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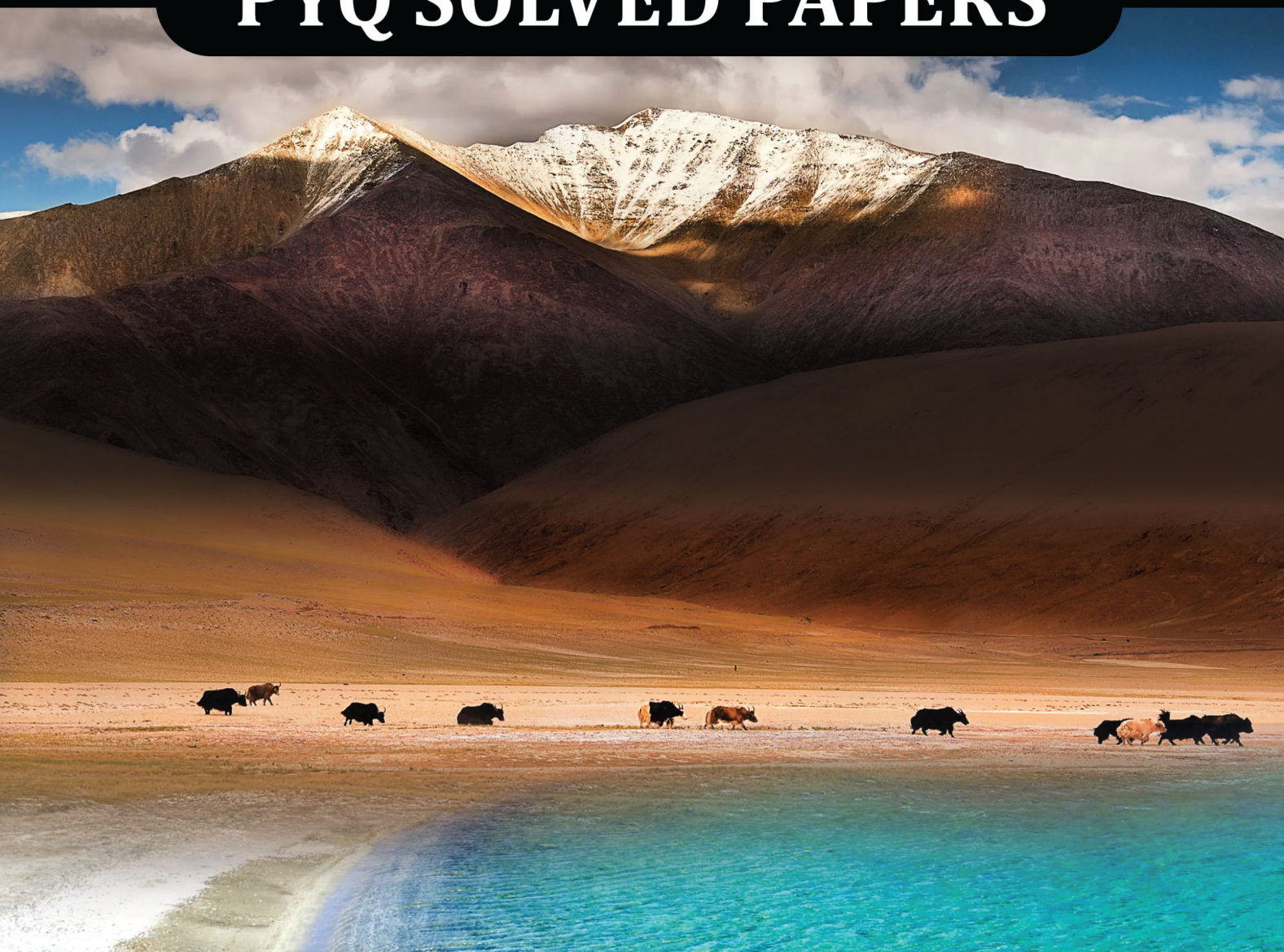
IAS Mains Q&A

10 Years (2016-2025)

GEOGRAPHY

TOPICWISE

PYQ SOLVED PAPERS



Topic-wise
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PYQ Solved Papers

This book features 10 years (2016–2025) of topic-wise solved papers for Geography Optional IAS Mains. With detailed solutions strictly aligned to the UPSC syllabus, it helps aspirants master PYQs for Civil Services and State PSC examinations.

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Edited by **- N.N. Ojha**
Guiding Civil Services Aspirants Since 36 Years
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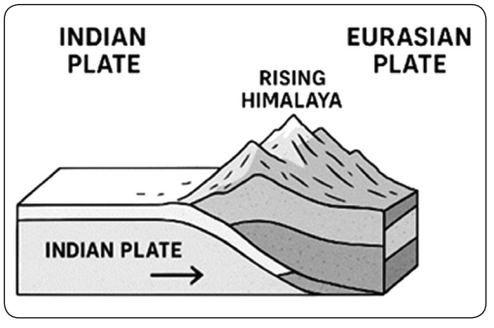
1

GEMORPHOLOGY

Q. "The Himalaya is still rising", expand this statement and describe the process involved in it with suitable sketches and examples.
(CSE-2025)

Ans: The Himalayas, Earth's youngest and tallest mountain range, are actively rising due to the ongoing collision between the Indian and Eurasian tectonic plates. This process began around 50 million years ago and continues today, making the Himalayas a dynamic and evolving orogenic system.

This process is reinforced by both tectonic uplift and geological phenomena such as isostatic rebound, and is validated by recent geoscientific research and GPS measurements.



Tectonic Mechanism Behind the Uplift

The Indian Plate is still moving northward at a rate of approximately 4–5 cm per year, subducting beneath the Eurasian Plate. This convergence causes:

i. **Crustal shortening and thickening**
ii. **Thrust faulting**, especially along the **Main Himalayan Thrust (MHT)**
iii. Vertical uplift, particularly in the Higher Himalayas

The ongoing deformation is evident in frequent seismic activity, including major earthquakes like the 2015 Nepal quake, which are direct results of accumulated tectonic stress.

Geological and Geophysical Evidence

- **Fossil records** found near the summit of Mount Everest (e.g., marine limestone with fossil shells) indicate that the region was once under the ocean, confirming dramatic uplift.
- **GPS and satellite data** show measurable vertical movement in parts of the Himalayas, especially in Nepal and Arunachal Pradesh.
- **Sedimentary records** from the Bengal Basin reflect the deflection of rivers like the Brahmaputra due to rising terrain.
- **Exhumation of metamorphic rocks** such as the Vaikrita Group and Higher Himalayan Crystallines suggests deep crustal material is being pushed upward.

Climate and Environmental Implications

The rising Himalayas influence regional and global climate patterns:

- They act as a barrier to monsoon winds, creating distinct wet and dry zones.
- Orographic uplift leads to enhanced rainfall on the southern slopes and rain shadows in the north.
- The uplift contributes to glacial formation, which feeds major rivers like the Ganga, Brahmaputra, and Indus.

The statement "The Himalaya is still rising" is not metaphorical—it's a scientific fact supported by tectonic, geological, and geophysical evidence. This ongoing uplift shapes not only the landscape but also the climate, hydrology, and seismic risk of South Asia. It's a vivid reminder that Earth's surface is alive, constantly reshaped by forces deep within the planet. The UN Decade on Ecosystem Restoration stands as a defining moment in global environmental policy, emphasizing that restoration is not merely a corrective measure but a proactive investment in planetary health and human prosperity.

Q. What is solifluction? what are its impacts?
(CSE-2025)

Ans: Solifluction is a widespread phenomenon in the alpine and subalpine ecotones of high mountain areas and in polar and sub-polar region. It is a distinctive type of periglacial mass wasting in both non-permafrost and permafrost settings.

Rates and processes of solifluction depend on climate, hydrology, geology, sedimentology, topography, and vegetation. Understanding and predicting the evolution of periglacial landforms related to solifluction

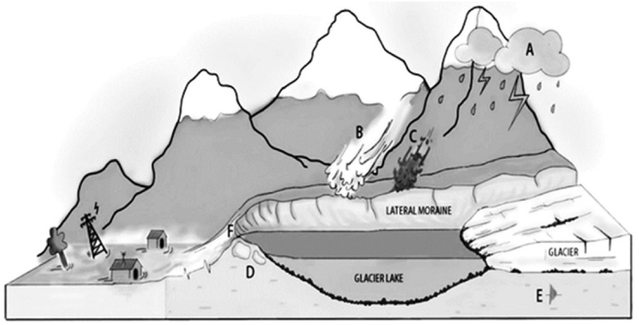
2

CLIMATOLOGY

Q. Explain the causes of glacial lake outburst flood. (CSE-2025)

Ans: Sudden releases of water from a glacial lake, commonly referred to as glacial lake outburst floods (GLOFs), have become characteristic of climate change in many mountain areas throughout the world.

- GLOFs are described as low-frequency, high-magnitude events with major geomorphic consequences, extreme hydrological characteristics and possibly adverse impacts on societies.
- Glacial lake outburst floods (GLOFs) are among the most concerning consequences of retreating glaciers in mountain ranges worldwide.
- GLOFs have attracted significant attention amongst scientists and practitioners in the past two decades, with particular interest in the physical drivers and mechanisms of GLOF hazard and in socio-economic and other human-related developments that affect vulnerabilities to GLOF events.



