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South West Monsoon system in India - Climatology Part 1

#1 What is monsoon?

- 1) Monsoons are seasonal winds. Rhythmic + Periodic and secondary wind movement
- 2) They flow from sea to land during the summer and from land to sea during winter.
- 3) These wind movements are type of large convection cells.

#2 What are it's types ?

- 1) South West monsoon
- 2) The North – East monsoon

#3 What are the various factors responsible for formation of South West monsoon?

- 1) Differential heating effect between the ocean and land in South Asia.
- 2) Coriolis force causes the wind movement to turn right into the landmass.
- 3) Role of moisture and condensation which release latent heat and augments the differential heating produced by the land-sea contrast.
- 4) The Tibetan plateau exerts its influence both as a mechanical barrier in the atmospheric flow as well as a high level heat source.
- 5) Permanent high pressure cell in the South Indian Ocean (east to north-east of Madagascar in summer).

#4 What are the factors that influence the onset of south-west monsoons?

- 1) The role of Jet streams Sub tropical/ Tropical Westerly Jet stream, Tropical/ Equatorial Easterly Jet stream.
- 2) Annual migration of thermally induced planetary winds and pressure belts or shifting of ITCZ (Inter Tropical Convergence Zone).

#5 What are the factors that influence the intensity of south-west monsoons?

- 1) Mascarene High (high pressure area at sea south of equator) and the Somali Jetstream.
- 2) Indian Ocean branch of Walker Cell.
- 3) Variation in the axis of the monsoon trough. Break in monsoon, the trough shifts to the base of Himalayas.
- 4) Teleconnections and see-saw pattern of meteorological change of ENSO – El-Nino and Southern Oscillation Index.

(*Topics of Jet stream and El nino will be dealt in a separate Concept class)

North East Monsoon in India- Climatology Part 2/2

#1 What is North East monsoon?

- 1) Withdrawal of South-West monsoon and onset of North East monsoon is a gradual phenomena (3 months), hence also called **Retreating monsoon**.

#2 Why the monsoon retreats?

- 1) Low-pressure area over the north-western parts of India weakens → gradual transition of **ITCZ towards the South**
- 2) High pressure starts to build up over the **Tibetan plateau** and **central Asia**.
- 3) Sun shifts towards the **equator(equinox)**.
- 4) Eastern tropical jet stream and Somali Jet stream begin to die → onset of Westerly jet stream

#3 What are the temperature conditions during retreating monsoon?

- 1) Rise in temperature with high humidity → "**October Heat**" or "Kwar ki Umas"
- 2) The rainfall is scanty due to anti cyclonic circulations on land.
- 3) **Exceptions:-** rainiest months of the year in coastal areas of Tamil Nadu → due to large indentation made by the Bay of Bengal.
- 4) Possibility of tropical cyclones and passage of cyclonic depressions.

#4 What is the variability of rainfall in India and issues related to it?

- 1) **Average rainfall** in India – 125cm; Areas of High Rainfall- west coast, Western Ghats, Khasi hills; Areas of **Medium** Rainfall - areas of Gujarat, east Tamil Nadu, north-eastern Peninsula, northern Ganga plain, Cachar Valley; Areas of **Low** Rainfall – N-W part of India and parts of Deccan Plateau. Areas of **Inadequate** Rainfall – Rain shadow regions of Western ghats and cold, hot deserts of India.
- 2) More than 50% farmland rain-fed, 70% of annual rainfall in monsoon season. Low summer monsoon affects planting of Kharif crop, weak retreating monsoon → Rabi
- 3) **Low rainfall** → drought, affects rural consumption, automobile, fast moving consumer goods, increases the imports of essential food staples; government measures like **farm loan waivers** due to **political populism**; increases fiscal deficit.
- 4) The Monsoon rains helps in increasing output of hydro-electric power projects in **perennial** river systems. The monsoon winds → **wind energy** in Kuch and TN coast.
- 5) The debit side, Indian economy suffers heavy losses due to floods and droughts. Farmer suicides and disaster related expenditures.

Air Mass

#1 What is air mass?

- 1) **Homogeneous** air block → **temperature + humidity + moisture**.
- 2) Extend from surface to **lower stratosphere** → part of global planetary wind system

#2 What are the conditions for their formation?

- 1) **source regions** → homogeneous air masses are **created**
- 2) Main source regions → high pressure belts in sub tropics, poles, low-latitude deserts like the Sahara, continental interiors of North America and Eurasia.
- 3) **Source region properties** → extensive, gentle, divergent air circulation, little pressure gradient
- 4) **Two** major types → **Tropical** air mass(warm) & **Polar** air mass (cold); Heat exchange process occur slowly between surface and air mass.

#3 What are the characteristics of Air Mass?

- 1) Maritime air masses → high humidity → produce large amount of precipitation; continental air mass is dry → produce less precipitation.
- 2) Air mass spreads over large areas → little variation in temperature + stability + moisture
- 3) Retain its original identity & not torn apart by differences in airflow.

#4 What is the role of air mass in macro - climatic changes?

- 1) **Vertical distribution** of **temperature, moisture content** → weather system to change, stall + transfer of latent heat → removing **latitudinal heat balance**.
- 2) Boundary **zone of convergence** separating the two air masses → **fronts**.
Atmospheric disturbances originate at these fronts → **Frontogenesis** → Temperate cyclones are formed (*Will be dealt in a separate concept class).
- 3) Oceanic air mass → atmospheric moisture → oceans to continents + cause precipitation over landmass → **Frontal precipitation**.
- 4) Dry air mass → arid condition → hasten the process of desertification. Ex- Sahel region
- 5) Continental Arctic air mass → cause of extreme cold conditions → **polar vortex**.
- 6) Air mass transport from north-west to **Delhi** → conspicuous amount of highly volatile + semi-volatile aerosols + Columns of NO₂, Ozone → photo chemical **smog**.
- 7) **stagnation** of wind → stable air mass → dust + PM_{2.5} + PM₁₀ particles = cloud condensation nuclei → increases haze and smog.

Jet streams

#1 What are Jet streams?

- 1) Narrow concentrated bands + high velocity + **geostrophic** wind in upper troposphere
- 2) They are **circumpolar** & follow the boundaries between hot and cold air mass.

#2 What are the influencing factors & characteristics for the Jet Stream Flow?

- 1) **High velocity** → **thermal contrast** → temperature gradient
- 2) **Meandering** → encircle the globe, follow a curved path → 3 dimensional flow + develop crests + trough → covering a wide area → travel from west to east → **"Rivers of the air"** → pressure gradient force at the core
- 3) Seasonal variations + shift with the movement of the sun + Forms **"Eddies"**
- 4) **Landmass** → friction + temperature differences (decides intensity + height);
- 5) **Coriolis** force → **centrifugal** effects; Temperature of **stratosphere** → strength + position of jet stream; Cooler stratosphere → Greater strength of jet stream

#3 What is the role of Jet stream in macro-climatic changes and associated weather phenomena?

- 1) **Role in Polar vortex** → Meandering becomes extreme → **temperature gradient**. Global warming → warming of pole → Permanent jet streams or polar front jets → got shifted southward by depleting ozone layer
- 2) Maintains **latitudinal heat balance** → air mass movement + exchange
- 3) Contain **wind shear**, high wind velocity → major threat to airlines. Help airlines too. East bound flight time < Westbound flights.

#4 How does the Jet stream affect the weather system in India?

- 1) **Role in Western disturbances** (from **Mediterranean**) → mid-latitude region → Westerly jet stream → low pressure system → snowfall in winter in NW parts → important for Rabi crops (Wheat); 5-10% of India's annual rainfall → changing nature resulted into disasters → Cloudbursts, landslides, flooding
- 2) **Role in monsoon** → **Tropical Easterly Jet/ African Easterly Jet** → reversal of upper air circulation pattern; **Somali Jet** → southwesterly → intensity of monsoon → strengthens Mascarene high; **Subtropical Jet Stream (STJ)** → blocks solar monsoon cell + inhibits solar monsoon → creates ridge (**anticyclonic**) and trough (cyclonic air movement); **Burst** of monsoon → STJ withdraws from sub continent → Northward movement; **High Pressure** due to STJ + High Pressure over **Tibet** = strong divergence = no rainfall in winter

Tropical cyclones

#1 What are Tropical cyclones?

