-sugarcane lock-in toward pulses, oilseeds, millets, horticulture, and fodder. India needs it for aquifers, nutrition, and price risk. Farmers stay in the old pattern because markets, MSP, and water rules still pay them to. Technology can lower that risk. It cannot repeal MSP politics by itself.

Body

Present challenges

- **MSP and open-ended paddy-wheat procurement** in Punjab, Haryana, and western UP make diversification a private loss even when it is a social gain.
- **Groundwater and free power** keep flood-irrigated paddy rational in water-stressed blocks.
- **Thin markets** for pulses, millets, and perishables: no assured buyer, high price crash after a good crop, weak storage and processing.
- **Risk and credit:** banks and input dealers know the wheat cycle; a new crop looks unbankable without insurance that actually pays.
- **Fragmented holdings** and tenancy insecurity reduce experiments that take more than one season.
- **Knowledge and labour:** horticulture and spices need skill, cold chain, and timely labour that cereal mechanisation already supplies.
- **Policy overload:** seed, fertiliser, and electricity subsidies are still cereal-tilted. **NITI** and State diversification plans stall at the mandi gate.
- Climate uncertainty raises the cost of being first to switch.

How emerging technologies open a door

- **Soil Health Cards, GIS, and remote sensing** show which blocks should not grow paddy, and can target incentive to those blocks.
- **Precision irrigation and fertigation** (drip, sensors) make horticulture and high-value vegetables feasible on less water.

• **Short-duration and stress-tolerant seed**, including public millet and pulse varieties, shorten the hunger gap between two cereals.

• **e-NAM, FPO digital platforms, and warehouse receipts** can, if actually used, give a pulse or oilseed grower a buyer beyond the local cartel.

• **Drones, advisory apps, and weather nowcasts** cut pest and climate surprise on diversified plots.

• **Traceability, GI, and export residual testing** open spices, organic, and horticulture to better prices.

• **Food processing, irradiation, and cold-chain IoT** turn a tomato glut into paste instead of a crash.

• **Solar pumps with feeder-level management** can be tied to crop-shift conditions so technology does not only pump more paddy.

What must sit beside the gadget

• **Price deficiency or limited MSP** for pulses and oilseeds, **crop holiday** or bonus for paddy in dark zones, and **direct diversification payments**.

• FPOs and processing so technology is not a phone app on an unsold heap of bajra.

• **Research:** not only GM slogans, but **public breeding** for local millets and oilseeds.

Flow diagram

Cereal MSP power -> Low diversification

Seed drip sensors eNAM cold chain -> Lower risk and water

Procurement reform FPO -> Pulses oilseeds horticulture

Lower risk and water -> Pulses oilseeds horticulture

Conclusion

Diversification is blocked by procurement, water, and thin markets, not by a lack of farmer wisdom. Emerging tools - sensors, seed, drip, digital mandis, and cold chain - reduce risk and water cost. They work when policy pays for the crop the aquifer needs.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/what-are-the-present-challenges-before-crop-diversification-how-do-emerging-technologies-provide-an-opportunity-for-crop-diversification/

Q15 · 15 marks

What are the research and developmental achievements in applied biotechnology/? How will these achievements help to uplift the poorer sections of the society?

GS III · 2021 · Indian Economy

Revision summary

Applied biotech in India includes vaccines, PCR and rapid tests, tissue culture, bio-inputs, biosimilars, and Bt cotton.

Public marker-assisted breeding and livestock vaccines are as important as GM headlines.

The poor gain first from cheap immunisation and diagnostics, then from clean seed and climate-tolerant varieties.

Bt cotton's income gain was real in some years and later limited by resistance and costs.

Without extension, water, and markets, lab achievements stay in journals.

Introduction

Applied biotechnology is the use of cells and molecules to make seed, vaccines, diagnostics, enzymes, and bio-inputs. India has real achievements in vaccines, diagnostics, tissue culture, and Bt cotton. These can lift the poor when they cheapen calories, health, and farm risk. They do not lift the poor when patents, irrigation, and extension stay out of reach.