Various Reasons for GLOF (Glacial Lake Outburst Flood) Occurrence: (A) Cloudburst, (B) Snow Avalanche, (C) Landslide, (D) Melting of Ice in Moraine, (E) Earthquake, (F) Overflow

Causes of GLOFs

- **Climate Change:** Accelerated glacial retreat due to global warming increases the number and size of glacial lakes.
- **Weak Moraine Dams:** Natural dams are structurally unstable and prone to collapse under pressure.
- **Avalanches & Landslides:** Sudden mass movements into lakes can trigger overflow.
- **Seismic Activity:** Earthquakes can destabilize lake boundaries.
- **Heavy Rainfall or Rapid Snowmelt:** Increases water volume and pressure on the dam.

Consequences

- **Loss of Life & Property:** Sudden floods devastate downstream communities.
- **Infrastructure Damage:** Roads, bridges, and hydropower projects are vulnerable.
- **Environmental Impact:** Alters river morphology and aquatic ecosystems.

GLOFs represent a growing threat in the context of climate change and Himalayan vulnerability. A multi-pronged approach—combining technology, policy, and community resilience—is essential to mitigate their impact and safeguard lives and livelihoods.

Q. Examine the distribution and balance of energy in the Earth's atmosphere system. (CSE-2025)

Ans: The distribution and balance of energy in Earth's atmospheric system is a fundamental process that governs the planet's climate, weather, and ecological stability. This system operates as a global heat engine, driven primarily by solar radiation and regulated through complex interactions between the atmosphere, oceans, land surfaces, and space.

Solar radiation is the primary source of energy, arriving at the top of the atmosphere. However, this energy is not evenly distributed—equatorial regions receive more direct sunlight than the poles due to the curvature and tilt of the Earth.

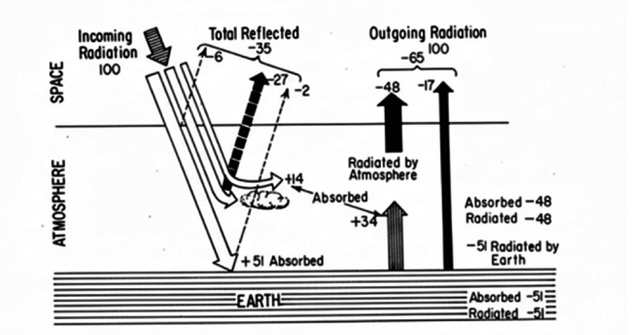


***Figure**: Heat Budget (balance between insolation and terrestrial radiation)*

3

OCEANOGRAPHY

Q. What is deep-sea mining? What are the potential benefits and risks associated with it? (CSE-2025)

Ans: Deep Sea Mining (DSM) refers to the extraction of mineral resources from the ocean floor, typically at depths beyond 200 meters.

It targets three primary types of deposits:

i. **Polymetallic Nodules:** Rich in manganese, nickel, copper, and cobalt, found on abyssal plains.
ii. **Cobalt-rich Crusts:** Located on seamounts, containing cobalt, platinum, and rare earth elements.
iii. **Seafloor Massive Sulphides (SMS):** Formed at hydrothermal vents, rich in copper, gold, silver, and zinc.

Potential Benefits of Deep Sea Mining

- **Resource Security:** DSM offers access to critical minerals essential for renewable energy technologies, electric vehicles, and electronics, reducing dependence on terrestrial sources.
- **Economic Opportunity:** Countries with limited land-based mineral reserves can benefit from marine resources, potentially boosting GDP and employment.
- **Reduced Land Degradation:** Compared to terrestrial mining, DSM may reduce deforestation, displacement, and land pollution.
- **Technological Advancement:** Stimulates innovation in underwater robotics, remote sensing, and environmental monitoring.
- **Precautionary Principle:** Until comprehensive ecological assessments are available, DSM should proceed cautiously.
- **Strengthening ISA Protocols:** Robust environmental impact assessments (EIAs), transparent monitoring, and stakeholder engagement are essential.
- **Investment in Research:** Deep-sea biodiversity, ecosystem services, and long-term impacts must be studied before large-scale exploitation.
- **Global Cooperation:** Equitable sharing of benefits and responsibilities among nations is vital to avoid resource conflicts.
- **Scientific Discovery:** DSM expeditions contribute to marine biology, geology, and climate science.

Risks and Challenges

- **Ecological Disruption:** DSM threatens fragile deep-sea ecosystems that are poorly understood and slow to recover. Mining activities can destroy habitats, alter sediment composition, and disrupt species interactions.
- **Biodiversity Loss:** Many deep-sea organisms are endemic and may face extinction before being scientifically documented.
- **Sediment Plumes:** Mining generates plumes that can smother marine life, reduce light penetration, and affect filter feeders over large distances. These can travel hundreds of kilometers, smothering benthic organisms and disrupting filter feeders.
- **Habitat Destruction:** Mining polymetallic nodules and sulphides can permanently alter seafloor habitats.
- **Slow Recovery Rates:** MIDAS research shows that deep-sea habitats may take decades—or longer—to recover from mining disturbances.
- **Species Extinction:** Many deep-sea species are endemic and poorly studied. Mining could lead to irreversible biodiversity loss before species are even documented.
- **Noise and Light Pollution:** Disturbs marine fauna, especially species adapted to dark, quiet environments.
- **Regulatory Gaps:** Despite ISA's framework, enforcement and environmental safeguards remain weak, especially in national waters.
- **Technological and Economic Uncertainty:** High costs, engineering challenges, and fluctuating metal prices make DSM commercially risky.
- **Geopolitical Leverage:** Nations with DSM capabilities may gain strategic control over future mineral supply chains.

4

BIOGEOGRAPHY

Q. Analyze the spatial patterns and regional specialization of plantation crops across tropical and subtropical regions.

(CSE-2025)

Ans: Plantation agriculture, characterized by large-scale, monocultural production of cash crops, exhibits distinct spatial patterns and regional specialization across tropical and subtropical zones.

These regions, defined by warm temperatures, high humidity, and seasonal rainfall, provide ideal agro-climatic conditions for crops such as oil palm, rubber, tea, coffee, sugarcane, and cocoa.

- The spatial distribution of these crops is not random but closely tied to environmental suitability, colonial legacies, and global market demands.

Spatial Patterns

Latitudinal Zonation

- **Equatorial Belt (within ~10° of the equator):** This zone, characterized by high temperatures, abundant rainfall year-round, and high humidity, is ideal for crops like rubber (e.g., Southeast Asia), oil palm (e.g., Southeast Asia, West Africa), and cocoa (e.g., West Africa, parts of Latin America). These crops thrive in consistent warmth and moisture.
- **Tropical and Subtropical Margins (10-30° latitude):** As one moves away from the equator, rainfall patterns often become more seasonal, and temperature variations increase. This zone is suitable for crops that can tolerate a dry season or slightly cooler periods, such as coffee (e.g., Brazil, Colombia, Vietnam), tea (e.g., India, Sri Lanka, Kenya), and sugarcane (e.g., Brazil, India, Caribbean). Citrus plantations also flourish in these areas.

Regional Specialization Examples

Southeast Asia

- **Oil Palm:** Dominate vast tracts of land in Malaysia and Indonesia, making them the world's leading producers. The hot, humid climate and well-distributed rainfall are ideal.
- **Rubber:** Historically a major crop, especially in Malaysia and Thailand, benefiting from similar climatic conditions as oil palm.
- **Coffee & Tea:** Vietnam has emerged as a major Robusta coffee producer, while tea is significant in parts of Indonesia.

South Asia

- **Tea:** India (Assam, Darjeeling, Nilgiris) and Sri Lanka (Ceylon tea) are world-renowned for their tea plantations, often found in highlands with distinct monsoon climates.
- **Rubber:** Significant in Kerala, India.
- **Sugarcane:** Extensive cultivation across the Indo-Gangetic plains of India.

West Africa

- **Cocoa:** Côte d'Ivoire and Ghana are the largest global producers, relying on the hot, humid climate of the equatorial belt.
- **Oil Palm:** Major producer in Nigeria and other West African countries, where the crop is indigenous.
- **Rubber:** Also grown in countries like Liberia and Nigeria.

Latin America & Caribbean

- **Coffee:** Brazil is the world's largest producer (both Arabica and Robusta), followed by Colombia (famous for Arabica in highland regions).
- **Sugarcane:** Brazil is the largest global producer, with vast plantations primarily in the São Paulo region and Northeast.
- **Bananas:** Central American countries (e.g., Ecuador, Costa Rica) and the Caribbean are major exporters, often grown in coastal lowlands.
- **Cocoa:** Significant in countries like Ecuador and Brazil.

East Africa

- **Tea:** Kenya is a major exporter, with plantations in high-altitude areas.
- **Coffee:** Ethiopia is the birthplace of Arabica coffee and a significant producer, as are Uganda and Kenya.

These spatial patterns reflect not only climatic suitability but also historical and economic forces. Colonial powers established many of these plantations to serve European markets, creating enduring

5

ENVIRONMENTAL GEOGRAPHY

Q. Man and wildlife conflicts are ever increasing. Discuss its causes, consequences and remedies. (CSE-2025)

Ans: Human-wildlife conflict is defined when actions from either side harm the other party. Man-wildlife conflict refers to interactions between humans and wild animals that result in negative outcomes for either or both parties—such as injury, death, crop damage, livestock loss, or retaliatory killing of wildlife.

