Date –29- January 2025

# PRELIMS BITS: THE SCIENCE BEHIND FOG AND THUNDERSTORM

WHY IN THE NEWS?

The India Meteorological Department (IMD) has forecast dense fog conditions over Uttarakhand, Punjab, Haryana, Chandigarh, Sub-Himalayan West Bengal, and Sikkim today, with similar conditions expected in isolated pockets of Uttar Pradesh, Gangetic West Bengal, Coastal Odisha, and Bihar for the next 2-3 days. Additionally, light to moderate rainfall accompanied by thunderstorms is predicted over Arunachal Pradesh, Assam, and Meghalaya for the next two days. IMD has also projected a rise in temperature by 2-4°C over Northwest, Central, and East India during the next four days. These weather conditions may impact transportation, visibility, and overall climate patterns in the affected regions.

WHAT IS FOG?

The World Meteorological Organization (WMO) defines fog as a suspension of very small water droplets in the air that reduces visibility at ground level to less than one kilometer.
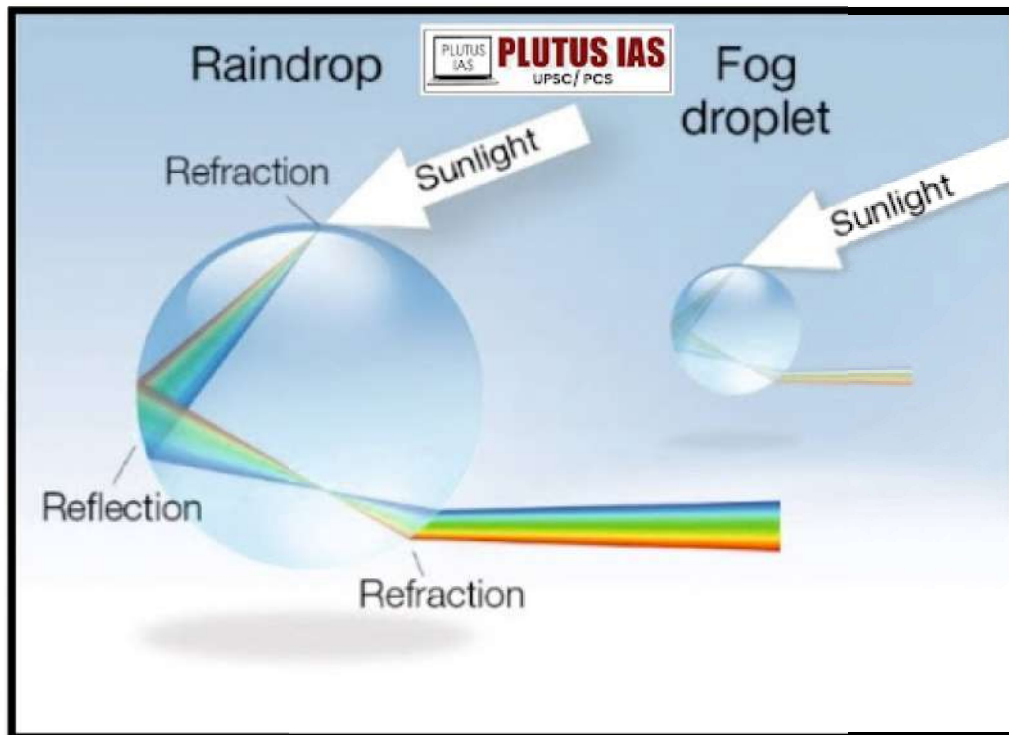
MECHANISM OF THE FORMATION OF THE FOG:

Similar to Cloud Formation: Fog forms like clouds but occurs at the surface rather than higher in the atmosphere.

Cooling to Dew-Point Temperature: Air must cool to its dew-point temperature (the temperature at which condensation occurs) for fog to form.

Condensation of Water Vapour: Invisible water vapour condenses into tiny droplets, creating fog.