Body

Research and development achievements

- **Vaccines:** India is a large producer of **WHO-prequalified** vaccines (including pentavalent, rotavirus, and later COVID platforms). **Recombinant hepatitis B** and indigenous rotavirus strains are public-health biotech, not only a private brand story.
- **Diagnostics:** ELISA, PCR, and rapid antigen platforms scaled for **TB, HIV, and COVID**. Cheaper tests matter more to the poor than a new luxury drug.
- **Bt cotton:** the main commercial GM crop in India. It cut bollworm losses in many years of the 2000s. **Pink bollworm resistance** later showed that one gene is not a permanent harvest.
- **Tissue culture:** banana, potato, and sugarcane planting material raised yields for small growers who can buy clean seed.
- **Biofertilisers, biopesticides, and fermentation:** rhizobium, trichoderma, and industrial enzymes for food and feed.
- **Medical biotech:** recombinant **insulin**, biosimilars, and public-sector work on affordable biologics.
- **Public research:** ICAR, DBT, CSIR, and universities on **marker-assisted breeding**, drought and salt lines, and livestock vaccines (for example classical swine fever and veterinary diagnostics).
- **GM mustard and other food GM** remain politically contested; achievement should not be written as if every file is already in the field.

How this can uplift poorer sections

- **Cheaper vaccines and diagnostics** cut death and out-of-pocket shock, which is the most direct biotech-to-poverty channel.

• **Clean planting material and bio-inputs** raise small-farm output without the full chemical bill when extension is honest.

• **Bt cotton** raised incomes for many commercial smallholders in some periods; it also raised seed cost and did not remove **monsoon and price** risk. Uplift was real and partial.

• **Drought- and flood-tolerant varieties** (conventional plus molecular markers, not only GM) protect the poorest rainfed plots first.

• **Livestock and fish vaccines** protect the asset base of pastoral and small dairy households.

• **Skills and MSME fermentation** (enzymes, spawn, tissue-culture nurseries) can be rural jobs if quality regulation holds.

• **Nutrition:** biofortified zinc wheat and iron pearl millet from public breeding help hidden hunger cheaper than a capsule campaign.

Conditions so the poor actually gain

• Public procurement of vaccines and seed, **DBT-ICAR extension**, and regulation that keeps **spurious kits and illegal GM** out.

• Do not equate every lab press note with a poor household's plate.

• Pair biotech with **credit, water, and MSP or deficiency payments**, or the extra quintal still sells in a crash.

Flow diagram

Applied biotech -> Vaccines diagnostics

Applied biotech -> Seed tissue culture Bt

Vaccines diagnostics -> Lower health shock

Seed tissue culture Bt -> Farm output and less pest loss

Price water extension -> Uplift of poorer households

Lower health shock -> Uplift of poorer households

Farm output and less pest loss -> Uplift of poorer households

Conclusion

India's applied biotech record is strongest in vaccines, diagnostics, tissue culture, and a mixed Bt-cotton lesson. Those tools uplift the poor when they are cheap, public, and bundled with water and markets. A gene without an extension worker is not a social policy.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/what-are-the-research-and-developmental-achievements-in-applied-biotechnology-how-will-these-achievements-help-to-uplift-the-poorer-sections-of-the-society/

Q16 · 15 marks

The Nobel Prize in Physics of 2014 was jointly awarded to Akasaki, Amano and Nakamura for the invention of Blue LEDs in 1990s. How has this invention impacted the everyday life of human beings ?

GS III · 2021 · Indian Economy

Revision summary

The 2014 Physics Nobel honoured Akasaki, Amano, and Nakamura for efficient blue LEDs in the 1990s.

Blue plus phosphor (or RGB mix) made white LED lighting practical.

White LEDs cut household and street electricity use and enabled solar lanterns.

Screens, traffic signals, and many medical lights rest on the same family of devices.

Quality, e-waste, and night-time blue light are the downsides of a genuine everyday revolution.

Introduction

The 2014 Nobel Prize in Physics went jointly to **Isamu Akasaki**, **Hiroshi Amano**, and **Shuji Nakamura** for efficient **blue light-emitting diodes** developed in the 1990s. Red and green LEDs already existed. Without blue, white light from semiconductors was incomplete. Blue LEDs made cheap, long-life white lamps possible, and that changed how the world lights rooms, screens, and streets.