These conflicts typically arise when expanding human activities—like agriculture, infrastructure, and settlement—encroach upon natural habitats. Wildlife, in turn, may enter human spaces in search of food, water, or territory, leading to competition and confrontation.

Causes

- **Habitat Loss and Fragmentation:** Expansion of agriculture, infrastructure, and urbanization leads to shrinking and fragmented wildlife habitats, forcing animals into human-dominated landscapes.
- **Resource Competition:** Wildlife competes with humans for food, water, and space. For example, elephants raid crops due to loss of foraging grounds.
- **Climate Change:** Altered rainfall patterns and temperature shifts affect migration and feeding behaviour, increasing encounters with humans.
- **Poor Land Use Planning:** Settlements near protected areas and corridors increase the likelihood of conflict.
- **Attractive Nuisance:** Improper waste disposal and livestock grazing near forests attract carnivores and scavengers.

Consequences

- **Loss of Human Life and Property:** Attacks by large mammals like tigers and elephants cause fatalities and damage to crops and homes.
- **Retaliatory Killings:** Fear and economic loss often lead to revenge killings of wildlife, threatening endangered species.
- **Psychological and Economic Stress:** Communities living near forests suffer anxiety, reduced income, and disrupted livelihoods.
- **Conservation Backlash:** Negative perceptions of wildlife hinder conservation efforts and reduce local support.

Remedies

- **Habitat Restoration and Buffer Zones:** Reforestation and creation of buffer zones reduce animal movement into human areas.
- **Community Engagement:** Involving locals in conservation and providing alternative livelihoods fosters coexistence.
- **Early Warning Systems and Technology:** Use of GPS collars, camera traps, and mobile alerts can prevent surprise encounters.
- **Compensation and Insurance Schemes:** Timely and fair compensation for losses builds trust and reduces retaliation.
- **Physical Barriers and Deterrents:** Fencing, bio-fencing, and livestock guarding dogs help minimize intrusions.

Man-wildlife conflict is a complex socio-ecological issue requiring integrated solutions. A balancing human development with ecological integrity demands participatory governance, scientific innovation, and sustained investment in conservation. These conflicts are shaped by social, cultural, and psychological factors, and often reflect deeper systemic issues like inequality, governance failures, and unsustainable consumption patterns. So, man-environment conflict is not just a physical clash—it's a socio-ecological crisis that demands integrated solutions combining science, policy, and community engagement.

Q. What are the ecological consequences of agricultural deforestation in the Amazon and Congo basins, particularly concerning biodiversity and climate regulation? (CSE-2025)

Ans: Agricultural deforestation—clearing forests for crop cultivation and livestock grazing—is among the most ecologically disruptive land-use changes on Earth. Its impacts are particularly severe in tropical rainforests like the Amazon and Congo Basins, which act as global biodiversity reservoirs and climate regulators. The ecological consequences manifest through biodiversity loss, disruption of climate regulation, hydrological imbalance, soil degradation, and long-term ecosystem destabilization.

6 PERSPECTIVES IN HUMAN GEOGRAPHY

Q. Analyze the role of language and religion in delineating major cultural regions of the world. (CSE-2025)

Ans: Cultural regions are spatial units defined by shared traits such as language, religion, customs, and historical experiences. Among these, language and religion are two of the most potent forces shaping cultural identity and territorial boundaries. They serve not only as markers of group identity but also as instruments of social cohesion, political mobilization, and cultural continuity.

Language as a Cultural Delineator

- Language is more than a medium of communication—it is a repository of cultural values, traditions, and collective memory. It defines how communities perceive the world and interact with it.
- Language regions often exhibit cultural homogeneity, with shared folklore, literature, and historical narratives.
- Example: The Francophone world (French-speaking regions) shares linguistic ties that foster cultural and political cooperation across Europe, Africa, and the Americas.
- In multilingual countries like India, language delineates subnational cultural regions.

Example: Tamil Nadu, Punjab, and West Bengal—each with distinct linguistic identities that shape local governance and cultural expression.

- Language also serves as a boundary marker.

Example: The division between Germanic and Romance languages in Europe, for instance, corresponds to broader cultural and historical divides.

Religion as a Spatial and Cultural Force

Religion plays a central role in shaping cultural regions by influencing values, rituals, architecture, and social norms.

- Religious regions often transcend national borders. For example:
  - The Islamic world spans North Africa, the Middle East, and parts of Asia, unified by religious practices, Arabic script, and shared historical narratives.
  - The Christian cultural region includes Europe, the Americas, and parts of Africa, with sub-regional distinctions between Catholic, Protestant, and Orthodox traditions.
  - Hinduism, largely concentrated in South Asia, defines cultural practices and spatial organization in India and Nepal.
- Religious language also reinforces cultural boundaries. Arabic, for instance, is not only a spoken language but also a sacred one in Islam, used in Qur'anic recitations and religious scholarship.

Interplay and Conflict

Language and religion often intersect, reinforcing cultural boundaries but also sparking conflict:

- Linguistic and religious identities can overlap to form strong ethno-religious regions, such as Arabic-speaking Islamic regions **or** Spanish-speaking Catholic regions.
- In contrast, mismatches—like linguistic diversity within a single religious group—can lead to internal tensions, as seen in multilingual Islamic societies or Christian denominations across linguistic lines.
- Political manipulation of language and religion has historically led to cultural fragmentation, as noted in the HRMARS study, which discusses how linguistic conflict can fuel religious discord.

Language and religion are foundational to the delineation of cultural regions across the globe. They shape collective identities, influence territorial organization, and foster both unity and division. While they have historically served as tools for cultural preservation and regional cohesion, they also pose challenges in multicultural and globalized contexts. Understanding their spatial dynamics is essential for navigating cultural geopolitics and promoting intercultural dialogue. Religious communities often cluster geographically, creating spatially distinct cultural landscapes—such as the Sikh-majority Punjab, the Muslim-dominated Kashmir Valley, or the Christian heritage of Goa.

The interplay between language and religion can reinforce cultural boundaries, as seen in regions where sacred languages like Arabic, Sanskrit, or Hebrew serve

7

ECONOMIC GEOGRAPHY

Q. Why is oil important for energy security? What is the role of oil in clean energy transition? (CSE-2025)

Ans: Oil has long been the backbone of the global energy system, powering transportation, industry, and defense with unmatched energy density and reliability. Despite growing momentum toward renewable energy, oil remains deeply embedded in national energy strategies due to its strategic value and vast infrastructure.

As the world grapples with climate change and geopolitical instability, the dual challenge emerges: maintaining energy security while accelerating the shift to cleaner energy sources. This tension places oil at the center of a complex transition—one where its continued relevance must be balanced against the urgent need for decarbonization.

Understanding oil's role in both securing energy supply and enabling the clean energy shift is essential for crafting resilient and sustainable energy policies.

Why oil is crucial for energy security?

Oil remains central to energy security due to its unique characteristics and entrenched infrastructure:

- **High Energy Density:** Oil provides more energy per unit than most alternatives, making it ideal for transport, industry, and defense.
- **Global Infrastructure:** A century-old network of pipelines, refineries, and shipping routes ensures reliable distribution and storage.
- **Strategic Reserves:** Many countries maintain emergency oil stockpiles to buffer against supply disruptions caused by geopolitical tensions, sanctions, or natural disasters.
- **Economic Stability:** Oil powers key sectors—aviation, shipping, manufacturing—so any disruption can trigger inflation, trade imbalances, or national security risks.
- **Flexibility in Supply Chains:** Oil's global trading system allows countries to diversify import sources and adapt quickly to market shifts.

Role of Oil in Clean Energy Transitions

Though oil is a fossil fuel, it plays a transitional and strategic role in the shift toward cleaner energy:

- **Bridge Fuel:** Oil continues to support energy systems while renewables scale up. For example, aviation and shipping still rely heavily on oil-based fuels.
- **Revenue for Renewables:** Oil-exporting nations are increasingly using oil revenues to invest in solar, wind, hydrogen, and carbon capture technologies.
- **Decarbonization Innovation:** Oil companies are developing low-carbon solutions like biofuels, carbon capture and storage (CCS), and efficiency improvements.
- **Market Lessons:** The oil market's resilience—through strategic reserves and global trading—offers models for managing critical minerals like lithium and cobalt in renewable supply chains.
- **Gradual Demand Decline:** While oil demand is projected to peak in the 2030s, it will remain part of the energy mix for decades, especially in developing economies.

Balancing Act

The challenge lies in managing the dual role of oil: ensuring short-term energy security while accelerating long-term sustainability. As the International Energy Agency notes, oil supply disruptions will remain a risk even as demand declines.

Therefore, governments and industries must navigate this transition carefully—scaling renewables without destabilizing energy systems.

So, oil remains a cornerstone of global energy security due to its unmatched energy density, established infrastructure, and strategic importance in powering critical sectors like transportation and industry. Even as the world moves toward cleaner energy systems, oil continues to play a transitional role—supporting economic stability, enabling technological innovation, and providing a financial bridge for investments in renewables.

However, its long-term sustainability is challenged by environmental concerns and the urgent need to decarbonize. Navigating this dual role requires careful policy planning, international cooperation, and a balanced approach that ensures reliable energy access while accelerating the shift to a low-carbon future.