Nighttime Cooling: The most common cause of fog is overnight cooling, as the ground radiates heat absorbed during the day.

Ideal Weather Conditions: Clear skies, light winds, and a high-pressure system favor fog formation.

Role of Wind: Too much wind → Low clouds form instead of fog. Too little or no wind → Dew forms on surfaces instead of fog.

Moisture Content in Air: Measured by the dew-point temperature—higher values indicate more moisture. Fog forms when air temperature and dew-point temperature are close together.

Temperature Difference Matters: If the daytime temperature is too high compared to the dew point, nighttime cooling may not be sufficient for condensation.

Classic Fog Formation Pattern: Rain in the evening increases the dew-point temperature. A high-pressure system follows, bringing clear skies and light winds overnight. This setup often results in thick, dense fog.
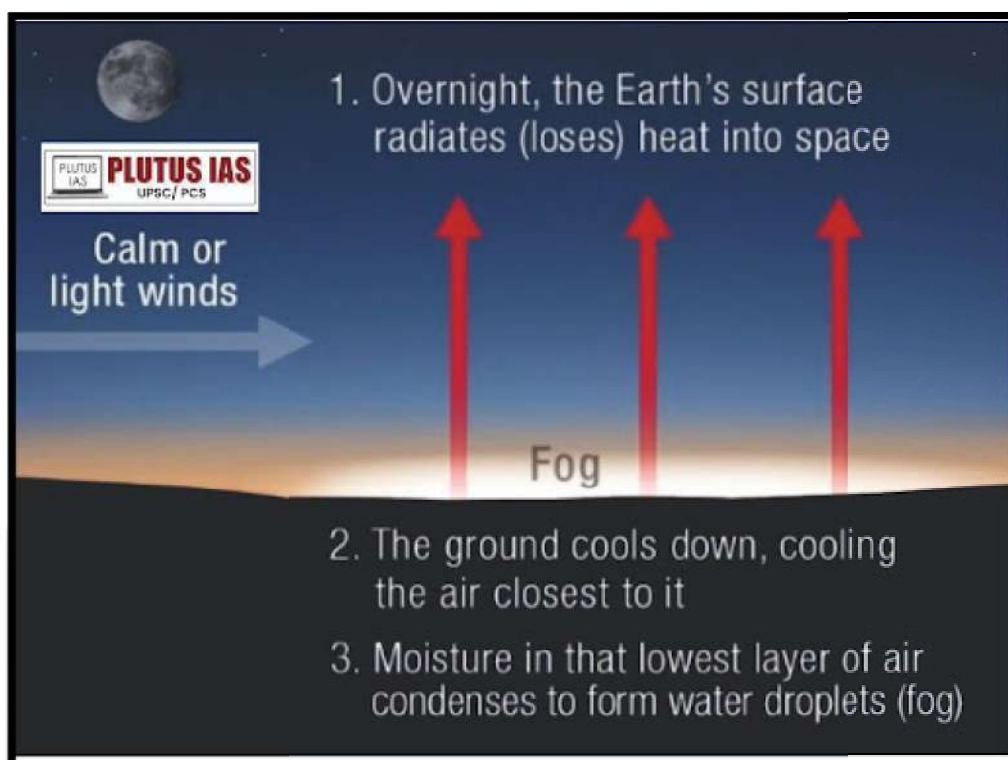
TYPES OF FOG

Type	Formation Process	Characteristics
Radiation Fog	Forms when the ground cools overnight, causing air near the surface to reach the dew-point temperature.	Most common type, occurs under clear skies and light winds.
Advection Fog	Forms when warm, moist air moves over a cooler surface.	Common in coastal areas; **sea fog** is a type of advection fog.
Upslope Fog	Forms when moist air is forced up a slope and cools to saturation.	Can occur over mountains, hills, or even gentle slopes.
Fogbow	Caused by the refraction and reflection of sunlight in fog droplets.	Similar to rainbows but appears white due to smaller droplet size.