Body

What they actually invented

- Akasaki and Amano at Nagoya, and Nakamura at Nichia, produced **bright gallium-nitride blue LEDs** after years when textbooks said it was too hard.
- Blue light plus a **yellow phosphor** (or red-green-blue mixing) yields **white LED light**.
- The prize was for the physics and materials breakthrough of the 1990s, not for every later bulb brand.

Everyday lighting and energy

- White LEDs use **far less electricity** than incandescent bulbs and typically less than compact fluorescents for the same lumen, with **longer life** and no warm-up.
- Households, shops, and offices cut bills and heat load. That is the largest daily impact.
- **Street lighting and public programmes** (including India's UJALA-era LED push) scaled the same physics into a national power-saving tool.
- Off-grid **solar lanterns** became useful because the lamp finally sipped watts that a small panel could feed. That changed nights in unelectrified and unreliable-grid homes.

Screens, signals, and work

- **Mobile phones, laptops, and TVs** use LED backlights or OLED cousins of the same semiconductor family. Daily reading, navigation, and work sit on that light.
- **Traffic signals, railway aspects, and automotive lamps** last longer and fail less, which is a safety as well as a power fact.
- **Flashlights, bicycle lamps, and indoor plants' grow lights** became small and cheap.

Health, environment, and culture

• Lower power for lighting cuts **coal and oil burn** at the margin, which is a climate and urban-air gain when grids are fossil-heavy.

• LEDs avoided some **mercury** that fluorescent tubes carried, though they create an **e-waste** stream that policy must collect.

• Medical **phototherapy** and dental curing lights use blue and related LEDs.

• **Cultural life:** cheaper stage and festival lighting, and a 24-hour visual culture of screens.

Limits of the miracle

• Poor-quality LEDs flicker or render colour badly. **Blue-rich night light** can disturb sleep if used thoughtlessly.

• The Nobel was not a prize for every Chinese bulb in a grey market. Quality standards decide whether the poor actually save.

Flow diagram

Blue LED 1990s -> White LED with phosphor

White LED with phosphor -> Low-watt home and street light

White LED with phosphor -> Screens signals lanterns

Low-watt home and street light -> Daily energy saving

Screens signals lanterns -> Daily energy saving

Conclusion

Akasaki, Amano, and Nakamura's blue LED completed white semiconductor lighting. Everyday life changed through cheaper, longer-lasting lamps, solar lanterns, screens, and signals. The human impact is energy saved in the room and light where a grid never reached.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/the-nobel-prize-in-physics-of-2014-was-jointly-awarded-to-akasaki-amano-and-nakamura-for-the-invention-of-blue-leds-in-1990s-how-has-this-invention-impacted-the-everyday-life-of-human-beings/

Q17 · 15 marks

Describe the major outcomes of the 26th session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). What are the commitments made by India in this conference?

GS III · 2021 · Environment and Conservation

Revision summary

COP26 produced the Glasgow Climate Pact, a coal phase-down formula, Article 6 market rules, and pressure on the USD 100 billion finance gap.

India-UK Green Grids and other side deals sat beside the Pact.

India's Panchamrit includes 500 GW non-fossil capacity, 50 per cent non-fossil installed capacity by 2030, a 45 per cent GDP intensity cut, 1 billion tonnes less projected carbon, and net zero by 2070.

Fifty per cent of installed capacity is not fifty per cent of the energy mix.

LiFE and OSOWOG were the diplomatic companions to those numbers.

Introduction

COP26 at Glasgow in November 2021 produced the Glasgow Climate Pact and a set of side deals on methane, coal, forests, and carbon markets. India announced **Panchamrit**: five domestic climate numbers, including **net zero by 2070** and **about 50 per cent of installed electricity capacity from non-fossil fuels by 2030**. That capacity share is not a promise that half of India's total energy mix will be renewable.

Body

Major outcomes of COP26

• The **Glasgow Climate Pact** asked parties to keep **1.5°C** within reach and to **revisit and strengthen 2030 NDCs**.

• On coal, the final text used **phase down** of unabated coal power, not **phase out**, after late objection involving India and others. That wording is an outcome, not a footnote.