8 POPULATION & SETTLEMENT GEOGRAPHY

Q. "Pull factors in internal migration are often based on perceptions rather than reality". Explain (CSE-2025)

Ans:

Pull Factors

Pull factors in internal migration—such as the allure of better employment, modern infrastructure, and improved access to services—are often shaped by perception rather than grounded in reality.

Many migrants, especially from rural or underdeveloped regions, are influenced by stories from relatives, media portrayals, or social narratives that paint urban centers or industrial hubs as lands of opportunity. These perceptions create a powerful psychological pull, leading individuals to believe that migration will automatically result in upward mobility and a better quality of life.

However, upon arrival, the reality can be starkly different. Migrants may face overcrowded living conditions, informal or unstable employment, limited access to affordable healthcare and education, and social exclusion.

Push Factors

These are conditions that compel people to leave their place of origin. They often stem from hardship or lack of opportunity.

- **Economic Hardship:** Unemployment, low wages, or lack of livelihood options in rural or underdeveloped areas.
- **Environmental Stress:** Natural disasters, droughts, floods, or land degradation that make living conditions difficult.
- **Social Issues:** Caste discrimination, ethnic conflict, or lack of social mobility.
- **Poor Infrastructure:** Limited access to education, healthcare, transportation, and basic services.

Intervening Obstacles

These are barriers that can hinder or delay migration, even when push or pull factors are strong.

- **Financial Constraints:** Lack of money for travel or relocation.
- **Legal and Administrative Hurdles:** Documentation issues or lack of formal identity papers.
- **Family Obligations:** Dependents or cultural expectations that discourage leaving home.
- **Geographical Barriers:** Difficult terrain or lack of connectivity between regions.

Personal Aspirations and Social Networks

These are individual-level influences that shape migration decisions.

- **Ambition and Aspiration:** Desire for a better lifestyle, education, or career growth.
- **Peer Influence:** Friends or relatives who have migrated and share positive experiences.
- **Marriage and Family Ties:** Migration for marriage or to join family members already settled elsewhere.

Policy and Institutional Factors

Government policies and institutional support can either encourage or restrict migration.

- **Urban Development Schemes:** Programs that attract labor to cities (e.g., Smart Cities Mission).
- **Rural Employment Programs:** Initiatives like MGNREGA may reduce migration by providing local jobs.
- **Housing and Welfare Support:** Availability of affordable housing or social services in destination areas.

Q. Critically evaluate the role of primate cities in dominating the urban spheres of influence in developing countries. (CSE-2025)

Ans: Primate cities—urban centers that vastly outsize and out-power all others in a national hierarchy—play a pivotal role in shaping the urban landscape of developing countries.

These cities often emerge as dominant hubs due to historical, political, and economic centralization, exerting disproportionate influence over national development.

While they can drive economic growth and global connectivity, their overwhelming dominance frequently leads to spatial inequality, infrastructure strain, and regional underdevelopment.

9

REGIONAL PLANNING

Q. How do regional components make the regional synthesis in spatial arrangement? Explain. (CSE-2025)

Ans: Regional synthesis in spatial arrangement refers to the integration of diverse geographical elements—physical, human, economic, cultural, and political—into a coherent spatial structure that defines the identity and functionality of a region. It is a central concept in geography and regional planning, helping scholars and policymakers understand how different components interact to shape spatial patterns and regional development.

- By combining areal differentiation with systematic analysis, regional synthesis transforms fragmented geographic data into a meaningful spatial narrative, essential for regional planning, resource allocation, and sustainable development.

Key Regional Components in Spatial Synthesis

Physical Components

- Landforms, climate, soils, rivers, and vegetation form the foundational layer of spatial arrangement.
- These elements determine natural resource availability, agricultural potential, and settlement patterns.

Example*: Fertile alluvial plains with monsoon climates in northern India support dense agricultural settlements and high population densities.*

Human Components

- Population density, demographic structure, and settlement patterns influence and are influenced by the physical environment.
- Human activities adapt to and reshape the landscape, creating dynamic spatial interactions.
- **Example***: Urban sprawl around Delhi reflects demographic pressure and migration trends.*

Economic Components

- Agriculture, industry, trade, and infrastructure shape spatial organization by clustering activities around resource-rich or strategically located areas.
- Economic hubs often emerge along transport corridors or near ports, reinforcing spatial hierarchies.

Example*: Industrial belts in western India (e.g., Gujarat) align with transport networks and resource availability.*

Cultural and Political Components

- Languages, religions, traditions, governance structures, and historical legacies contribute to regional identity and influence spatial behavior.
- **Cultural landscapes—such as temple towns or pilgrimage routes—add symbolic meaning to spatial arrangements.**
- **Political boundaries and administrative divisions also affect resource distribution and planning priorities.**
- How these Components Create Regional Synthesis?
- Spatial synthesis involves intra-regional homogeneity (similarities within a region) and inter-regional heterogeneity (differences between regions).
- It helps geographers answer two core questions: "Why are things arranged this way?" and "How is this arrangement organized?".
- The synthesis allows for location-based analysis, cultural landscape interpretation, and economic system mapping, which are essential for regional planning and sustainable development.

Regional synthesis in spatial arrangement is the outcome of complex interactions among physical, human, economic, cultural, and political components. These elements do not function in isolation; rather, they coalesce to form the spatial identity and operational logic of a region. As research shows, understanding these interdependencies is vital for effective regional planning, resource management, and policy formulation. The concept of regional synthesis transforms fragmented geographic data into a holistic understanding of space—one that reflects both natural structure and human agency.

Spatial Synthesis

Spatial synthesis refers to the "complex whole made up of a number of parts unified," where the spatial organization of phenomena reflects both intra-regional homogeneity and inter-regional heterogeneity. This synthesis enables geographers to interpret the distribution, interaction, and arrangement of phenomena across space, answering the dual questions of "why" things are arranged as they are and "how" this arrangement manifests.

10 MODELS, THEORIES & LAWS IN HUMAN GEOGRAPHY

Q. Why has F. Perroux's theory of growth pole as a model of regional growth been criticized? Explain with examples. (CSE-2025)

Ans: Regional development has long been a central concern in economic geography and planning. One influential model is François Perroux's Growth Pole Theory, introduced in the 1950s, which posits that economic growth is not uniform across space but rather concentrated around dynamic centers—called growth poles. These poles are driven by large, innovative firms whose activities generate backward and forward linkages, stimulating growth in surrounding areas.

The theory has inspired regional planning strategies worldwide, particularly in developing countries seeking to accelerate industrialization and spatial equity.

However, despite its theoretical appeal, Perroux's model has faced significant criticism. Scholars argue that its assumptions often fail in practice, leading to spatial inequality, limited diffusion of benefits, and environmental and social externalities.

This critique has prompted a shift toward more inclusive and decentralized models of regional development.

Q. What is Complementary Region? With reference to hierarchy of settlements, describe the different types of complementary regions as proposed by Christaller. (CSE 2024)

Ans. A complementary region refers to the area served by a central place in terms of goods and services. It represents the spatial extent within which people depend on a central settlement for fulfilling their economic, social, and administrative needs.

- In the context of Walter Christaller's Central Place Theory (1933), complementary regions are the areas of influence of central places, determined by the type and level of services provided by settlements in a hierarchical system.

Hierarchy of Settlements in Christaller's Central Place Theory

- **Central places** are settlements that provide goods and services to the surrounding population.
- They are classified into various levels of hierarchy based on the range (maximum distance consumers are willing to travel) and threshold (minimum population required to sustain a service) of the services they offer.

Hierarchical Structure

- **Hamlets:** Lowest in hierarchy, providing basic necessities.
- **Villages:** Offer primary goods and services like groceries and small-scale markets.
- **Towns:** Provide higher-order services such as hospitals, schools, and regional markets.
- **Cities:** Offer specialized and high-order services such as universities, specialized hospitals, and government offices.

Types of Complementary Regions

- Christaller proposed different types of complementary regions, reflecting the varying spatial organization of settlements based on their functions and levels in the hierarchy.

Market Principle (K=3 System)

- **Complementary Region:** Hexagonal areas are formed around each central place to minimize the distance customers travel to access goods and services.
- Emphasis on efficient market coverage.
- Three lower-order settlements are served by one higher-order settlement.

Transport Principle (K=4 System)

- **Complementary Region:** Settlements are arranged to optimize transportation and connectivity, prioritizing linear or network routes.
- Emphasis on reducing transport costs and ensuring efficient linkages.

Administrative Principle (K=7 System)

- **Complementary Region:** The central place serves as the administrative or political hub, encompassing a larger number of settlements.
- Overlap of complementary regions is avoided to ensure clear jurisdictional boundaries.

PAPER-II

GEOGRAPHY OF INDIA

India Maps

Physical Setting

Resources

Agriculture

Industry

Transport, Communication and Trade

Cultural Setting

Settlements

Regional Development and Planning

Political Aspects

Contemporary Issues

INDIA–MAPS

Q. On the outline map of India, mark the location of all of the following. Write the significance of these locations, whether physical/commercial/economic/ecological/ environmental/cultural, in not more than 30 words each.