COMPARISON BETWEEN SMOG, FOG, AND MIST

Factor	Smog	Fog	Mist
Definition	A mixture of **fog, smoke, and air pollutants**	A dense suspension of **tiny water droplets** reducing visibility	A light suspension of **water droplets** with less density than fog
Main Components	Smoke, dust, industrial pollutants, and fog	Water droplets formed by condensation	Water droplets formed by condensation but in

Factor	Smog	Fog	Mist
			lower concentration
Visibility Reduction	Can reduce visibility **to a few meters**	Reduces visibility to **less than 1 km**	Visibility remains **more than 1 km**
Color	**Yellowish or brownish** due to pollutants	Usually **white or gray**	Appears **whitish and thin**
Formation Process	Forms when pollutants mix with fog in the presence of **high humidity and temperature inversions**	Forms when air **cools to the dew-point temperature**, causing condensation	Forms similarly to fog but with **fewer water droplets**
Common Causes	**Vehicular emissions, industrial pollution, burning of fossil fuels**	**Cooling of air, high humidity, light winds, and clear skies**	Same as fog but with **less moisture and higher visibility**
Occurrence	More common in **urban areas** with high pollution	Found in **valleys, near water bodies, and low-lying areas**	Appears in **open landscapes, hills, and near water sources**
Health Impact	**Severe respiratory issues**, eye irritation, and lung diseases due to pollutants	Generally harmless but can cause **breathing discomfort in sensitive individuals**	No significant health impact
Impact on Transportation	Causes **major traffic, air, and rail disruptions** due to extremely low visibility	**Reduces visibility**, causing travel delays	Minimal impact on transportation
Example Events	**London's Great Smog (1952)** caused **8,000+ deaths**	Common in **winter mornings in valleys and plains**	Often seen over fields and water bodies in the early morning

THUNDERSTORMS:

WHAT IS A THUNDERSTORM?

A thunderstorm is a rain shower accompanied by the sound of thunder. Since thunder is produced by lightning, all thunderstorms are characterized by the presence of lightning.

MECHANISM OF THUNDERSTORM FORMATION

Ingredients for Formation: Moisture, Rising unstable air (air that continues to rise when disturbed), Lifting mechanism (e.g., hills, mountains, or air collisions).

Surface Heating: The sun heats the earth's surface, warming the air above it.
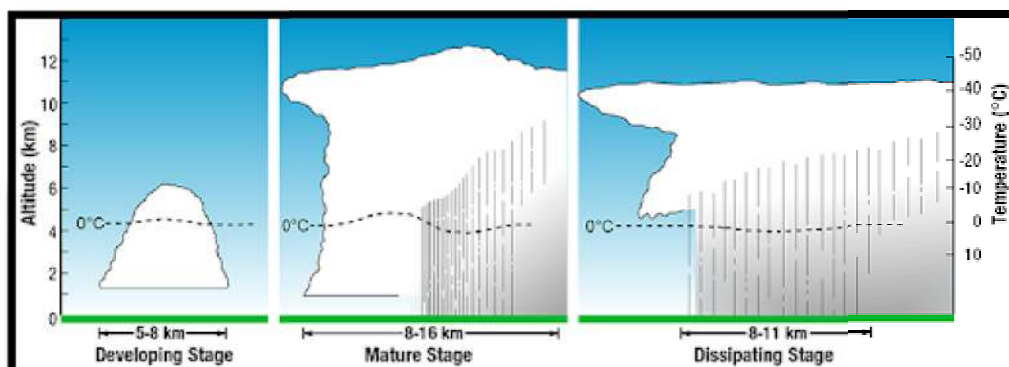
Rising Air: Warm air rises because it is lighter and warmer than the surrounding air. This upward movement is driven by convection.

Cloud Formation: As the air rises and cools, its water vapor condenses into a cloud. The cloud grows as it continues to rise into colder parts of the atmosphere.