- 1) Violent storms → areas of low pressure (decides wind intensity) over ocean → violent winds (squalls) + torrential rainfall + storm surge
- 2) Irregular wind movement + closed air circulation → rapid upward movement of hot air

#2 What are factors responsible for formation of tropical cyclones?

- 1) Large sea surface + sea surface temperature > 27°C; latent heat of condensation
- 2) Coriolis force → create cyclonic vortex + direction; Weak low-pressure area + depression
- 3) Upper divergence above sea level system; Small local variations in temperature + wind speed → low-pressure centers of small size
- 4) rising of humid air => adiabatic lapse rate => fall in temp => condensation of moisture => latent heat released => hotter and lighter air uplifted => more air fills gap => new moisture available for condensation
- 5) convergence of air masses → spiraling circular wind (eye) & multiple convective cells

#3 What are the impacts of tropical cyclones on India?

- 1) 10% of world's tropical cyclone exposed to India; primary peak in November.
- 2) Storm surge inundates low lying areas + causes heavy floods + coastal erosion + destroys vegetation + reduces soil fertility → salinity increases
- 3) Gulab, Yaas and Tauktae growing intensity of wind + unconventional weather pattern → preparedness time is low → Dense population + poor capacity → pandemic adds to problem → Public health + economic and climatic security + mangrove ecosystem
- 4) Institutional structures + insurance systems for financial protection from material loss

#4 Why more tropical cyclones occur on eastern coast?

- 1) Higher vaporization from sea + Fresh water inflow + trough-like shape coastline + Pacific cyclones (break away typhoons) + Land on three sides → Greater heat from landmass
- 2) Flatter plain, land, emergent eastern coast – prevent deflection of winds

#5 Why the frequency of cyclones in Arabian sea is increasing?

- 1) Rising sea surface temperature; Altering the cycles of El Nino (EN) and El Nino Modoki (ENM) → creating larger area for wind convergence → intensification of cyclonic depression in Arabian sea
- 2) Intensification of easterly winds → Ex :- Ockhi generated in BoB → towards Arabian sea

Plate tectonic theory

#1 What is plate tectonic theory?

- 1) Lithosphere broken → floats on asthenosphere → horizontal movement → rigid units
- 2) Oceanic crust → Simatic (thinner); Continental crust → Sialic (thicker)
- 3) Movement of plates → convection currents in mantle → thermal gradient

#2 What are evidences that support plate tectonic theory?

- 1) Paleomagnetism → Polar wandering → orientation of iron grains → sea floor spreading
- 2) older rocks → continents; younger rocks → ocean floor
- 3) Gravitation anomalies → value of gravitational constant less → loss of material
- 4) Earthquake and vulcanism → along plate boundaries; creation of convection cell

#3 What are the land forms formed due to plate tectonic theory?

- 1) Convergent plate boundaries → crumpling + folding + destruction → orogenic collision → fold mountains →
Ex:- Himalayan Boundary Fault; Zone of subduction → trenches; volcanic arc systems + oceanic plate boundaries → island arcs;
- 2) Divergent plate boundaries → move away → Mid-ocean ridges → basaltic magma → sea floor spreading → East African rift valley → shallow focus earthquake + crust formation
- 3) Transform plate boundaries → no creation/destruction → deformation → creates faults perpendicular to mid oceanic ridges → San Andreas Fault

#4 What has been the movement of Indian tectonic plate?

- 1) Present form → tertiary geological age → Peninsular + Australian continental portion → boundary between India and the Antarctic plate → oceanic ridge
- 2) Plate tectonic → height of Himalayas increasing; Northward movement of plate → colliding with Asiatic plate → Makes tectonic active zone + seismic zone IV
- 3) The northward movement → formation of Deccan trap (shield volcano)

#5 Why the frequency of Earthquakes over Delhi has increased?

- 1) Proximity to main boundary thrust fault; Release of stress by frequent collision of Indian plate and Eurasian plate; Presence of loose alluvial soil of plains amplifies the quake
 - 2) Presence of other weak zones and faults → Delhi-Haridwar ridge, Dehradun subsurface fault, Moradabad fault, etc.
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Land forms- Fold mountains

#1 What is a land form and what are its various types?

- 1) Natural+artificial feature ->planetary body; Formed by internal process (uplift +sinking); External process (wearing down+rebuilding) → Erosion+Deposition→ water, ice, wind
- 2) Five major land form → Fluvial(water)+ Aeolian(wind)+ Glacial+ Wave+ Karst
- 3) Folding, Faulting, and Vulcanism → secondary land forms → due to endogenic forces

#2 What are fold mountains?

- 1) sedimentary rock strata →geosynclines →compression forces; Folding in metamorphic rock rare → hard +brittle → break → reverse fault → mark plate boundaries
- 2) Fold→ undulating structure→ multiple layers→ upward convex(anticline) → downward convex(syncline)

#3 What are the types of fold mountains?

- 1) Origination → Very old, old fold, alpine young fold (rugged, lofty, conical)
- 2) Nature of fold→ Simple (syncline+ anticline); Complex (detached folds - 'nappe')

#4 What are the characteristics of fold mountains?

- 1) Rock type→ sedimentary rocks→ marine origin→ deposition+ consolidation; shallow water deposits; Recurrent seismicity;
- 2) May or may not have volcanism → volcanic rocks of ancient times;
- 3) Youngest mountains→ lofty→ width small→ granite intrusion; concave+convex slope

#5 Why the fold mountain systems located along the margins of continents?

- 1) Folding + uprising sediment; ocean-continent collision; continent-continent collision;
- 2) Over thrust folds → Further folding → fracture → Nappe; Upper layer slides over lower layer→ energy released → Earth quakes; Convergence of denser plates→ release magma from mantle region → high pressure→ continental plane;

#6 What are the effects of fold mountains on human life?

- 1) Impact climate→ Vegetation →Orographic rainfall → unique ecosystem →flora+fauna;
 - 2) significant economic importance → Tourist spots+ adventure sport; Hydro Electric Power→ steep slope → Hinterland connectivity; de-carbonise;
 - 3) Prone to landslides, flash floods→ loose soil+ gravitational pull+ due to steep slope
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Himalayan System – Part 1 of 2

#1 How did Himalayas originate?

- 1) **Plate tectonic theory** → Indian+ Eurasian plate → great geosynclines → Tethys sea; Some Himalayan river older than Himalaya.
- 2) **Tethys sea** → **Marine limestone** → summit of peaks → Tibetan plateau → **upthrusting**
- 3) line of collision → Tibetan Plateau+ Indian Plate → **Indus–Tsangpo Suture Zone** → **compression tectonic fault**; Further south- Murree Foredeep, Shiwalik foredeep
- 4) **Relief structure** → Tibetan plateau|Indus –Tsangpo Suture Zone → Tethyan/Trans Himalayas → Great Himalaya|MCT| Lesser Himalaya → MBF| Shivalik → HFF| Plains

#2 What are the different Himalayan ranges?

- 1) Parallel/**converging** ranges → **dissected** topography → southern slope → steep gradient
- 2) **Trans/Tibetan Himalaya** → Zaskar, Ladakh, Kailas, Karakoram → **East-west** direction → Indus → **Northern** slopes Kailas range; **Karakoram** → greatest glaciers outside pole
- 3) **Great/Himadri Himalaya** → (a) central **crystallines (granites+ gneisses)**, (b) **metamorphosed** sediments symmetrical+ steep slope, (c) convex to south → ends at syntaxial bends (**Nanga Parbat** in north-west + **Namcha Barwa** in north-east)
- 4) **Middle/Lesser Himalaya** → (a) steep, bare southern slopes [prevents soil formation], (b) gentle, forest covered northern slopes; (c) **Pir Panjal** range → Jhelum to Beas → **Continuous** hence need passes (**Banihal**); (d) **Kashmir** valley → synclinal basin + alluvial, **lacustrine** [lake deposits], fluvial [river action], glacial deposits; Jhelum river → deep gorge in Pir Panjal; **Kangra** → **strike valley**; **Kulu** → **transverse valley**.
- 5) **Shivalik range** → Potwar plateau-Brahmaputra valley; Tista river; Valley- syncline; hills → anticline; Southern slope → devoid of forest, dissected streams → **Chos; Duns**
- 6) **Purvanchal/ Eastern hills** → **Dihang** gorge → Himalayas southern bend → convex to west → sandstone; **Jaintia, Khasi and Garo** → eastward → **Indian peninsular block**

#3 What are the characteristics of Longitudinal vision Himalayas?