(i) Rushikulya River
(ii) Datar Hill
(iii) Kikruma
(iv) Choritand Tillaya
(v) Byalalu
(vi) Neyyar
(vii) Uttarlai
(viii) Sri Vijayapuram
(ix) Dharwas
(x) Gitabitan
(CSE 2025)

- **Ans.**

(i) Rushikulya River: It is one of the prominent rivers of Odisha. It originates from Daringbadi hills of the Eastern Ghats and flows into the Bay of Bengal.

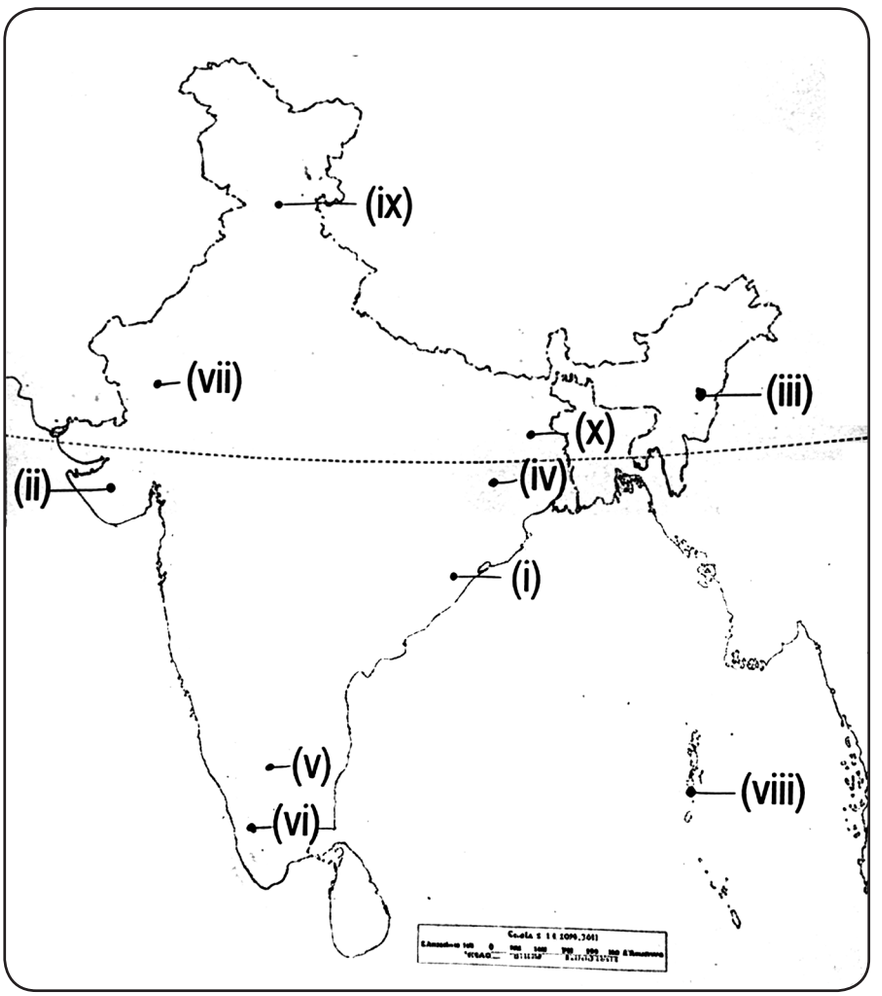
- **Tributaries:** Major tributaries include Padma, Badanadi, Baghua, and Goraharah.
- **Ecological Importance:** The river is known for its Olive Ridley turtle nesting sites, especially near its mouth.

(ii) Datar Hill: Situated near Junagadh, Gujarat, Datar Hill is part of the Girnar Hill range.

- **Spiritual Importance:** It is revered by both Hindus and Muslims. The shrine of Saint Jamiyal Shah Datar, a Sufi saint, is located at the summit.
- **Pilgrimage Site:** Devotees undertake a steep climb of over 3,000 steps to reach the shrine, especially during the annual Urs festival.

(iii) Kikruma: It is a village in Phek district of Nagaland. It is known for its traditional water management system, where locals have historically used bamboo channels to distribute water for agriculture.

- **Ecological Significance:** The village is part of the community-led conservation efforts in Nagaland, often cited in government-supported biodiversity and watershed management programs.



1

PHYSICAL SETTING

Q. Referring to the location and physical formation of karewas, highlight their economic significance. (CSE 2025)

Ans. Karewas are unique geological formations found in the Kashmir Valley, characterized by their flat-topped terraces and rich alluvial deposits.

Formed during the Quaternary period through lacustrine and glacial processes, these landforms are deeply embedded in the region's physical geography and cultural identity.

Location of Karewas

- Karewas are plateau-like terraces found primarily in the Kashmir Valley, Jammu & Kashmir.
- They occupy an area of approximately 2,500 sq km, resting over the folded Paleozoic–Mesozoic rocks of the Kashmir basin.
- Bounded by the Pir Panjal Range in the southwest and the Zanskar Range in the northeast, they lie within an intermontane basin formed by Himalayan tectonics.

Physical Formation

- Karewas are composed of unconsolidated to semi-consolidated sediments—sand, clay, silt, and conglomerates—deposited during the Quaternary period.
- These sediments were laid down in lacustrine (lake) and fluvial environments, often influenced by glacial and interglacial cycles.
- The Hirpur Formation, a lower Karewa unit, contains evidence of tropical to temperate vegetation, indicating climatic shifts during the Plio-Pleistocene era.
- Their formation is closely tied to the uplift of the Himalayas, which obstructed monsoonal flow and altered sedimentation patterns.

Economic Significance

- **Agriculture**: Karewas are highly fertile due to their rich alluvial deposits. They support cultivation of:
  - **(a) Saffron** (notably in Pampore)
  - **(b) Almonds**, **apples**, and **walnuts**
  - **(c) Barley**, **wheat**, and **vegetables**
- **Hydrocarbon Potential**: The Karewa Basin has been evaluated for **hydrocarbon exploration** due to its sedimentary structure and organic content.
- **Paleoclimatic Research**: Their stratigraphy provides valuable data for **climate reconstruction**, aiding in environmental planning and disaster risk reduction.
- **Urban Expansion**: Many **cultivated fields and settlements** in the Kashmir Valley are situated on Karewa terraces, making them central to regional development.

Beyond their geological intrigue, Karewas hold immense economic value—supporting saffron cultivation, horticulture, and even hydrocarbon exploration. Their preservation and sustainable use are vital for the ecological and agricultural resilience of the Kashmir Valley.

Q. Discuss the basis of various explanations for the formation of Shiwalik. (CSE 2024)

Ans. The Shiwalik Hills, the outermost range of the Himalayas, have formed through a combination of geological and environmental processes over millions of years.

- **Plate Tectonics:** The primary cause of the Shiwalik's formation is the collision between the **Indian Plate** and the **Eurasian Plate**. This tectonic activity, starting around 50 million years ago, led to the uplift of the Himalayas, with the Shiwalik range forming as an outer fold belt, experiencing less uplift than the central Himalayas.
- **Erosion and Sedimentation:** As the Himalayas rose, they supplied large amounts of sediment to the region. Rivers flowing from the higher Himalayas deposited sediments in a **foreland basin**, forming conglomerate rocks. Over time, these sediments compacted to create the Shiwalik range.
- **Gravitational Collapses and Landslides:** The steep slopes of the Shiwaliks are prone to **landslides** and **mass wasting**, which continue to shape the landscape. These processes contribute to erosion and the alteration of the terrain.
- **Foreland Basin Formation:** The collision of the Indian and Eurasian Plates created a **foreland**

2

RESOURCES

Q. Why are coral reefs in India most important with respect to its dynamic ecosystem? Explore. (CSE 2025)

Ans. Coral reefs in India—found in regions like the Gulf of Mannar, Lakshadweep, Gulf of Kutch, and Andaman & Nicobar Islands—are among the most biologically rich ecosystems on Earth.

These reefs not only support marine biodiversity but also regulate coastal processes, making them indispensable to India's ecological and economic stability.

India hosts fringing reefs (Gulf of Mannar, Gulf of Kutch), atolls (Lakshadweep), and barrier reefs (Andaman & Nicobar Islands), each with distinct ecological roles. Coral reefs form over millions of years through the accumulation of calcium carbonate skeletons of coral polyps. These reefs evolve into coral islands, such as those seen in Lakshadweep.

- **Coral Bleaching Monitoring:** The Indian National Centre for Ocean Information Services (INCOIS) provides coral bleaching alerts and monitors marine heatwaves, helping predict stress events and guide conservation efforts.
- **Legal Protection:** Coral species are listed under Schedule I of the Wildlife Protection Act, 1972, granting them the highest level of legal protection in India.
- **Restoration Efforts:** The Zoological Survey of India (ZSI) and Central Marine Fisheries Research Institute (CMFRI) are actively involved in coral transplantation, resilience studies, and long-term reef monitoring programs.