Ice Particle Creation: As the cloud reaches freezing temperatures, liquid water drops freeze into ice particles. These ice particles grow by collecting supercooled liquid droplets or vapor.

Collision of Ice Particles: When ice particles collide, they build up electric charges. Some collisions transfer charge, leading to the formation of lightning.

Lightning and thunder: The electric discharge from lightning creates thunder (sound waves), which we hear during a storm.

THUNDERSTORM TYPES AND FEATURES

Thunderstorm Type	Features
Single-Cell Thunderstorm	– Small, brief, weak storms
	– Lasts about **1 hour**
	– Typically driven by **afternoon heating**
	– May produce brief **heavy rain** and **lightning**
Multi-Cell Thunderstorm	– Common, garden-variety thunderstorms
	– New updrafts form along the **gust front** (leading edge of rain-cooled air)
	– Cells usually last **30 to 60 minutes**, system can last for **several hours**
	– May produce **hail**, **strong winds**, **brief tornadoes**, and/or **flooding**
Squall Line	– Group of storms arranged in a **line**
	– Accompanied by **squalls** of high wind and heavy rain
	– Can be **hundreds of miles long**, but **10-20 miles wide**
	– Less likely to produce **tornadoes** than **supercells**
Supercell	– Long-lived (greater than **1 hour**), highly organized storms
	– Features a **tilted rotating updraft** (mesocyclone), which can extend up

Thunderstorm Type	Features
	to **10 miles in diameter**
	– Can lead to violent **tornadoes** (most large tornadoes come from supercells)
Bow Echo	– Radar signature of squall line that **"bows out"**
	– May indicate **high winds** in the middle of the line, with possible **brief tornadoes**
	– Often evolves into a **comma-shaped storm complex**
Mesoscale Convective System (MCS)	– Collection of thunderstorms that act as a system
	– Can cover an entire **state** and last **more than 12 hours**
	– Includes subtypes like **Mesoscale Convective Complex (MCC)** and **Mesoscale Convective Vortex (MCV)**
Derecho	– Long-lived wind storm associated with a band of rapidly moving thunderstorms
	– Produces **straight-line wind damage** along a swath
	– By definition, **extends over 240 miles** and **wind gusts of 58 mph** or more

PRELIMS QUESTION:

Q.1. Which of the following conditions are prerequisites for the formation of Fog?

1. Cooling of air
2. Low humidity,
3. Light Calm winds
4. Clear skies
5. High temperature

Select the correct answer using the code given below:

(a). 1, 2 and 3 Only

(b). 1, 3, and 4 Only

(c). 2, 4, and 5 Only

(d). 3, 4 and 5 Only

ANSWER: b

Q.2. The term 'Mesoscale Convective System (MCS) ' is sometimes mentioned in the news in the context of:

(a) Climate change

(b) Urban Heat Island Effect

(c) Landslides

(d) Thunderstorms

ANSWER: d

Munde Dhananjay Navnath

INVESTMENT LANDSCAPE IN INDIA

WHY IN THE NEWS?

India's investment landscape is evolving, with a recent State Bank of India (SBI) report highlighting key trends. The report shows a rise in private sector contributions and underscores the growing importance of External Commercial Borrowings (ECBs) in corporate financing. These developments reflect increasing confidence in the Indian economy and greater access to foreign capital. As India seeks stronger economic growth and global integration, understanding these trends is crucial for businesses, investors, and policymakers.

WHAT IS INVESTMENT?

An investment is an asset or item acquired to generate income or gain appreciation. Appreciation is the increase in the value of an asset over time. It requires the outlay of a resource today, like time, effort, and money, for a greater payoff in the future, generating a profit.

Types of Investments

1. Stocks: Also called equities or shares, stocks represent ownership in a company and offer the potential for growth through price appreciation and dividends.

2. Bonds: Bonds are debt securities where you lend money to a government or corporation in exchange for regular interest payments and the return of the principal amount at maturity.