- 1) **Kashmir Himalaya** → Karewa formation → Lake deposits → Clay+silt+sand → glaciation → cultivation of Zafran; (b) **Nepal Himalaya** → Tallest section; (c) **Sikkim Himalaya**- Jelep La Pass- Tri junction of India-China-Bhutan; (d) **Assam Himalaya** → formation of **Duar**; Diphu Pass – Tri junction of India-China-Myanmar;
 - 2) **Eastern Himalayas** snowline at higher altitude; **Western Himalayas** → lower, gradual slope → peaks far away from plains → climatic conditions moderated on plains
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Himalayan System – Part 2 of 2

#1 What are the economic significance of Himalayas?

- 1) **Agriculture** → Horticulture crops [apple, citrus, peach, plum]; **Shivalik** range→ Eastern Himalayas suited for Tea; Kashmir Himalaya- **Saffron** cultivation; Pine tree- resins, pulp
- 2) **Mineral resources** → coal+oil reserve; Metallic ores [Copper, lead, zinc, nickel, cobalt, antimony, tungsten]+precious stone;
- 3) **Energy** → **small** and micro hydro electric energy; Regional Integrated Energy Plans – decentralize renewable→ **spatiotemporal** variability→ local demands
- 4) **Tourism**→ pilgrimage+leisure+adventure tourism→ multiplier-effect

#2 How can the effects of Climate change on Himalayas be reduced?

- 1) Influence precipitation, rainfall → runoff pattern→ downstream water availability
- 2) **Black carbon**→ accentuating glacial melting; **Measures**→ fuel-efficiency standards, efficiency of brick kilns, Cleaner cook stoves, fossil fuel to renewable energy sources
- 3) Increased frequency + magnitude → extreme weather events- high intense rainfall, flash floods, landslides and debris flows, Glacial lake outburst floods (**GLOF**)
- 4) Shrinking **Permafrost**→ altered **hydrological** cycle, vegetation composition, carbon dioxide and methane fluxes→ increased seasonal thawing→ instability+erosion→ activation of **soil carbon pool**→expansion of non-permafrost→ desertification increase
- 5) **Fragmentation** of habitat+**ecosystem**→ shifts in the latitude of **forest boundaries** + upward movement of tree line → change in species and vegetation composition

#3 What steps need to be taken to resolve issues arising out of tourism industry?

- 1) **Indian Himalayan Region (IHR)** ~ 71.5 billion\$ to GDP; Some states ~ 10%GDP; **Investment is less**; Unsustainable models of tourism; informal sector; loss of forest
- 2) **Non-climatic issues** → human wildlife conflicts, water insecurity, land degradation→ socio-demographic change (**out-migration**-Ghost Villages of Uttarakhand), solid waste, air pollution; (b) **Synergy deficits** - investments + interventions synchronised
- 3) **Balanced economy**+long term **preservation**+ **sensitive** to needs of **host population**
- 4) community-based, tourism management committees (b) **sector centric** forest policy; (c) waste management, marketing, and branding and tourism enterprise development (**governance**) (d) overcoming **fragility, marginality, and inaccessibility** by upstream-downstream linkages of cultures and ecosystem services

#4 What is the cultural significance of Himalaya?

- 1) Livelihood of tribal→ fuel wood + Minor forest produce → new farming practice and water demand management; high-altitude wetlands, sacred grooves
- 2) Composite of several cultural cosmoses→ **High Altitude** → **nomadic** and dispersed; **Mid Altitude**-sedentary zones, village settlements; **Low altitude and foothills**- 'slash and burn' cultivation+ terrace farming;
- 3) Monastery [Tabo,Hemis]+spiritual significance; Rich weaving + tapestry work[Pashmina]

Western Ghats Part 1

#1 How are the Western Ghats formed?

- 1) Western edge → Deccan table land; Steep sided (escarpment) + terraced + flat topped hills
- 2) Horizontally bedded lava → stepped/ landing stair feature; Abrupt rise → Coastal plain
- 3) Slope gently on Eastern side; Southern side → separated by Rift valley
- 4) Older than Himalaya and Eastern ghats → Spread over six states; Continuous Range → Passes → Thal, Bhor, Pal, Senkota; 3 coasts → Konkan + Kanara + Malabar

#2 What are the effects of Western ghats on climatology of India?

- 1) Altitudinal gradation → Montane forest ecosystem + Warm tropical humid climate
- 2) **Role in Monsoon** → Key barrier → South western Monsoon; **Orographic** rainfall → create rain shadow regions → Vidarbha,
- 3) **Hydrological role** → Origination → peninsular rivers [Krishna, Kaveri, Godavari, etc] → Water tower and watershed of Peninsula;
- 4) Evolutionary **Ecotone** → speciation related to Gondwana land → Out of "Asia and Africa"

#3 What are the biodiversity significance of Western ghats?

- 1) Montane forest ecosystems, Moist deciduous, Tropical evergreen, scrub forest, High rainfall savannas; Myristica swamps – unique vegetation types
- 2) High degree of endemism + species richness; one of the 8 Hottest Hotspots; 6% land – 30% fauna; Variation in endemism → latitudinal length of dry season gradient + temperature-elevation gradient; endemism higher → short dry season + higher altitudes
- 3) Endemic Fauna species → Lion-Tailed Macaque; Nilgiri Tahr; Malabar Civet;
- 4) **Shola forest**- isolated compact evergreen patches → folds of rolling downs → moisture content is high → stunted trees

#4 What are the biological hot spots of Western Ghats?

- 1) **Nilgiris**- First biosphere reserve → Confluence of Biotic zones (Afro-tropical and Indo-Malayan); **Tributaries** of Kaveri → Bhavani, Moyar, Kabini; **Confluence of** → Mudumalai WS + Wayanad WS, Bandipur NP + Nagarhole NP + Mukurthi NP + Silent Valley
 - 2) **Silent valley** → Tropical rain forest → high and continuous ridges + steep escarpment → shielded from extreme climate → ecological island → special micro climate; River Kunthipuzha flows; Home of Lion tail Macaque (endangered); **Silent Valley Movement** → against hydro electric project in 1973
 - 3) Part of project Elephant + project tiger
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Western Ghats Part 2

#1 What are the economic significance of Western ghats?

- 1) Subsistence → World heritage site; Particularly Vulnerable Tribal groups- Toda, Irula etc. → ethos of livelihood; Non - timber forest produce, medicinal plants
- 2) Rich in -> iron, manganese, bauxite ores;
- 3) Pepper, cardamom, coffee, rubber, tea → plantation crops
- 4) Tourism (Ooty, Waynad) + Pilgrimage centers (Sabarimalai, Mahabaleshwar)

#2 What are the effects of Climatic change on Western Ghats?

- 1) **Impact on precipitation** → erratic and localized rainfall → North – South variability in rains; Drought in areas of Krishna, Kaveri basins; flooding, landslides
- 2) **Impact on agriculture** → Rain fed agriculture → reduced yield; plantation crop → hastened soil drying, soil cover loss; reduction in local variety of crop
- 3) **Impact on forest** → Net Primary productivity reduced
- 4) **Impact on Biodiversity** → Species loss → constricted gene pool → climate stress → fragmentation of habitat (Ex- endemic brown mongoose)

#3 How can Western ghats be saved from ongoing destructive development?

- 1) Linear infrastructure projects → unscientific construction + urbanisation
- 2) Unsustainable mining activities → Iron ore extraction (Goa) → Sand Mining (Kerala)
- 3) Indiscriminate promotion of tourism → Solid waste generated → recycling→ hard metals
- 4) Increasing Landslides; destruction of riparian forest + tree cover; river regime affected
- 5) Construction of dam → Proper EIA → Natural and free flowing river maintained;
- 6) Projects avoid → Deforestation; Prior informed consent → locals; social audit incorporate
- 7) Community + traditional water harvesting; watershed measures; Rice intensification
- 8) Increasing Human wildlife conflict → Bhadra Wildlife Sanctuary → 11% of grain loss

#4 What are the recommendations made by different committees?