Ecological Importance of Coral Reefs in India

- **Biodiversity Hotspots:** Coral reefs host thousands of marine species including fish, mollusks, crustaceans, sponges, and algae, rivaling tropical rainforests in biodiversity. They serve as nurseries for fish, supporting both subsistence and commercial fisheries.
- **Coastal Protection:** Reefs act as natural breakwaters, absorbing wave energy and protecting shorelines from erosion, storms, and tsunamis. This function is critical for low-lying islands like Lakshadweep, where coral atolls buffer human settlements.
- **Climate Regulation and Carbon Cycling:** Coral reefs contribute to carbon sequestration through calcium carbonate deposition. They also influence local oceanic temperature and salinity, playing a role in broader climate dynamics.
- **Livelihood and Tourism:** Coral ecosystems support eco-tourism, diving, and recreational fishing, especially in Andaman & Nicobar Islands and Goa. They provide income to coastal communities, particularly in regions like the Gulf of Mannar, where reef-based fisheries are vital.
- **Scientific and Educational Value:** Reefs are key sites for marine research, climate studies, and biodiversity monitoring. Institutions like ZSI and CMFRI conduct long-term coral reef monitoring and restoration programs.

Threats and Conservation Measures

- Coral bleaching, driven by rising sea surface temperatures, has been observed in Lakshadweep and other regions.
- Sedimentation, pollution, and destructive fishing practices continue to degrade reef health.
- Government interventions include:
- Coral transplantation and restoration under the Integrated Island Management Plan.
- Legal protection under Schedule I of the Wildlife Protection Act, 1972.
- CRZ Notification 2019, which restricts harmful activities in ecologically sensitive areas.

India's coral reefs are ecological keystones—supporting biodiversity, protecting coastlines, and sustaining livelihoods.

Their dynamic role in marine and coastal ecosystems makes their conservation not just an environmental priority, but a socio-economic imperative. Strengthening reef resilience through science-based management and community engagement is essential for long-term sustainability.

3

AGRICULTURE

Q. Examine the validity of Blue Economy initiatives of India. Elaborate the impacts of this economy on country's development.
(CSE 2025)

Ans. According to the Ministry of Earth Sciences, the Blue Economy is: "The sustainable use of ocean resources for economic growth, improved livelihoods, and jobs while preserving the health of ocean ecosystems."

This concept integrates coastal and marine activities such as fisheries, aquaculture, maritime transport, renewable energy, tourism, and deep-sea mining, with a strong emphasis on environmental sustainability and inclusive development.

The Indian Council of Agricultural Research (ICAR) further elaborates that the Blue Economy includes: "Fisheries and aquaculture, biotechnology, marine biodiversity, renewable energy, shipping, ports, maritime logistics, and coastal tourism, all contributing to economic growth through sustainable ocean-based trade."

India's Blue Economy initiatives represent a strategic pivot toward harnessing oceanic resources for sustainable growth. Based on official government publications and research from institutions like ICAR and ICRISAT, these initiatives are not only valid but increasingly central to India's long-term development strategy.

India's Blue Economy Initiatives

- India's Blue Economy framework is grounded in policy, investment, and innovation.
- The **Ministry of Earth Sciences**, through its white paper *Transforming India's Blue Economy*, outlines a roadmap to 2035 that emphasizes sustainable marine resource utilization, public-private partnerships, and targeted financial mechanisms.

Major Initiatives include:

- **Sagarmala Programme**: Enhances port infrastructure, logistics, and coastal employment.
- **Deep Ocean Mission**: Focuses on ocean exploration, biodiversity mapping, and climate resilience.
- **Harit Sagar Guidelines**: Promote eco-friendly port operations and marine conservation.

These programs are backed by 25 central ministries and coordinated with coastal states and union territories, ensuring cross-sectoral integration and regional relevance.

Impacts on India's Development

A. Economic Growth and Livelihoods

- **Fisheries and Aquaculture**: India is the second-largest fish producer globally, with inland aquaculture contributing over 85% of farmed fish. Technological advances in cage culture and mariculture are expanding income opportunities for coastal communities.
- **Seaweed Cultivation in Odisha**: A community-led initiative offering low-investment, high-impact livelihoods to over 10,000 households, while also contributing to carbon sequestration and water quality improvement.

B. Infrastructure and Innovation

- **Smart Ports in Kochi**: Use of digital twin technology has improved operational efficiency, reduced vessel waiting times, and enhanced environmental monitoring.
- **Shipbreaking in Alang, Gujarat**: Adoption of international standards has improved resource recovery and waste management, minimizing ecological damage.

C. Environmental Sustainability

- **Marine Protected Areas (MPAs)** and bans on single-use plastics in the Andaman & Nicobar Islands have preserved coral reefs and reduced waste in tourist zones.
- **Climate Resilience**: Blue economy practices like seaweed farming and sustainable aquaculture help mitigate climate change impacts and restore marine ecosystems.

India's Blue Economy initiatives are not just valid—they are visionary. By aligning marine resource management with sustainability, innovation, and inclusive development, India is positioning itself as a global leader in ocean governance. These efforts are already yielding tangible benefits in employment, infrastructure, and ecological health, especially in coastal and island regions.

4

INDUSTRY

Q. Write a critically argued essay on nautical tourism and its infrastructure in India. (CSE 2025)

Ans. India, with its 7,500 km coastline (recently updated by the Survey of India to 11,098.81 KM), 200+ minor ports, and 20,000 km of navigable waterways, possesses immense potential for nautical tourism—a segment encompassing cruise tourism, riverine travel, yachting, and coastal recreation.

Despite this natural advantage, the sector remains underdeveloped, constrained by fragmented infrastructure and policy gaps.

Strategic Potential and Government Vision

The Draft National Strategy for Cruise Tourism outlines India's ambition to become a global hub for nautical tourism. It identifies key assets:

- Major Ports like Mumbai, Kochi, Chennai, and Mormugao are being upgraded to handle international cruise liners.
- River Cruise Corridors along the Ganga and Brahmaputra are being developed under the Sagarmala and Inland Waterways Authority of India (IWAI) initiatives.
- Island Tourism in Lakshadweep and Andaman & Nicobar is being promoted for luxury and eco-cruise experiences.

Infrastructure Challenges and Gaps

- **Port Infrastructure Deficiencies:** Most Indian ports lack dedicated cruise terminals, berthing facilities, and passenger amenities. Turnaround time for cruise ships is high due to manual customs and immigration processes, deterring international operators.
- **Limited Private Investment:** The sector suffers from low investor confidence, partly due to regulatory ambiguity and lack of long-term concessions for cruise operators.
- **Connectivity and Accessibility:** Poor last-mile connectivity from ports to tourist destinations hampers seamless travel. Inland waterways remain underutilized due to seasonal navigability, siltation, and lack of dredging.
- **Environmental and Regulatory Concerns:** Coastal tourism projects often face delays due to CRZ (Coastal Regulation Zone) restrictions and environmental clearances, which are essential but slow-moving.
- **Emerging Models and Success Stories:** Mumbai Port Trust has developed a state-of-the-art cruise terminal, handling over 100 cruise calls annually. Ganga Vilas, the world's longest river cruise, launched in 2023, showcases India's inland waterway potential. Public-private partnerships in Kochi and Goa have led to improved marina facilities and yacht tourism.

India's nautical tourism sector is poised for growth, but its infrastructure must evolve from fragmented upgrades to a cohesive, multi-modal strategy. With robust policy backing, targeted investment, and streamlined regulation, India can transform its vast water assets into a thriving tourism economy. The challenge lies not in potential, but in execution.

Q. Explain the factors which contribute to the growth of India's pharmaceutical industry with specific reference to its concentration in western region of India. (CSE 2025)

Ans. India's pharmaceutical sector has evolved into a global powerhouse, ranking third in volume and fourteenth in value globally. While the industry is spread across the country, the western region—especially Gujarat and Maharashtra—has emerged as a dominant hub, driven by strategic, infrastructural, and policy-based advantages.

Factors Driving National Growth

- **Strong Export Base:** India exported $26.5 billion worth of pharmaceuticals in FY 2023–24. Over 20% of global generic drug exports originate from India.
- **Robust API Manufacturing:** India is the third-largest producer of Active Pharmaceutical Ingredients (APIs) globally. Over 500 APIs are manufactured domestically, with 57% prequalified by WHO.

Government Support & R&D Ecosystem

- Establishment of National Institutes of Pharmaceutical Education and Research (NIPERs).

5 TRANSPORT, COMMUNICATION & TRADE

Q. With reference to the transport and communication network of India, critically discuss the Sagarmala project. (CSE 2025)

Ans. India, with a coastline stretching over 7,500 km (recently updated by the Survey of India to 11,098.81 KM) and 13 major ports, has immense potential to leverage maritime transport for economic growth. Yet, historically, the country has underutilized its coastal and inland waterways.

The **Sagarmala Project**, launched by the Government of India, aims to change that by transforming ports into engines of development and integrating them into the broader transport and communication network.

- To further accelerate innovation, the government launched the Sagarmala Startup Innovation Initiative (S2I2) in March 2025. This programme supports startups working in green shipping, smart ports, maritime logistics, and sustainable coastal development.
- Anchored in the principles of Research, Innovation, Startups, and Entrepreneurship (RISE), S2I2 is designed to foster a future-ready maritime ecosystem.
- Sagarmala project envisions reducing logistics costs for domestic and EXIM cargo with efficient infrastructure and multimodal transport solutions.
- Sagarmala is also a key pillar of the Maritime Amrit Kaal Vision 2047, which envisions India handling 10 billion metric tons of cargo annually and becoming one of the top five shipbuilding nations globally.
- With Rs. 40,000 crore in budgetary support for Sagarmala 2.0, the government aims to unlock Rs. 12 lakh crore in investments over the next decade.