3. Mutual Funds: These pool money from multiple investors to invest in a diversified portfolio of assets, such as stocks, bonds, or a mix of both.

4. Real Estate: Involves purchasing properties for investment, either for rental income or potential appreciation in value over time.

5. Life Insurance Plans: These policies not only provide financial protection for loved ones but can also serve as an investment, building cash value over time.

6. Retirement Plans: These long-term investments, such as pension plans or 401(k)s, help individuals save and grow their money for retirement, often with tax advantages.

STATITICS ON INVESTEMENT IN INDIA:

Category	Details
FDI Inflows	**FY2022**: $84 billion (historic high) **FY2023**: Strong inflows (official figures pending)
FDI by Sector	**Top sectors**: Services (20-25%), IT (software & hardware), Automobiles (including EVs), Construction
FDI by Country	**Top investors**: Singapore (25-30%), Mauritius, US (IT, infrastructure, manufacturing)
Foreign Portfolio Investment (FPI)	**FY2022**: $9.5 billion in inflows

Category	Details
Infrastructure Investments	**National Monetization Pipeline (NMP)**: Rs. 6 lakh crore (US$ 75.18 billion) over 4 years Ongoing investments in roadways, railways, airports
Domestic Investment	**Venture Capital**: Indian startups raised $24 billion in 2022

GOVT. INITIATIVES TO PROMOTE INVESTMENT:

1. Production Linked Incentive (PLI) Scheme: Launched across 14 sectors, such as electronics, textiles, and pharmaceuticals, this scheme has attracted significant investments, including over Rs. 12,000 crore (US$ 1.5 billion) in the electronics sector alone.

2. Ease of Doing Business Reforms: India's ranking improved from 142 in 2015 to 63 in 2020 in the World Bank's Doing Business Report, reflecting regulatory reforms that make it easier to invest and do business in India.

3. FDI Policy Reforms: The government has liberalized FDI policies, allowing 100% FDI in many sectors through the automatic route. This has made India more attractive to global investors.

4. National Monetization Pipeline (NMP): Launched to monetize central government assets, the NMP targets investments worth Rs. 6 lakh crore (US$ 75.18 billion) over a four-year period.

5. Foreign Investment Facilitation Portal (FIFP): An online platform designed to streamline the approval process for foreign direct investment (FDI), improving transparency and reducing delays.

6. Sector-Specific FDI Caps: The government has raised FDI caps in sectors like defence (up to 74% through the automatic route) and relaxed FDI norms in areas such as civil aviation and retail.

7. Support for Infrastructure Development: Initiatives like the National Logistics Policy and the continued interest-free loan for state governments aim to stimulate investment in infrastructure projects.

8. Startup Ecosystem Support: The government has encouraged startup growth through various schemes and incentives, leading to India becoming the third-largest startup ecosystem globally with over 100 unicorns.

9. Tax Incentives and Reductions: Corporate tax rates have been reduced, and measures like the Goods and Services Tax (GST) have streamlined taxation, enhancing India's investment appeal.

ROLE OF INVESTMENT IN ECONOMIC GROWTH:

1. Capital Formation: Investment is a key driver of capital formation, which leads to the creation of new infrastructure, machinery, and technology.

2. Job Creation: Investments, especially in industries like manufacturing, construction, and services, create new job opportunities. This leads to reduced unemployment, higher incomes, and an improvement in living standards.

3. Increased Productivity: Investment in new technologies, equipment, and skills enhances productivity in both the short and long term. This helps businesses become more competitive, reducing costs and improving the quality of goods and services.

4. Innovation and Technological Advancement: Investment, particularly in research and development (R&D), drives innovation and technological advancements.

5. Infrastructure Development: Investment in infrastructure (roads, railways, airports, energy, etc.) is crucial for economic growth. It reduces transportation and communication costs, connects markets, and improves the efficiency of the economy.

6. Foreign Direct Investment (FDI): FDI brings in foreign capital, which boosts the domestic economy, introduces new technologies, and creates employment.