- 1) **Gadgil** Committee report (WGEEP) → entire hill range → Ecologically Sensitive Area (ESA) and Ecologically Sensitive Zones (ESZ); Proposes → Bottom (Gram Sabha led) to Top approach; Establishing a Western Ghats Ecology Authority;
- 2) **Kasturirangan** committee Report → complete ban → mining + quarrying + sand mining in ESA; 37% area as ESA; Distinguished between 'cultural & natural landscape (41% area)'; monitoring agency set up;
- 3) MoEFCC + NGT → "No go Zone" → phasing out mines within 5 years
- 4) Need to understand → distributional patterns+ habitat requirements+ financial incentives + sustainable farming + incentive schemes + payments for ecosystem services (REDD+)

Himalayan River system part 1

#1 What is the Himalayan drainage system?

- 1) River originating → Himalayan + trans-Himalayan range;
- 2) Three major river system → **Ganga; Brahmaputra; Indus;**

#2 What are the features of Himalayan river system?

- 1) Melting snow + Precipitation → Perennial;
- 2) **Upper reach** → Youthful stage → Gorges, V-shaped valleys, rapids, waterfalls etc.
- 3) **Middle part** → Plains → deposition features → Meandering → flat valleys, ox-bow lakes, flood plains, braided channels, deltas

#3 How are the Himalayan River system formed?

- 1) Shiwalik → entire longitudinal extent → Assam to Punjab (lacustrine origin and alluvial deposits) → dismembered into three drainage
- 2) Dismemberment → Pleistocene upheaval + Western Himalaya + uplift of Potwar Plateau (Delhi Ridge) → act as water divide → Indus/Ganga River system
- 3) Down thrusting → Malda gap → Rajmahal Hill; Meghalaya Plateau → Bay of Bengal drainage

#4 What is Indus River water system?

- 1) River basin → One third India (Jammu & Kashmir, Himachal Pradesh, Punjab)
- 2) **Origin** - Glacier → near Bokhar Chu → Kailash Mountain range (Tibet called Singi Khamban)
- 3) **Course**- Enters India- Damchok → Flows → Leh → Deep gorge → Enters Pakistan (Chillar, Dardistan) → deep gorge → hair pin bend → Discharge → Arabian sea
- 4) Major Right-bank tributaries → Shyok, Kabul, Gilgit, Khurram, Kunar, Hunza, Tochi, Nubra
- 5) Left-bank tributaries → Zaskar; '**Panjnad**' → joins at Mithankot → five rivers → Satluj, Beas, Ravi, Chenab, Jhelum

#5 What are the features of the Panjnad system?

- 1) **Jhelum** → rise → Verinag (Pir Panjal) → Navigable in some part; Tulbul Navigation Project
- 2) **Chenab** → Chandra + Bhaga → Originate → Bara Lacha pass (Lahaul) → largest tributary → Indus; Flows between → Pir Panjal – Greater Himalaya; Important project → Baglihar
- 3) **Ravi** → Rises Rohtang pass → flows → Chamba valley → drains Pir Panjal- Dhauladhar;
- 4) **Beas** → originate- Beas kund; Meets Sutlej → Harike; Only river of Panjnad that lies entirely in India;
- 5) **Satluj** → Originate → Rakas Lake (near Mansarovar) → Passes through Shipki La → Antecedent River → Canal system of Bhakra Nangal; Sutlej-Yamuna Link (SYL) canal
- 6) **SYL canal issue** → b/w Punjab & Haryana; 1960 – Indus water treaty → 'free and unrestricted use'; 1966 → Creation of Haryana → Green revolution; Water stress grew; Punjab refusal → Riparian principle; 2020 → Punjab → Tribunal → time bound assessment

Himalayan River system part 2

#1 What is the Ganga River System?

- 1) **Largest** → 26.3% geographical area, 10 states; **Ambala** water divide → Indus and Ganga
- 2) **Rises** → **Gangotri** glacier near Gaumukh (Uttarakhand) → Bhagirathi; **Devprayag** → Bhagirathi + Alaknanda; Enter plains → Haridwar; Allahabad → Ganga + Yamuna; Rajmahal hills, Ganga → bifurcates at **Farakka** into **Hugli** in West Bengal, **Padma** → Bangladesh
- 3) **Left** bank tributaries → Ramganga; Gomati; Ghaghara; Gandak; Kosi; Mahananda
- 4) **Right** bank tributaries → Son, Yamuna (originates → Bandarpunch; longest tributary)
- 5) **Chambal** → Badland topography, **Kosi** → braided + shifting course → Sorrow of Bihar

#2 What are the features of Brahmaputra River System?

- 1) **Origin** → Chemayungdung glacier of Kailash range near Mansarovar Lake.
- 2) Tibet → **Tsangpo**; Hair pin "U" turn → Namcha barwa; Dihang/Siang gorge; Tista + Brahmaputra → **Jamuna** (Bangladesh);
- 3) **Left** bank → Dihing, Dhansari, Kalang; **Right** bank → Subansiri, Sankosh, Kameng, Manas
- 4) Forms canyon → Tibet; **Majauli** island → world's largest **riverine island** + India's first island district; Excessive meandering → **Duars**;

#3 How is the ecological flow of Himalayan Rivers being affected?

- 1) Changing river regime → **drying** of springs (90% water); receding glaciers; deforestation
- 2) Drilling, tunneling, blasting → **run - river** hydro project → sedimentation → bed-load change
- 3) Pressure on land-use; depleting groundwater reserves; growing consumption demands → migration + settlement patterns change; reduction of temporal spread of rainfall
- 4) Identifying recharge areas + developing local capacity + incentivizing rainwater harvesting
- 5) Check dams, percolation ponds, injecting water into aquifers

#4 What are the various steps that can be taken to clean Ganga?

- 1) Classifications of Mini + Micro Projects; Maintaining base flow/natural flow; nirmaldhara + aviraldhara; Preserving natural ecosystem → Gharial → Chambal river
- 2) Policy of Zero discharge → Reuse + Recycle → grey water, natural manure; Non-Point sources → organic/natural farming;
- 3) Eco-hostile river-front development; minimum interference + minimum ecological flow;
- 4) **Namami Gange** → multi-sectoral + multi-dimensional + multi-stakeholder; 100% share - central sector scheme; Three level – (a) Entry level → river surface cleaning (b) Medium term → arresting the municipal and industrial pollution (c) Long term → determination of e-flow, increased water-use efficiency + improved efficiency of surface irrigation.

Peninsula River system

#1 What is the Peninsula River System?

- 1) **Older** than Himalayan drainage → broad, largely-graded shallow valleys → Maturity
- 2) Concordant drainage pattern → non-perennial+rain fed; Fluvial land forms;
- 3) Almost reached-→ base level river profile; Vertical down cutting→ negligible

#2 How are the peninsular river systems formed?

- 1) **Origin** → a) Subsidence of→ western flank of Peninsula; b) Upheaval of the Himalayas; c) Slight tilting of the Peninsular block →causing subsidence → rifts (trough, faults)
- 2) Earlier→ Sahyadri-Aravali axis → water divide; Cause east + west flowing river systems
- 3) Straight coastline+ absence of delta formations on the western coast

#3 What are the different components of peninsular river systems?

- 1) **East** flowing river → Bay of Bengal River system → **Mahanadi** (tributary→ Seonath, Jonk, Hasdo, Mand, Ib, Ong, Tel) + **Godavari** (tributary → Manjira, Penganga, Wardha, Wainganga, Pranahitha, Indravat) + **Krishna** (tributary → Kali Ganga, Koyna, Warna, Panchganga, Dudhganga, Ghataprabha, Malaprabha, Tungabhadra) + **Cauvery** (Tributary → Harangi, Hemavati, Bhavani, Kabini, Noyyal, Arkavathi, Shimsha) flow eastwards → drain Bay of Bengal → make deltas at mouth
- 2) **West** flowing river → Narmada, Tapi, Mahi → estuary formation → short course + drains fast into the sea + high inclination → hard rock → no distributary
- 3) Rivers draining into Ganga → **Chambal**, Ken, Betwa, Son, Damodar → bad land topography

#4 How are the Peninsular River system different from Gangetic River system?

- 1) **Originate** → Peninsular plateau, no glacial activity, variability in river regime → precipitation; waterfall at any course
- 2) Small basin + catchment area; flow in shallow valleys; little erosion activity; fixed course; absence of meanders, old plateau shields; not flood prone
- 3) Consequent drainage; superimposed; rejuvenated → trellis; rectangular; radial pattern
- 4) Western ghats → water divide; Western ghats → formation of springs; steep slope

#5 What are the importance of Peninsular River systems?