Strategic Objectives

- **Port Modernization**: Upgrading existing ports and developing new ones to handle increased cargo volumes.
- **Port Connectivity**: Improving road, rail, and inland waterway links to reduce bottlenecks.
- **Logistics Efficiency**: Promoting coastal shipping and multimodal logistics parks.
- **Skill Development**: Empowering coastal communities through training and employment. Over **802 projects** identified under Sagarmala, worth Rs. 5.5 lakh crore.
- Development of **multi-modal logistics parks** and **Ro-Ro ferry services**.
- Enhanced cargo movement via **National Waterways**, especially NW-1 (Ganga) and NW-2 (Brahmaputra).

Challenges and Criticisms

- **Environmental Concerns**: Coastal infrastructure development risks damaging fragile ecosystems.
- **Land Acquisition Issues**: Delays due to resistance from local communities.
- **Coordination Gaps**: Between central ministries, state governments, and private stakeholders.
- **Limited Private Investment**: Despite policy incentives, private sector participation remains cautious.

The Sagarmala Project is a visionary step toward reshaping India's maritime economy and integrating it with the national transport and communication network. While its goals are ambitious and its progress notable, the project must navigate environmental sensitivities, social equity, and inter-agency coordination to truly deliver transformative outcomes.

Q. The Indian Space Policy, 2023 supports the commercial presence in space. In what ways will it benefit the socio-economic development and security of India? (CSE 2024)

Ans. The global space economy is valued at USD 360 billion, with India contributing only 2% of this market. Despite being a spacefaring nation, India has yet to fully leverage space industry opportunities. The Indian Space Policy, 2023, aims to boost the commercial space sector by encouraging private sector participation, thus enhancing India's global competitiveness, socio-economic development, and national security.

Potential for Growth in India's Space Sector

- **Current Space Economy:** India's space economy exceeds USD 9.6 billion, while ISRO's budget stands at USD 1.6 billion. This shows significant untapped potential for growth.
- **Growth Projections:** India's space industry could grow to USD 60 billion by 2030, creating over 200,000 jobs.

6

CULTURAL SETTING

Q. What are the key features of sex-ratio of population in India? Evaluate the impacts of child sex-ratio on general sex-ratio in the country. (CSE 2025)

Ans. Sex ratio is a demographic measure that indicates the number of females per 1,000 males in a given population. It serves as a critical indicator of gender equity, social health, and population dynamics.

- According to the **Census of India,** sex ratio is defined as the number of females per 1,000 males in the population. It reflects underlying social processes and gender-based preferences in society.
- Sex ratio is a vital demographic indicator that reflects the social fabric and gender dynamics of a nation. In India, it has long been a subject of concern due to persistent gender imbalances rooted in cultural, economic, and social factors.
- The skewed sex ratio, especially among children, has prompted national-level interventions like the **Beti Bachao, Beti Padhao (BBBP)** campaign, aimed at correcting gender disparities and promoting the value of the girl child.

Broader Interpretation

A **balanced sex ratio** (close to 1,000) suggests equitable survival and treatment of both genders.

- A **low sex ratio** (below 950) often signals gender discrimination, including female foeticide, neglect of girl children, and unequal access to healthcare and nutrition.
- A **high sex ratio** (above 1,050), though rare in India, may indicate male outmigration or better female survival rates in specific regions.
- Sex ratio is not just a number—it's a mirror of societal values. Persistent imbalances can lead to long-term demographic challenges, including:
- Marriage squeeze (shortage of brides)
- Increased trafficking and exploitation
- Social unrest and gender-based violence

Sex Ratio in India

- **Regional Variation**: States like Kerala and Tamil Nadu report higher sex ratios, while Haryana and Punjab have historically shown lower ratios.
- **Urban-Rural Divide**: Rural areas tend to have slightly better sex ratios than urban centers, though both face challenges.
- **Temporal Trends**: While the overall sex ratio has improved marginally over decades, the child sex ratio has shown alarming declines, especially between 2001 and 2011.

Impact of Child Sex Ratio on General Sex Ratio

- **Demographic Imbalance**: A low CSR leads to a future adult population with fewer women, affecting marriage patterns and social stability.
- **Gender Discrimination**: Skewed CSR reflects deep-rooted **son preference,** often resulting in sex-selective abortions and neglect of girl children.
- **Policy Pressure**: Declining CSR has prompted government action, including the **BBBP scheme**, which aims to improve CSR through awareness, enforcement of laws, and education.
- **Long-Term Consequences**: A persistently low CSR can lead to increased trafficking, forced marriages, and social unrest due to a shortage of women in certain regions.

India's sex ratio and child sex ratio are more than just numbers—they are reflections of societal values and gender equity. While the overall sex ratio has seen gradual improvement, the child sex ratio remains a critical concern. Its impact on the general sex ratio is profound, shaping future demographic patterns and social dynamics.

The Ministry of Women and Child Development reports that districts targeted under BBBP have shown positive trends in CSR, especially in states like Haryana and Rajasthan.

Correcting the child sex ratio is not just a demographic necessity—it is a moral imperative. Sustainable change will require continued policy commitment, community engagement, and cultural shift toward valuing daughters equally.

Q. "Spatial distribution of religious groups in India does not show any specific pattern." Illustrate with arguments. (CSE 2025)

Ans. India is globally recognized for its religious diversity, with Hinduism, Islam, Christianity, Sikhism,

7

SETTLEMENTS

Q. "The rural settlements in India are highly diversified due to both physical and cultural factors." Justify the statement with examples. (CSE 2025)

Ans. India's rural settlement patterns reflect a dynamic interplay between natural geography and socio-cultural identity. With over 65% of the population residing in rural areas, understanding this diversity is crucial for effective planning, infrastructure development, and livelihood strategies.

As highlighted in NABARD's Changing Structure of Rural Livelihood in India, rural settlements are shaped not only by ecological zones but also by historical, ethnic, and caste-based factors that influence spatial organization and community life.

Rural Settlement

A rural settlement refers to a cluster of dwellings located in the countryside, where the primary occupation of residents is linked to agriculture, forestry, fishing, or other natural resource-based activities. Rural settlements are typically small, sparsely spaced, and specialize in primary economic activities. These settlements range from isolated hamlets to large villages and are shaped by physical features like terrain, climate, and water availability, as well as cultural factors such as caste, religion, and ethnicity.

The Census of India defines a rural area administratively as one governed by a Gram Sabha, and demographically as a settlement with:

- A population less than 5,000,
- At least 75% of the male working population engaged in agriculture,
- A population density below 400 persons per square kilometer.

Physical Drivers of Settlement Diversity

Topography and Terrain

- In **mountainous regions** like Himachal Pradesh and Uttarakhand, settlements are dispersed and located along river valleys or terraced slopes due to steep terrain and limited arable land.
- In **plains and deltas** (e.g., Punjab, West Bengal), flat and fertile land supports compact, nucleated settlements with high population density.

Soil and Water Availability

- **Alluvial soils** in the Indo-Gangetic plain encourage dense agricultural settlements.
- **Laterite and black soils** in the Deccan Plateau lead to semi-dispersed settlements due to variable fertility.
- **Water proximity** influences settlement clustering—villages near rivers like the Brahmaputra or Godavari are densely populated, while arid zones like Rajasthan show sparse, scattered habitation.

Climate and natural hazards

- In flood-prone regions (e.g., Assam), settlements are built on raised platforms or embankments. In drought-prone areas (e.g., Bundelkhand), settlements are often located near tanks or step wells.

Cultural and Social Factors of Settlement Diversity

Caste and Social Stratification

- In **North India**, caste-based segregation leads to distinct hamlets or "tolas" within villages—e.g., separate quarters for Dalits and upper castes in Bihar and Uttar Pradesh.
- In **South India**, agraharams (Brahmin quarters) reflect religious and caste-based spatial planning.

Tribal and Ethnic Identity

- In **Northeast India**, tribal settlements (e.g., Nagaland, Mizoram) are organized around clan systems and often located on hilltops for strategic and cultural reasons.
- In **Central India**, tribal villages in Chhattisgarh and Jharkhand are dispersed and forest-adjacent, reflecting dependence on forest produce and traditional governance systems.

Religious and Linguistic Influence

- In **Kerala**, Christian-majority villages often have churches as focal points, influencing layout and community interactions.
- In **Punjab**, Sikh settlements are centered around gurudwaras, which serve as both religious and social hubs.

The diversity of rural settlements in India is not incidental—it is a product of centuries of adaptation to geographic realities and cultural evolution. Whether it's the terraced hamlets of the Himalayas, the caste-

8 REGIONAL DEVELOPMENT & PLANNING

Q. "Watershed is most appropriate spatial unit for planning". Comment. (CSE 2025)

Ans. A watershed is a geo-hydrological unit defined by natural topography, where all water—rainfall, surface runoff, and groundwater—drains into a common outlet such as a stream, river, or lake. It represents a natural spatial framework for managing land, water, vegetation, and human activities in an integrated manner.

According to the Ministry of Agriculture's watershed planning document, a watershed "Constitutes a natural spatial frame of hydrologic units for harnessing and utilizing water, soil, and forest resources in a sustainable manner within its ecosystem."