• Developed countries were pressed on the missed **USD 100 billion** climate-finance goal and asked to deliver it urgently, with a process toward a new post-2025 goal.

• **Article 6** rules for cooperative carbon markets were agreed after years of deadlock, with some accounting and corresponding-adjustment language.

• **Side coalitions: Global Methane Pledge** (many States; India did not join that pledge), **Glasgow Leaders' Declaration on Forests**, and the **Green Grids Initiative-OSOWOG** (India-UK).

• Adaptation, loss and damage, and a **dialogue** on loss and damage were pushed by developing countries; a full loss-and-damage facility was not yet created at COP26.

• Non-state net-zero announcements multiplied. Their quality varies.

India's commitments (Panchamrit)

• Raise **non-fossil installed electricity capacity to 500 GW by 2030**.

• Meet **50 per cent of installed (electric) capacity from non-fossil sources by 2030**. Do not write this as **50 per cent of the energy mix** or of total primary energy. Coal, oil, and

traditional biomass still dominate energy use even when half of power **capacity** is non-fossil, because utilisation factors differ.

• Cut the **emissions intensity of GDP by 45 per cent by 2030** from 2005 levels (an update of the earlier 33-35 per cent intensity pledge).

• Reduce **total projected carbon emissions by 1 billion tonnes** between then and 2030.

• Achieve **net-zero carbon emissions by 2070**.

• India also spoke of **LiFE** (Lifestyle for Environment) as a mass behavioural complement, and co-led **OSOWOG / Green Grids** with the UK.

How to read the pledges

• Capacity is not generation, and generation is not the whole energy basket (heat, transport fuel).

• 2070 net zero is later than many rich-country dates, which India defends with equity and remaining carbon space.

• Implementation still depends on **finance, grids, storage, and a just coal transition**.

Flow diagram

COP26 Glasgow Pact -> 1.5 COP26 Glasgow Pact NDCs coal phase-down

COP26 Glasgow Pact -> Finance Article 6

India Panchamrit -> Net zero 2070

India Panchamrit -> 500 GW and 50 percent non-fossil capacity

India Panchamrit -> 45 percent intensity and 1 bn t

500 GW and 50 percent non-fossil capacity -> Not 50 percent energy mix

Conclusion

COP26's Pact kept 1.5°C language, phased down coal, unlocked Article 6, and shamed the 100-billion gap. India's Panchamrit set 500 GW non-fossil, a 50 per cent non-fossil **capacity** share, a 45 per cent intensity cut, a 1-billion-tonne reduction, and net zero in 2070 - not a 50 per cent renewable energy-mix slogan.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/describe-the-major-outcomes-of-the-26th-session-of-the-conference-of-the-parties-cop-to-the-united-nations-framework-convention-on-climate-change-unfccc-what-are-the-commitments-made-by-india-in-this-conference/

Q18 · 15 marks

Describe the various causes and the effects of landslides. Mention the important components of the National Landslide Risk Management Strategy.

GS III · 2021 · Indian Economy

Revision summary

Causes of landslides are geology, monsoon pore pressure, earthquakes, and human toe-cutting and deforestation.

Effects include fatalities, cut highways, river damming, and sediment disasters.

NDMA's National Landslide Risk Management Strategy (2019) centres on hazard mapping, land-use regulation, early warning, structural and bio-engineering, awareness, and R&D.

GSI, IMD, BRO, and States must share one inventory.

Enforcement on construction and road design is the usual failure, not the absence of a document.

Introduction

A landslide is the downslope movement of rock, debris, or earth under gravity. In India it is a Himalayan, Western Ghats, and north-eastern monsoon hazard, made worse by roads cut into weak slopes. The National Landslide Risk Management Strategy (NDMA, 2019) is the Union's checklist: map, regulate, warn, and build capacity - not only send NDRF after the hill has moved.

Body

Causes

- **Geology:** fractured Himalayan thrust sheets, laterite and gneiss in the Ghats, and thick debris on steep valleys fail when strength drops.
- **Rainfall and cloudbursts:** pore-water pressure in the monsoon is the usual trigger; **Kedarnath 2013** mixed flood, debris flow, and slope failure.
- **Earthquakes:** shaking adds load; 2015 Nepal and 2011 Sikkim showed co-seismic slides.
- **Human:** road and rail **toe-cutting**, unplanned **hill construction**, mining, deforestation, and drainage blocked by debris or poor culverts.
- **Hydropower and tunnelling** in fragile belts, if poorly designed, change slope water.
- **Climate:** more intense rain bursts raise the frequency of debris flows even on old scars.