- 1) Increases **water availability** → rain shadow regions; groundwater recharge; Delta formation→ biodiversity → Krishna + Godavari delta; Ex: Kaleshwaram Lift multi-purpose irrigation project (World's largest Irrigation + Drinking Water System + transportation);
- 2) **Inland + national waterway** → Ex: River Godavari + Krishna → Kakinada- Puducherry
- 3) River basin → **agricultural bowl**; Kaveri → TN, Lower Karnataka → rice bowl;
- 4) Hydroelectricity projects → Ex: **Polavaram** Hydro Electric Project; Nagarjuna Sagar
- 5) Cultural significance → **Narmada** valley project+Sardar sarovar project → River basin approach; Ecological cost/impact → Submerging Forest + agricultural land → Displacement Catchment area treatment → Narmada Bachao Andolan

Soil System of India - Part 1

#1 How are soils Formed?

- 1) **Pedogenic Processes** → Addition + Losses + Translocation + Transformations
- 2) Acted by → climate + organisms; **Passive** factors → **Parent** material + **Climate** (role of precipitation + temperature) + **Biota** + **Topography** + **Time**

#2 What are the different characteristics of soils?

- 1) **Colour** → physical + chemical characteristics → Ex: Humus rich (dark); Red yellow (iron)
- 2) **Texture** → coarseness/fineness of mineral matter; 3 major → Clay, Silt, Sand
- 3) Texture affects → water content, water flow, retention of nutrients, aeration extent
- 4) **Structure** → arrangement → **Permeability** (greatest in sandy soils, poor in clayey soils) + Porosity (Clay → Porous but not permeable; granite → non-porous but permeable)
- 5) **Chemistry** → soil **acidity** (humid), **alkalinity** (arid, semi-arid), **neutrality**

#3 What are the different classifications of soil found in India?

- 1) Ancient India → Urvara → fertile; Usara → sterile;
- 2) ICAR classification of soils → Inceptisols, Entisols, Vertisols, Aridisols, Ultisols, Etc.
- 3) On basis of dominant features → Zonal soil; Azonal soil; Intra Zonal soil
- 4) Colour/Composition → Alluvial, Black, Laterite, Red and Yellow, Saline, Peaty, Forest, Arid

#4 What are Alluvial soils?

- 1) **Formation** → debris, sedimentation → silt of Tethys Sea → Azonal soil;
- 2) **Areas** → Northern plains + river valleys → narrow corridor → extend to Rajasthan, Gujarat; Peninsula → delta east coast + river valley; Upper + middle Ganga plain → **Khadar** + **Bhangar**
- 3) **Texture** → Sandy loam to clay → Sand content decrease west – east
- 4) **Colour** → light grey- ash grey; Depends on → Depth of deposition + texture + maturity
- 5) Transported soil → Lack humus + nitrogen [Except: Sunderban delta]; Rich → Potash+ lime
- 6) Soil profile → no stratification; certain areas → covered → unproductive wind-borne → **Loess**

#5 What are the importance of Alluvial soils?

- 1) New alluvium → rich organic matter; Periodic flooding → rejuvenation → soil fertility. Ex: Zuni people in southwestern US;
- 2) Requiring → least water → high porosity. India → 46% of total area of India
- 3) Major crops grown → rice, wheat, sugarcane, tobacco, maize, cotton, soybean, jute, etc.
- 4) Three dimensional riparian areas → **Ecotone** → Terai regions → ground water recharge; Biodiversity → flood plain → Wetland
- 5) Urban development → Low slopes → wide valleys → easy to excavate → population density
- 6) Fine particle → clay; Brick making + Pottery; Gravel nature → road aggregate + construction

Soil system of India - Part 2

#1 What are Black Soils?

- 1) **Regur soil** → 'tropical chernozems'; Deccan traps → Formation → Zonal soil
- 2) Maharashtra, MP, Gujarat, Andhra Pradesh, Tamil Nadu → Regions of Deccan plateau
- 3) **Texture** → Calyey → deep + **impermeable** → high water retention capacity
- 4) **Colour** → Black → Iron + Aluminium compounds + humus; Fertile soil; Thick → lowlands;
- 5) Soils swell → Sticky → wet; Dry → wide cracks; **self-aeration/ploughing** → absorb Nitrogen;
- 6) **Chemical** → Rich → lime, iron, magnesia, alumina; Poor → phosphorous, nitrogen
- 7) **Crops** → highly productive → cotton, pulses, millets, linseed, tobacco, sugarcane, citrus fruits

#2 How are Red Yellow and Laterite soils different?

Red yellow	Laterite soil
Formation → granites, gneisses, metamorphic rocks; well drained conditions, zonal soil	Formation → high flat erosion surface → High, seasonal rainfall; leaching → Zonal soil
Areas → piedmont zone → Western Ghats; Southern middle Gangetic plain;	Areas → Higher Peninsular plateau; Karnataka, Kerala, TN, MP
Colour → Red; Diffusion → Iron → crystalline + metamorphic rock; yellow → Hydrated	Reddish brown → iron oxide; lime + silica leached; humus content removed → drought
Porous , friable, poor → Nitrogen, humus, airy + need irrigation; intense leaching	Low in fertility; humus decomposed ; Poor → organic matter; Rich → Iron oxide; potash

#3 What are the importance of Black, Red, Yellow and laterite soils ?

- 1) Black soil → cereal production + pasture + range + forage system → food security; high **soil organic carbon (SOC)** content → greenhouse gas + mitigate climate change;
- 2) Laterite soil → soil stabilization → construction material → low-cost road, buildings
- 3) Red soil → 13% global abundance; Largest in India; Millet production

#4 What are the different irrigation methods that the soil system require?

- 1) Well Water Irrigation system → deep + shallow → red soils → drained in wet season;
- 2) Inundation Irrigation system → Alluvial deposits → Canal irrigation;
- 3) **Micro** → Sprinkler, Drip Higher Cropping + irrigation intensity; Water use efficiency → energy efficiency; off grid farmer → diesel + solar pump; Fertiliser use efficiency; increasing crop **productivity** → quality + quantity; **inter cropping** + crop rotation + **fertigation**; doubling farmer's income → overcome land salinization + degradation → Sustainability
- 4) **Challenges** – Variability in energy demand + low awareness + expensive set up cost
- 5) **IoT** based Smart Irrigation system → Precision agriculture → Hydroponic + Aquaponic

Soil system of India - Part 3

#1 How can soil erosion be reduced?

- 1) Natural + anthropological process; Medium – **Water** → Sheet + Rill + Stream + Coastal
- 2) 90% → water → Hydro dynamic force; Rill + Gully erosion → Punjab → Chos;
- 3) **Reason** → Rainfall Erosivity + Soil Erodibility + Topography + Soil surface cover + deforestation + Overgrazing + Faulty practices of agriculture+ road construction+ land use changes
- 4) **Consequences** → Primary sector + qualitative loss of productivity → economy; agriculture; loss of nutrient; **Siltation** → reduce water holding capacity-> flooding; wetland → reduce
- 5) **Conservation** → contour tillage + bunding + check dams + terrace farming + checking the extension of gullies + strip cropping + shelter belts + afforestation + ban shifting cultivation, controlled grazing + mixed cropping + mixed farming + rotation of crops + mulching
- 6) **Gov steps** → Drought Prone Area Programme (DPAP) + Desert Development Programme (DDP) + Integrated Wasteland Development Project (IWDP) + PMKSY + Rural development

#2 How is increasing soil salinity affecting food security?

- 1) **Reasons** → Irrigation, poorly drained + evaporation, leaching of salt, water table shallow+ seepage zones, over use of fertilizer, over extraction groundwater; sea water intrusion
- 2) **Outcome** → Chemical composition → natural water resources; poor soil structures; loss of fertile soils; yield + productivity reduces; Taxonomic replacement → halo-tolerant species;
- 3) **Food security** → reducing net cultivable area + choice of cultivable crops reduce + uncertain+ unstable livelihood security; low incomes;
- 4) Remedial measures → Nutrient based subsidy program, Pramparagat krishi vikas yojna, improving drainage, reducing surface evaporation, chemical treatments – Gypsum

#3 How is changing nature of land use causing soil desertification India?