7. Private Sector Growth: Investment fosters the growth of the private sector by enabling businesses to expand, diversify, and innovate. This leads to greater competition, which in turn improves product quality and services.

8. Government Revenue: Higher levels of investment contribute to greater economic output, which generates higher tax revenues for the government.

WHAT ARE THE ISSUES HAUNTING INVESTMENT IN INDIA?

1. Regulatory Complexities: While significant reforms have been made, the regulatory environment can still be cumbersome and slow-moving in some areas, deterring potential investors.

2. Land Acquisition Issues: Land acquisition for large projects continues to be a challenge, particularly with bureaucratic delays, legal hurdles, and protests from local communities.

3. Infrastructure Gaps: Despite improvements, infrastructure gaps persist, especially in rural and semi-urban areas. Poor infrastructure increases logistics costs, making it difficult for businesses to remain competitive.

4. Labour Laws and Skill Mismatch: While labour laws have been rationalized, implementation issues remain. Additionally, there is a skill mismatch between what industries require and the skills available in the workforce.

5. Taxation Uncertainty: Although tax rates have been lowered, periodic changes in tax policies and the complexity of the Goods and Services Tax (GST) can create uncertainty for investors.\

6. Political and Economic Instability: Fluctuations in policy or political instability at state or national levels can cause concerns for long-term investors, leading to hesitation in making major commitments.

7. Access to Finance for Small and Medium Enterprises (SMEs): While large corporations may find financing opportunities relatively easier, SMEs often struggle to access funds due to stringent criteria and high interest rates.

WAY FORWARD

1. Improved Regulatory Environment: The government needs to continue simplifying regulations, addressing loopholes, and offering more clarity to reduce the uncertainty for investors.

2. Infrastructure Upgrades: Focus on modernizing and expanding infrastructure to lower business costs and improve connectivity across the country.

3. Simplification of Land Acquisition: A more efficient, transparent, and predictable process for acquiring land for businesses will foster investment, especially in infrastructure and manufacturing sectors.

4. Promoting Skill Development: Collaboration between the government, industry, and educational institutions to better align skills training with the needs of the economy can help address labour shortages and productivity gaps.

5. Stable Tax Regime: The government should work towards ensuring that tax policies are stable, transparent, and investor-friendly to instil greater confidence among investors.

6. Support for SMEs: Offering targeted financial assistance and incentivizing investment in SMEs can help broaden the base of the economy and provide greater employment opportunities.

7. Regional Balance: Focus on promoting investments in underdeveloped regions to ensure inclusive growth and reduce the urban-rural divide.

CONCLUSION

India's investment landscape has shown significant improvement in recent years, thanks to reforms in FDI policies, infrastructure development, and initiatives like the Production Linked Incentive (PLI) Scheme. With

continued focus on improving regulatory efficiency, addressing infrastructure gaps, and supporting small and medium businesses, India can unlock its full investment potential. For both domestic and foreign investors, India presents vast opportunities for growth, innovation, and long-term economic development. However, overcoming the existing challenges and making necessary adjustments will be key to ensuring sustained growth in the years to come.

PRELIMS QUESTION:

Q. With reference to India's investment landscape, consider the following statements:

1. India recorded a historic FDI inflow of $84 billion in FY2022, with services and IT sectors receiving the largest share of investments.

2. The National Monetization Pipeline (NMP) targets Rs. 6 lakh crore (US$ 75.18 billion) worth of investment in infrastructure assets over five years.

3. Foreign Portfolio Investments (FPI) into India reached $24 billion in FY2022, driven by strong domestic growth and reforms in financial markets.

How many of the above-given statements are correct?

A. Only one
B. Only two
C. All three
D. None
Answer: B

MAINS QUESTION:

Q. Discuss the challenges that India faces in attracting and retaining investments, especially in sectors like infrastructure, defence, and technology. Suggest policy measures to address these challenges and ensure sustainable growth in these sectors. (250 words, 15 marks)

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