Effects

- Immediate **death and burial** of settlements and pilgrims (Malin 2014, many Himachal and Uttarakhand seasons, Manipur and Mizoram slides).
- **Isolation:** highways such as NH-10, NH-6, and hill State roads close, which is an economic landslide after the physical one.
- **Damming of rivers** and outburst risk; damage to hydropower, transmission, and army logistics in border hills.
- **Sediment** in reservoirs and plains floods downstream.
- Livelihood loss for terrace farmers and a long reconstruction bill that poor hill panchayats cannot pay.

National Landslide Risk Management Strategy - important components

- **Hazard zonation and mapping** at usable scales, with inventory of past slides and a national database.
- **Land-use and mountain-zone regulation:** restrict building on red zones; enforce town-and-country rules in hill stations.
- **Early warning** from rainfall thresholds, slope instruments, and community watch, linked to IMD and State SDMAs.
- **Loss reduction:** safe alignment of roads, retaining structures, drainage, and bio-engineering rather than only blasting a new cut.
- **Awareness, capacity, and preparedness:** local masons, panchayats, and tourist-route protocols; pre-positioned NDRF/SDRF.
- **Research, monitoring, and institutional coordination** among NDMA, GSI, NRSC, BRO, NHAI, and State DGMs.
- **Recovery** that does not rebuild on the same scar without a geotechnical veto.

Practice gap

- Maps exist; **enforcement on hotels and highway contractors** is the missing component more often than a new slogan.

Flow diagram

Weak slope rain quake -> Landslide

Road cutting building -> Landslide

Landslide -> Death isolation river damming

NDMA 2019 strategy -> Map regulate warn

NDMA 2019 strategy -> Safe roads capacity

Conclusion

Landslides join weak rock, water, quakes, and human cuts. Their effects are death, isolation, and river trouble. NDMA's 2019 strategy is mapping, land-use control, warning, engineered roads, awareness, and research. It works only if the next hill road obeys the map.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/describe-the-various-causes-and-the-effects-of-landslides-mention-the-important-components-of-the-national-landslide-risk-management-strategy/

Q19 · 15 marks

Analyse the multidimensıonal challenges posed by external state and non-state actors, to the internal security of India. Also discuss measures required to be taken to combat these threats.

GS III · 2021 · External Actors and Internal Security

Revision summary

State actors threaten India through proxy terror, LAC and cyber pressure, and neighbourhood influence.

Non-state actors bring transnational terror, narcotics, trafficking, and online radicalisation.

The two often share money, sanctuary, and media.

Measures are border management, NIA/fusion grids, FATF and diplomacy, cyber defence, coastal security, and political oxygen-denial in conflict districts.

Agency turf wars and weak State police undercut even good Union laws.

Introduction

India's internal security is not only a police subject. External **states** use proxies, fire, cyber, and maps. External **non-state** actors use terror, drugs, fake currency, and ideology. The two often work as a mix: a sanctuary, a wallet, and a narrative that land inside Indian districts.

Body

Challenges from external state actors

- **Cross-border terrorism and proxy war** from Pakistani territory has been the longest kinetic challenge to Jammu and Kashmir and to cities (from the 1990s through 26/11 and later modules).
- **China presents a different mix: LAC coercion that ties down forces, cyber and information** probes, and influence in the neighbourhood that can open secondary borders.
- **Intelligence, weapons, and communication** support to insurgent leftovers in the north-east, and to Khalistani or other diaspora- extremism, when a foreign capital finds it useful.
- **Economic and infrastructure leverage** in neighbouring States can become a security problem if ports and grids sit in a rival's playbook.
- **Fake Indian currency notes** and selected **diplomatic cover** for hostile networks.