- 1) Land degradation → climatic variations + human activity + population pressure on land pastoralism versus Sedentary cultivation; urbanization → lake capture; forest fires
- 2) **Outcome** → downward spiral of worsening degradation, poverty; rural migration → impoverishing cultural identity+ abandoning traditional knowledge, intercultural conflict
- 3) **Suggestions**→ irrigation facilities + ground water management + recharge; afforestation → suiting local needs; sand fences, shelter belts, woodlots, windbreaks, land reclamation Nutrient management, crop diversification→ Millet + legume intensification
- 4) Command Area Development Programme, National Afforestation Programme, National Action Programme to Combat Desertification, **Bonn Challenge** → land restoration and reclamation.

Ocean currents

#1 How are oceanic currents formed?

- 1) Ocean water movement → Horizontal → waves + currents; Vertical → Tides + Up - welling;
- 2) Ocean current → homogeneous block → definite path + direction; **Primary** force → heat + wind + gravity + Coriolis; **Secondary** force → Temperature + salinity difference
- 3) Solar insolation → Heat → expansion; Winds → magnitude, direction; Gravity → water down + gradient variation; Coriolis force → right → Northern hemisphere and Left → Southern
- 4) Secondary forces → vertical mobility; High salinity → Denser → Sinks; Cold water → Sinks

#2 What are the characteristics of oceanic currents?

- 1) **Types** → **Depth** → Surface + deep water (variation → Density + gravity); **Temperature** → Cold (high → Low latitude) + warm (warm → cold, low + middle latitudes); thermo - haline circulation
- 2) Northern hemisphere → clockwise; Southern hemisphere → anti - clockwise;
- 3) Warm currents → cool sea; Cold currents → Warmer seas; Convergence + Divergence;
- 4) Shape + geography → land forms; Some names of Currents

Boundary	Atlantic Ocean		Pacific Ocean		Indian Ocean
	North	South	North	South	
West → warm	Gulf stream	Brazil	Kuroshio	East Australian	Somali, Agulhas Mozambique
East → Cold	Canary	Benguela	California	Peru	West Australian

#3 How the oceanic currents results into Climatic changes across the globe?

- 1) Off-shore trade wind desert → Sahara, Kalahari, Mojave, Monte, Peru, Great Sandy
- 2) Western coast → Sub-Tropical High Pressure Belt → descending air, relative humidity low,
- 3) Cold current → mists, fogs; Desiccating effect → cold Peruvian Current → Chilean coast;
- 4) Warm current → heavy rainfall + high humidity → High evaporation; increase cloud cover

#4 What are the effects of oceanic currents on human activities?

- 1) **Fishing** → Mixing → cold + warm → richest fishing ground; Ex: Grand Banks, Japan coast
- 2) Replenish oxygen → growth of Plankton; Climate moderation, Precipitation, Growth → coral
- 3) **Navigation** → aided by Current → Strong near Surface; Ships follow routes;
- 4) Rain fed crop cultivation → agricultural activities, Forestry (lumbering activities), Grassland ecosystem → encouraged pastoralism, Desert Safari tourism → Namib desert

Iron and Steel Industries

#1 What are the factors that influence location of iron and steel industry?

- 1) **Raw material** → Source, heavy + weight losing raw material. Ex: TISCO – Chota Nagpur
- 2) **Markets** → heavy + bulky, transportation cost → high; minimize transportation cost
- 3) **Labour** → Cheap labour availability, Ex: Rourkela → Orissa; Bhilai → Chattisgarh
- 4) Availability of electricity → hydro+ Availability of water → Cooling; Ex: Bokaro → Damodar
- 5) Near ore mines → Manganese, Limestone, Dolomite; Near coal fields, Electricity smelting
- 6) Policy certainty → Gov subsidy, rebate, establishment costs, tax rebates, land acquisition

#2 Why is there a changing spatial pattern & distribution of iron and steel industry?

- 1) **Reasons** → Changing pattern → Consumption + Production + exchange of goods & services
- 2) Changing nature → Chinese production → 220% increase; Concentration → production → developing countries; Raw material concentration; Cross border → Acquisition + Merger
- 3) Within India → Deregulation, high priority industries → automatic approval; lowering of import duty → capital goods; Development of ports → Coastal location

#3 What are the issues with iron and steel industry in India?

- 1) Low steel import → Indian industry hit; Domestic steel company → losses; Cascading effect → Bad loan to the Banking sector; Strategic core industry → national security
- 2) Steps against **Chinese Steel dumping** → Anti-Dumping duty; Import tax → Boost domestic company; removal of quantitative restrictions on exports; Reduction → Rail + Power tariff; rationalize → coking coal classification
- 3) **Measures to boost demand** → Infrastructure, construction, rural and agro - based industries. Research and Development → setting → Institutes;
- 4) **National Steel policy** → steel production capacity → 300 MT by 2030; inter- sectoral growth; Self-sufficiency → Production; Channelizing → MSME; internationally competitive manufacturing capabilities; Domestic demand; Cost-efficient; Increase Per capita consumption → 160kg; Net steel exporter; Quality standards for Steel Production;
- 5) India's competitive advantage → steel production → indigenous availability of high-grade iron ore and non-coking coal; Contributor → manufacturing sector

#4 How is steel industry overcoming the problem of pollution?

- 1) Air-polluting emissions → metal oxide + smoke + fume + dust + organic, inorganic gases
- 2) Obsolete technology → inefficient system; Poor quality of ore, coke → Impurity → Leached
- 3) Covered under EPA, Need statutory clearance → Regulatory oversight; NMEEE → PAT
- 4) Iron & Steel Slag Utilization → construction & road making, soil conditioning, rail ballast
- 5) Reduce carbon footprint → Coke Dry Quenching, Energy efficient technology, Secondary Fume Extraction System, Regenerative Burners → Re-heating Furnaces, Re-use scrap

Coal

#1 What geological process led to the formation of coal?

- 1) Most abundant fossil fuel → 2/3rd of energy → India → 10% of global coal reserve
- 2) **Carbonation** → Dead vegetation + fauna → carbon rich coal → High temperature + Pressure
- 3) Carboniferous period → **peatification** and **coalification**; Bacterial action → Peat;
- 4) Energy in coal → Proportional → % of carbon content = More depth = more pressure + heat
- 5) Three main types: **lignite, bituminous, anthracite**. Coal deposits → India → Gondwana
- 6) **Coalification** → process → Peat → lignite → sub-bituminous → bituminous → anthracite

2 What are the location factors responsible for setting up coal based industries?

- 1) Gondwana coal → charcoal → labour + technology; Coal seams; Near to iron and thermal power plants; Bulky raw material + transportation;
- 2) Changing pattern due to access to → Port+inland waterways; Stringent norms
- 3) **Rat hole mining** → primitive + hazardous; pit → 3-4 feet diameter; vertical shafts; Illegal → Banned by NGT; Environment fall outs → increase acidic content of water bodies → acid run off

#3 What is the status of coal sector in India?

- 1) Coal → input → Steel (in coke form) → India only 15% coal reserve is coking coal;
- 2) Energy source → cement industry → later phased out → fly ash use; 10% of IIP
- 3) **Challenges** → High import dependence; Mining → clearing of forest → Delay in project approval; land acquisition; technology; monopolization of upstream sector CIL; Bottlenecks → Domestic transportation + logistic + hinterland connectivity; Coal block policy uncertainty → Captive/Non-Captive mining; Run of Mine project; Coal Mafia;
- 4) **Gov Initiatives** → Mineral Laws (Amendment) Ordinance 2020 → democratise the sector
- 5) 2015 Coal Mines (Special Provisions) Act; UTTAM → Transparency; SHAKTI scheme, Coal Mitra, Online Coal Clearance System, Coal Allocation Monitoring System, Commercial mining → revenue sharing mechanism

#4 How is the process of decarbonisation affecting coal sector in India?

- 1) Decarbonisation → process of reducing the amount of carbon → CO₂ → atmosphere
- 2) **Constraints** → Location + ownership factors + type of user constraint → Spatial distribution of energy; Coal → East + Central; Solar → South + West; Energy divide; tax revenue;
- 3) **Need** → Coal → dirty fuel → Mercury + SO₂ + Black Carbon → Acid rain; Health externality → lung, heart disease; Price parity; Acid mine drainage → exposure to Sulfur
- 4) **Dependence on Coal** → Electricity access + raise agriculture productivity; Cheap power → development aspirations; reliable + scalable; Employment generation- Ex: Rust belt USA
- 5) Policy pathways → job creation in low-carbon industries; robust low-carbon economic growth; peaking; Transition of workforce → coal mining to green jobs; energy access;

#5 Why is there a growing concern over shortage of coal recently?