In planning terms, the watershed approach is used to:

- Promote **in situ soil and water conservation,**
- Enable **ridge-to-valley treatment** of degraded lands,
- Integrate **livelihood development** with ecological restoration, and
- Facilitate **community participation** and decentralized governance.

The NITI Aayog-supported World Bank report emphasizes that **micro-watersheds** (typically 500–1000 hectares) are the most effective units for planning interventions, especially in drought-prone and ecologically fragile regions.

In the context of sustainable development and resource management, spatial planning requires units that reflect ecological, hydrological, and socio-economic realities.

A **watershed**, defined as a geo-hydrological unit where surface water drains to a common outlet, has emerged as a scientifically grounded and operationally viable unit for integrated planning.

As emphasized in the *Integrated Water Resource Development Plan for Mayurakshi Watershed* by Chowdary et al. and supported by the *Ministry of Jal Shakti*, watershed-based planning enables holistic management of land, water, vegetation, and human activities within a natural boundary.

Critical Analysis of Watershed as a Planning Unit

- **Ecological Coherence and Hydrological Integrity:** Watersheds represent natural drainage basins, making them ideal for managing water resources, soil conservation, and land-use planning. Spatial assessment of land and water resources within watershed boundaries enables targeted interventions like erosion control, drainage line treatment, and crop diversification. Unlike administrative boundaries, watersheds align with ecological processes, allowing planners to address environmental degradation at its source.
- **Integrated Resource Management**: Watershed planning supports the integration of surface and groundwater management, afforestation, livestock development, and agricultural productivity. The *IWA study on the Noyyal River Basin* demonstrates how morphometric analysis and prioritization of sub-watersheds using geospatial tools can guide soil and water conservation efforts. This approach ensures that interventions are spatially optimized and ecologically sustainable.
- **Participatory and Decentralized Governance:** Watershed-based planning encourages community participation and decentralized decision-making. Programs like the *Integrated Watershed Management Programme (IWMP)* under the *Department of Land Resources* have shown that involving local stakeholders in planning and implementation leads to better outcomes in terms of livelihood enhancement and resource conservation.
- **Technological Compatibility:** Modern planning tools such as **Remote Sensing, GIS,** and **Digital Elevation Models (DEMs)** are well-suited for watershed delineation and analysis. The *Geospatial Environment journal* emphasizes that spatial multi-criteria evaluation within watersheds enables identification of rainwater harvesting sites, groundwater potential zones, and land degradation hotspots.

Limitations and Challenges

Despite its strengths, watershed planning faces challenges:

- **Mismatch with administrative boundaries** can complicate implementation and funding.
- **Data gaps** in micro-watershed delineation may hinder precision.

9

POLITICAL ASPECTS

Q. With reference to international boundaries of India, discuss the related issues, giving suitable examples. (CSE 2025)

Ans. India's international boundaries are more than geopolitical lines—they shape the country's security, diplomacy, trade, and regional development. Stretching over 15,000 kilometers, these borders touch seven countries: Pakistan, China, Nepal, Bhutan, Bangladesh, Myanmar, and Afghanistan (via Pakistan-occupied Kashmir). Each boundary region presents unique challenges and opportunities, making regional planning and cooperation essential for national stability and sustainable development.

Regional International Boundaries

- As outlined by the Ministry of External Affairs, international boundaries are: "Geographical demarcations that define the territorial limits of a nation and regulate its relations with neighbouring countries through diplomatic, economic, and security frameworks."
- These boundaries are shaped by historical treaties, cultural ties, and strategic interests, and are managed through bilateral and multilateral mechanisms.

Importance of Regional International Boundaries

- **National Security:** Border regions are critical for defence and surveillance. Strategic zones like the Line of Control (LoC) with Pakistan and the Line of Actual Control (LAC) with China require constant monitoring and infrastructure development.
- **Economic and Trade Corridors:** Borders facilitate cross-border trade, such as the India–Bangladesh Integrated Check Posts and the India–Myanmar Trilateral Highway, boosting regional economies and connectivity.
- **Cultural and Ethnic Linkages:** Many border communities share linguistic, cultural, and familial ties across boundaries. Regional planning helps preserve these connections while managing migration and identity issues.
- **Environmental and Agricultural Cooperation:** Transboundary rivers like the Brahmaputra and Teesta require joint management to ensure water security, flood control, and agricultural sustainability.
- **Disaster Management and Climate Resilience:** Border regions often face natural disasters—earthquakes in the Himalayas, cyclones in coastal zones. Regional coordination enhances preparedness and response.

Issues Related to India's International Boundaries

Border Disputes and Territorial Claims

- **India–China (LAC)**: The Line of Actual Control remains undefined in several stretches, leading to periodic standoffs like the 2020 Galwan Valley clash. These disputes affect regional stability and defense preparedness.
- **India–Pakistan (LoC and Sir Creek)**: The Line of Control in Jammu & Kashmir is a flashpoint for cross-border terrorism and ceasefire violations. The Sir Creek dispute in Gujarat affects maritime boundaries and fishing rights.

Cross-Border Migration and Refugee Influx

- **India–Bangladesh**: Porous borders in West Bengal and Assam have led to undocumented migration, impacting local demographics and resource allocation. The fencing and border management efforts are ongoing under the Ministry of Home Affairs.
- **India–Myanmar**: Ethnic conflicts in Myanmar have triggered refugee movements into Mizoram and Manipur, requiring humanitarian and administrative responses.

Smuggling and Illicit Trade

- Border regions are vulnerable to trafficking of narcotics, arms, and counterfeit goods.
- **Example: Punjab border with Pakistan** sees frequent drug smuggling, **Northeast borders** are used for illegal wildlife trade and timber smuggling.
- **Environmental and Agricultural Challenges**
- **Transboundary Rivers**: Rivers like the Brahmaputra (India–China) and Teesta (India–Bangladesh) raise concerns over water sharing, dam construction, and ecological impact.
- ICAR and Ministry of Jal Shakti have emphasized cooperative frameworks for sustainable river basin management.

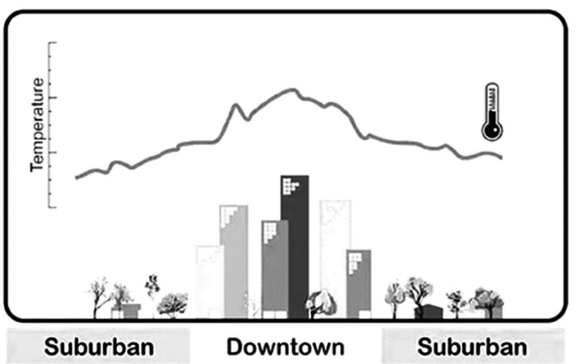
10 CONTEMPORARY ISSUES

Q. Describe the causes of the phenomenon of 'urban heat island'. What are the effective measures to deal with this phenomenon in India? (CSE 2025)

Ans. An Urban Heat Island (UHI) refers to the phenomenon where urban areas exhibit significantly higher temperatures than their surrounding rural regions, especially during night time. This temperature disparity arises due to land-use changes, built-up infrastructure, and anthropogenic heat emissions.

UHI is characterized by elevated near-surface air temperatures caused by reduced vegetation, increased impervious surfaces, and altered energy balances in urban environments.

India's rapid urbanization has led to the expansion of cities marked by dense infrastructure, vehicular emissions, and declining green cover. This transformation has intensified the Urban Heat Island effect, making cities hotter, more energy-intensive, and vulnerable to climate extremes, all major Indian cities—including Delhi, Mumbai, Chennai, and Kolkata—experience UHI effects ranging from 1°C to 5°C, contributing to thermal discomfort, increased energy demand, and public health risks.



Causes of UHI in India

Urban Heat Islands are not just a by-product of urbanization—they are a **symptom of unsustainable spatial planning**, material choices, and energy use.

Following factors intensify UHI effects:

- **Low-Albedo Materials**: Urban surfaces like asphalt and concrete absorb more solar radiation due to their low reflectivity, leading to higher surface and air temperatures.
- **Reduced Evapotranspiration**: The replacement of vegetation with impervious surfaces limits natural cooling through evaporation, increasing sensible heat flux.
- **Vertical Expansion and Urban Geometry**: High-rise buildings and narrow streets reduce sky visibility and trap heat, creating "urban canyons" that inhibit night time cooling.
- **Anthropogenic Heat Sources**: Air conditioners, vehicles, and industrial processes release waste heat, compounding ambient temperature rise.
- **Declining Relative Humidity**: Urban areas often experience lower humidity due to reduced vegetation and increased heat, which further exacerbates thermal discomfort.

Q. What are the causes and consequences of land degradation due to desertification in India? Examine with reference to various regional issues. (CSE 2025)

Ans. According to the **National Bureau of Soil Survey and Land Use Planning (NBSS&LUP),** under ICAR, land degradation is the decline in land quality caused by human activities and natural phenomena, resulting in reduced productivity of land resources.

It includes processes like soil erosion, salinization, waterlogging, nutrient depletion, and loss of vegetation cover, which impair the land's ability to support agriculture, forestry, and biodiversity.

Desertification

- The Ministry of Environment, Forest and Climate Change (MoEFCC) defines desertification as: "Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities."
- This process leads to the expansion of desert-like conditions, especially in regions like Rajasthan, Gujarat, and parts of Andhra Pradesh, where overgrazing, deforestation, and unsustainable farming practices accelerate soil degradation and water scarcity.