Challenges from external non-state actors

- **Transnational terror groups** and franchises that radicalise online without a classic training camp.
- **Drug cartels** on the Golden Crescent and Golden Triangle routes; money and addiction both hit Punjab, the north-east, and now Kerala coasts.
- **Arms, wildlife, and human-trafficking** networks that use the same porous stretches as migrants.
- **Communal and separatist online ecosystems** hosted on foreign servers.
- **Pirates and criminal gangs** in the Indian Ocean as a lesser but real maritime-internal link.

The nexus

- State and non-state are not clean boxes. **Safe havens, hawala, and social media** join them.

• A drone dropping rifles, a cyber strike on a power utility, and a riot video can arrive in the same month from different desks.

Measures required

• **Border management:** fencing where it works, floodlights, BOPs, riverine and drone patrols, and **integrated checkposts**; the India-Myanmar Free Movement reality needs intelligence, not only a slogan.

• **Counter-terror law and investigation: NIA**, **UAPA** used with due process, **NATGRID** and MAC-type fusion, and police modernisation so the first responder is not blind.

• **Neighbourhood diplomacy** so Bangladesh, Nepal, Bhutan, Sri Lanka, and Myanmar deny camps; **FATF** and UN listing to dry money.

• **Cyber and information defence** (CERT-In, NCIIPC) against state-grade tools in internal disruption.

• **De-radicalisation, madrasa and campus engagement, and fast courts** so the narrative war is not left to the terrorist's editor.

• **Coastal security** after 26/11: CISF, marine police, transponders - still uneven, still necessary.

• **Federal coordination:** Union forces assist; **State police** own the street. Rivalry between agencies is itself a vulnerability.

• Address **governance gaps** in Kashmir, the north-east, and Left-Wing districts so the external actor has less local oxygen - without confusing development with naivety about guns.

Flow diagram

External states -> Proxies cyber LAC

Non-state -> Terror drugs FICN

Proxies cyber LAC -> Internal security

Terror drugs FICN -> Internal security

Borders NIA FATF CERT police -> Denial and disruption

Conclusion

External states bring proxies, cyber, and maps; non-state actors bring terror, drugs, and online hate. India's reply has to be borders, fusion intelligence, law with process, neighbourhood denial of camps, and cyber resilience. A single ministry cannot cover that list.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/analyse-the-multidimens-onal-challenges-posed-by-external-state-and-non-state-actors-to-the-internal-security-of-india-also-discuss-measures-required-to-be-taken-to-combat-these-threats/

Q20 · 15 marks

Analyse the complexity and intensity of terrorism, its causes, linkages and obnoxious nexus. Also suggest measures required to be taken to eradicate the menace of terrorism.

GS III · 2021 · Border Security and Organised Crime

Revision summary

Terrorism in India's experience is networked, asymmetric, and often sanctuary-backed.

Causes include ideology, alienation, and state sponsorship; poverty is soil, not destiny.

The obnoxious nexus is narco, hawala, fake currency, arms, and sometimes political protection.

Measures are intelligence, NIA/PMLA/FATF, border and cyber control, counter-radicalisation, and diplomacy against safe havens.

Jobs and rights reduce recruits; they do not replace the need to stop the active cell.

Introduction

Terrorism is the organised use of fear against civilians for a political, religious, or criminal aim. Its intensity in India's neighbourhood has been high because ideology, territory, and crime share the same wallet. Eradication is a strong word. Reduction to a residual police problem is the practical goal, through law, money, and politics that do not feed the next recruiter.

Body

Complexity and intensity

- **Terrorism is** asymmetric**:** a small cell can shock a large democracy (Parliament 2001, 26/11, Pulwama).
- **It is** networked**:** local modules, diaspora money, online instruction, and sometimes a state sanctuary.
- Intensity in South Asia has included **fidayeen**, VBIEDs, and now **drones and encrypted command**, which raise the cost of policing.
- **Multiple theatres overlap: J&K**, **Left-Wing Extremism** (a different ideology, similar terror against civilians and the State), **north-east remnants**, and **urban modules**.
- The target set includes **soft civilians**, **security forces**, and **symbols** (temples, trains, hotels) to maximise publicity.