- 1) Monsoon → uneven distribution → heavy rainfall → mining + transportation; Post Pandemic recovery → growth → demand; lean coal inventories → thermal power plants
- 2) Decline in renewable → hydro + gas (increase in price) + nuclear (maintenance shutdown)
- 3) Increasing international coal price → imports declined by power plants → non power industries consumption increased.



Fertilizer Industry

#1 What are the factors that influence location of Fertilizer industry?

- 1) Presence of oil refinery → nitrogenous fertilizers → naphtha. Ex: Hazira fertilizer plant. Proximity to Natural gas → Urea + Nitrogen → input (Haber process); Efficient; Cleaner
- 2) Iron & steel industry → steel slug + coke + lignite; Pipeline Infrastructure → Transportation → distributed production → Sea based location → Port facilities → HBJ pipeline → Bijapur
- 3) Availability of market + Raw material (mineral phosphate, raw potash material)

#2 What is the status of Fertilizer industry in India?

- 1) Core industry → 2nd largest consumer of urea → 2 type → Primary + Secondary + Micro nutrient
- 2) Primary → Nitrogenous (Urea), Phosphatic (di-ammonium phosphate –DAP), Potassic
- 3) Secondary → Calcium, Magnesium, Sulfur; Micro nutrient → Iron, Zinc, Boron, Chloride
- 4) High domestic consumption → weak production (private sector);

#3 What are the issues with fertilizer industry in India?

- 1) Fertilizer subsidy → Increasing, Political populism → subsidy payment under delayed;
- 2) MRP → urea → statutorily fixed; MRP → Phosphatic, Potassic Fertilizers market controlled
- 3) Disproportionate use of Urea → price control; Import Dependence → heterogeneous → raw material + feed stock regulated; Volatile International Prices → Controls on movement & distribution; demand-supply gap; Black marketing, routing to other destination
- 4) National Urea policy → maximizing indigenous urea production; energy efficiency; rationalize subsidy; timely payment; Neem coating (delay release of Urea);
- 5) Streamline policy for P&K fertilizers → balanced fertilizer use → 'reasonable' MRP issue

#4 How is fertilizer industry overcoming the problem of pollution?

- 1) Nitrogen pollution → Eutrophication → Increase BOD; Soil salinization; Green house gas emission; Fluoride pollution → Phospho gypsum → soil leaching → enters food chain
- 2) **Solutions** → Market linking → prices; Reform → sluggish PSU → revive growth; Loan write off
- 3) Vibrant home-grown fertilizer industry; Frontier technologies; Greater accountability → Procurement, storage, distribution;
- 4) **Bio fertilizer** → Using microorganisms → enhance yield of crops → soil fertility + reduce surface runoff + pollution; Ex: → Rhizobium, Azotobacter, Blue green algae bio fertilizer
- 5) **Nano urea** → nano scale nitrogen particles → increase surface area → urea uptake efficiency increases;
- 6) **Fertigation** → fertilizers + irrigation water → Increases water use efficiency + rate of conversion into yield → Higher + pH of solution → balanced

Petroleum refineries

#1 What are the factors that influence location of Petroleum refineries?

- 1) 2 major → a) Upstream/exploration/production/drilling; b) Downstream/Refining
- 2) **Exploration** → creating geological survey; land rights; production activities; onshore + offshore drilling; Geological survey → testing subsoil → onshore + seismic imaging → offshore; **Proven reserves** → extent a company predicts its production economically viable/recoverable oil and gas in place → time bound + Present level of technology
- 3) **Refining** → Field based refinery → transport + proximity → Off shore sites → export based facilities; Intermediate Locations → Transported through pipelines; Market Locations → densely populated areas; Coastal sites; Petrochemicals industry locations → Finished product; Political stability → Middle East;

#2 What are the different types of Petroleum crude?

- 1) 100 crude oils → International trade → 2 Benchmarks → West Texas Intermediate, Brent
- 2) **Brent crude** → four different fields → North Sea; Light (low density) + sweet (low sulfur); refining → diesel fuel, transportation → easy → off shore → port connectivity; **West Texas Intermediate** → extracted from US + Supplies → landlocked + very light + very sweet + ideal for gasoline refineries; **Shale gas** → natural gas + sedimentary rocks → drilling + fracturing
- 3) Hydraulic Fracturing → High pressure liquid + Slick water fracturing+ extraction from coal bed+ Tight sand formations + shale formations; Bulk of US energy

#3 What are the issues with Petroleum refineries in India?

- 1) Shortage of Crude → import dependency; demand → lighter product; production deficiency
- 2) Dependency on foreign countries → Geo-politics; less diversification in trading partners
- 3) Price → International fluctuations → inflationary + High import bill; Pollution tax
- 4) Shortage → Refining Capacity → expansion → new refineries + setting up new joint ventures
- 5) Exploration → new reserves → Firm valuations small → absence of Global giant+ presence
- 6) Technology issues → production → middle distillates, fire fighting systems → R&D is less
- 7) Market-Determined Pricing System → Common good → regulated + PSU presence

#4 What are the future Prospects of India's Petroleum product refineries?

- 1) Investing in capacity → Dual → acid gas + sulfuric acid regeneration; Upward + downward linkage → Merging of HPCL + ONGC;
- 2) **Hydrocarbon exploration Licensing policy** → (a) production sharing regime → revenue sharing regime; (b) Open Acreage Licensing Programme → transparency + stream lining procedure; (c) reduced royalty rates, marketing and pricing freedom, round the year bidding; (d) single license → conventional + unconventional hydrocarbon
- 3) **Strategic petroleum reserve** → Stockpile → meet contingencies → shock of crude oil → Places → Visakhapatnam, Mangalore, Padur, Chandikhole, Bikaner; **Need** → reduce import dependency, overcoming volatility in prices; Energy security; Strategic Cooperation (UAE)

Industrial corridors

#1 What are industrial corridors?

- 1) Economic ecosystem → Transportation corridor(nerve) → 2 major economic center
- 2) Competitiveness in manufacturing → world class infrastructure + reduced logistics cost
- 3) National Industrial Corridor programme → industrial cities + townships + investment
- 4) Multi modal connectivity (inland waterway, Freight corridor) + “Plug & Play” infrastructure
- 5) Building resilient + sustainable future; SDG 11; Convergence with Smart City Mission

#2 What are the different locations of industrial corridors?

- 1) 11 corridors → Hub and spoke model → Cities act as engine of growth → Employment + Socio-economic development Major Corridors → Delhi-Mumbai; Chennai-Bengaluru (JICA); Bengaluru-Mumbai (UK); Hyderabad-Bengaluru; Amritsar-Kolkata; East Coast Corridor etc.
- 2) **DMIC** → Japan-India coordination → High Speed – High Capacity” connectivity;
- 3) Amritsar-Kolkata Industrial Corridor (AKIC) → backbone → Eastern dedicated freight corridor
- 4) Special Purpose Vehicle setup; National Industrial Corridor Development & Implementation Trust (NICDIT)→ unified development + coordinating body
- 5) **Defence Industrial Corridors** → 2 DIC → (a) UP (6 nodes → Aligarh, Agra, Chitrakoot, Jhansi, Kanpur, Lucknow); (b) Tamil Nadu (5 nodes-> Chennai, Coimbatore, Hosur, Salem, Tiruchirappalli) → defence manufacturing ecosystem + investment; indigenous production national security; self reliance; reduce import bill; MSME → direct,indirect employment

#3 What is the significance of industrial corridors in India?

- 1) **Economic benefits** → Logistics infrastructure, freight handling, feeder connectivity + industrialization+ urbanization; economies of scale; Reverse distress migration; hinterland development; cluster model → hub and spoke model; demographic dividend
- 2) **Socioeconomic benefits** → raise per capita incomes → better social indicators → Technical educational/skill training institutes; Increasing labor productivity
- 3) Manufacturing → competitiveness increase; Linking major cities → Federalism strengthened

#4 What are the Challenges to setting up industrial corridors?