Causes

- **Political:** unresolved self-determination narratives, alienation, and governance failure that a handler can script.
- **Ideological and religious** extremist teaching, including imported takfiri streams and, in other cases, ethno-national militancy.
- **Youth unemployment and humiliation** as recruitment soil, not as a full cause - most poor people never bomb a market.
- **State sponsorship** and safe havens that turn a local grievance into a trained unit.
- **Copy-cat media reward:** the more the blast leads the news, the more the method spreads.

Linkages and obnoxious nexus

- **Terror-crime:** kidnapping, extortion, and bank robbery (classic LWE and insurgent finance).
- **Terror-narco:** Golden Crescent heroin and Afghan-era routes funding modules; drugs also hollow the society that must resist.
- **Terror-hawala and fake currency:** moving value without a clean bank trail.
- **Terror-arms bazaars** and leftover small arms after regional wars.
- **Terror-cyber:** recruitment, recon, and sometimes disruption.
- **Obnoxious nexus with politics:** when a party, a police unit, or a foreign desk uses a militant as an asset, the State fights itself.

Measures to reduce and, as far as possible, eradicate

- **Intelligence-led policing**, not only post-blast special laws: human sources, financial intelligence, and tech intercept with oversight.
- **NIA, UAPA, PMLA**, and **UN 1267 listing** to freeze people and money; courts that conclude trials so law is not only detention.
- **Dry the nexus:** FATF-standard KYC, narcotics control (NCB), and coastal/border interdiction.
- **Counter-radicalisation** in prisons, campuses, and online, with credible community voices - not only takedowns.
- **Protect soft targets** without turning cities into permanent fortresses: hotels, rail, and religious sites after 26/11 lessons.
- **Diplomacy and, where needed, calibrated force** against sanctuaries; no impunity for state sponsors.
- **Address genuine grievances** (jobs, rights, local government) so the political file is not empty. This is not a substitute for disrupting the bomb-maker.
- **International:** UN conventions, Interpol, and data-sharing; a common definition is still contested, but extradition of named accused is concrete.
- Strategic communication that **denies theatre** without hiding facts.

Flow diagram

Grievance ideology sanctuary -> Terror modules

Narco hawala arms cyber -> Terror modules

Terror modules -> Civilian fear

Intel NIA PMLA FATF -> Disrupt money and cells

Governance without impunity -> Disrupt money and cells

Conclusion

Terrorism is intense because it mixes ideology, sanctuary, and a crime economy. India's tools are intelligence, NIA and financial law, border and cyber work, and a politics that neither bargains with the gun nor ignores the grievance. Eradication is the aim; relentless reduction is the method.

Open WRAP page — https://wrapexams.com/upsc/mains-answers/gs-3/2021/analyse-the-complexity-and-intensity-of-terrorism-its-causes-linkages-and-obnoxious-nexus-also-suggest-measures-required-to-be-taken-to-eradicate-the-menace-of-terrorism/

Compiled answer key

Last pages of this pack. Each question links to the WRAP model answer on wrapexams.com.

ask@wrapexams.com · wrapexams.com

Q1 **10 marks**	**Q2** **10 marks**	**Q3** **10 marks**	**Q4** **10 marks**
Q5 **10 marks**	**Q6** **10 marks**	**Q7** **10 marks**	**Q8** **10 marks**
Q9 **10 marks**	**Q10** **10 marks**	**Q11** **15 marks**	**Q12** **15 marks**
Q13 **15 marks**	**Q14** **15 marks**	**Q15** **15 marks**	**Q16** **15 marks**
Q17 **15 marks**	**Q18** **15 marks**	**Q19** **15 marks**	**Q20** **15 marks**

Question-wise key

Q1 · 10 marks Solution
Q2 · 10 marks Solution
Q3 · 10 marks Solution
Q4 · 10 marks Solution
Q5 · 10 marks Solution
Q6 · 10 marks Solution
Q7 · 10 marks Solution
Q8 · 10 marks Solution
Q9 · 10 marks Solution
Q10 · 10 marks Solution
Q11 · 15 marks Solution
Q12 · 15 marks Solution
Q13 · 15 marks Solution
Q14 · 15 marks Solution
Q15 · 15 marks Solution
Q16 · 15 marks Solution
Q17 · 15 marks Solution
Q18 · 15 marks Solution
Q19 · 15 marks Solution
Q20 · 15 marks Solution