- 1) Land acquisition → Legal hurdles + compensation issue + eviction of locals; Environment clearances + Eco – sensitive areas → Sustainability Versus Economic growth debate
- 2) Investment friendly policies; Friendly taxation system → clearly defined tax liabilities;
- 3) Agriculture land diverting → Land stress, food security → protest by farmers
- 4) Complexity → Inter ministerial + Intra regional + inter state → administrative issues
- 5) Relative comparative advantage of industries→ Integration with global value chain.
- 6) Existing forward and backward linkages + Skill availability; Power and water availability
- 7) Nurturing corridor → MSME supplier ecosystem → decentralized + equitable development
- 8) Labor reforms → progressive → balance wages + quality of work + institutional reform

Dedicated Freight Corridors

#1 What are Dedicated Freight Corridors?

- 1) High speed + high-capacity railway corridor → Transportation of freights → safe + efficient
- 2) Project → Ministry of Railways; 6 freight corridors → Western DFC, Eastern DFC, North-South, East-West (Bengal-Maharashtra), East-South (Bengal-Andhra Pradesh), South-South
- 3) Implementing Body → Dedicated Freight Corridor Corporation of India (DFCCIL)- 2006
- 4) **Western Dedicated Freight Corridor (WDFC)** → Dadri - Jawaharlal Nehru Port (1468km); JICA funded; 4 states → Haryana, Rajasthan, Gujarat, Maharashtra, Uttar Pradesh
- 5) **Eastern Dedicated Freight Corridor (EDFC)** → Ludhiana → Dankuni (west Bengal) 1760 km Route → Punjab, Haryana, Uttar Pradesh, Bihar, Jharkhand & West Bengal; Coal mines + Thermal power plant + industrial cities + Feeder route; World Bank funded;

#2 What was the need for setting up Dedicated Freight Corridors?

- 1) **Congestion** → increasing freight volume; increase in infrastructure, increased axle load, reduction → turn-round time, reduced unit cost of transportation, rationalization of tariffs
- 2) Saturated **Golden Quadrilateral Freight Corridor** → 55% revenue earning freight
- 3) **Single tracks** → Passenger + freight trains → Failing share of goods traffic (only 36%)
- 4) Under investment of Railways → Attract private investment + Ease of doing business

#3 What are the advantages of Dedicated Freight Corridors?

- 1) Better freight operation + handling + movement (speed); Complement port led development
- 2) Revenue for railways → Market share + non fare revenue → up gradation of technology
- 3) Inflationary diesel fuel → indigenous electric power → Current account deficit improve
- 4) Technology transfer + operational expertise + Skill + capacity. Ex: Delhi metro
- 5) Facilitate industrial activity + multi-modal value-addition services hubs + Industrial corridor
- 6) Double stack technology → Passenger trains → reduced ticket prices + increased access
- 7) Reduced emissions + green house gases → reduced pollution + earn carbon credits

#4 What are the Challenges to setting up Dedicated Freight Corridors?

- 1) Private freight terminals + Logistics parks → hurdles in implementation → Risk + uncertainty
- 2) Road (rural areas) → doesn't suit NHAI standards → heavy vehicular traffic
- 3) High land cost + inflexible contractual terms → PPP risk sharing+ objective contractual
- 4) Railways → Part of supply chain not a stand alone competitor
- 5) Delay → almost a decade old → Land acquisition (titling) → loan approval (mounting NPA)
- 6) Passing through multiple states → file movement → administrative delays → sub federalism

Inland Waterways

#1 What are inland waterways?

- 1) Network of river, canals, back waters, creeks → Transportation + hinterland connectivity
- 2) 14500 km navigable waterway → 111 projects → National Waterways Act 2016 – Inland water way authority of India → Statutory → build infrastructure + surveying + regulation

#2 What was the need for promoting inland waterways?

- 1) Low cost + Low capital + operational ease + maintenance + Low energy consumption;
- 2) Fuel efficiency + Fewer emission + Meet INDC targets → Process towards decarbonization.
- 3) Increase capacity (goods + passenger) + Under utilization of navigable waterway
- 4) Growth → Industrial growth + tourism; reduce logistic cost; reduce congestion of roads
- 5) Fewer accidents → safer + reliable medium; Accessibility → between remote areas
- 6) Private investment → inland vessel fleet → Market forces + bigger & better vessels

#3 Where are the different inland waterways located?

- 1) Criteria → capability of navigation, continuous, interest of more than one state, safety etc.
- 2) 13 waterway developmental activity underway → **NW 1** → Ganga-Bhagirathi-Hooghly River system → 4 states → Uttar Pradesh, Bihar, Jharkhand, West Bengal; (b) **NW 2** → Sadiya - Dhubri (Brahmaputra); (c) **NW 3** → Kollam-Kottapuram stretch (West Coast Canal)
- 3) NW 1, 2 → alluvial rivers → braiding, meandering, water level fluctuation etc. Pre requisite → Fairway → depth + width; navigational aids; multi modal terminals (road + rail)
- 4) NW 3 → tidal canal → predictable + uniform tidal variation; nominal maintenance

#4 What are the impacts of inland waterways on economy?

- 1) One time capital investment (Brownfield); No land acquisition → Time + cost overrun avoid
- 2) Employment generation → Supporting projects → Canals + Inter linking of river + JMVP
- 3) **Jal Marg vikas project** → Multi modal + Inter modal terminals + Roll on roll off ferry service + navigation lock (Farakka) + depth dredging, integrated vessel repair + River information system; Varanasi – Haldia stretch; World bank funded; PPP model
- 4) Reduce import bill → Fuel consumption reduce → Transportation of bulk goods
- 5) North East connectivity → Growth inclusive; New markets → Boost rural demand

#5 What are the issues in implementing inland waterways?

- 1) River diversion → irrigation, industrial needs; reduced depth + shoal formation;
- 2) Excessive silt loads → erosion of uplands → bad catchment management + deforestation → **LADIS** (Least Available Depth Information System) → real time data + transportation
- 3) River conservancy measures inadequate → gradual deterioration + inter state/intra country river dispute; Inadequate vertical + horizontal clearances → plying vessels → economic size → traditional waterway routes
- 4) Adequate terminal size lacking; Ecological sensitivity of rivers → Ex: Gangetic dolphins
- 5) Displacement of fishing community, people dependent on riverbed cultivation

Cropping pattern

#1 What are the features of Indian cropping pattern?

- 1) Proportion of area → crops → given time → unit area; Temporal + spatial arrangement
- 2) India → tradition bound + Food crop oriented (rice, wheat → base crop) + regional variation
- 3) Subsistence level → Number of crops grown; Cash crops → Negligible; Rain fed nature
- 4) Small size → Land holding; Over dependency → Food security; Pressure → Land resource
- 5) **Cropping System** = Cropping Pattern + Management; Efficient utilization of resources + Stability, Higher net agricultural return

#2 What are the factors affecting cropping patterns?

- 1) **Geographical** Factor → physical environment + fertility + climate + temperature + moisture
- 2) **Socio - Cultural** Factors- Food Habits, Customs, Traditions, local preferences etc.
- 3) **Infrastructure** Factors → Irrigation, Storage, Transport, Extension Services etc.
- 4) **Economic** Factors - Land Ownership, Land Tenancy, Land tenure, Size of Land Holding Labor Intensive and capital-intensive agricultural crops, information system + marketing
- 5) **Technological** factor → Mapping, drones, availability of genetic seeds
- 6) **Government** policy → Non-distortion, price support mechanism, rural credit availability

#3 What are the significance of cropping systems?

- 1) Enhancing soil fertility → Nitrogen fixation; perennial forages + millet → soil organic content
- 2) Inhibit pest, disease → biological predator; reduce homogeneity, against dispersal of pest
- 3) Resource efficiency → Integrated farming system → ecological sustainable
- 4) Reduce risk of crop failure → differential response → climate → income security to farmer
- 5) Food security → fork to farm; nutritional deficiency overcome; crop diversification

#4 What is the changing nature of cropping pattern in India?

- 1) **Pre-Green Revolution Phase** → 3/4th, → under food crops → sugarcane dominated
- 2) **Green Revolution Phase** → MSP announced → assured market + income; wheat-rice predominance; self-sufficiency; intensive + commercial agriculture production system
- 3) **Economic Reform Phase** → rise of Agricultural export + corporate, contract farming + mechanization + diversification → non-food crop prominence; Prime moving force

#5 What steps have been taken to correct the imbalances in cropping pattern?

- 1) Reasons → food grains → remunerative + productive; MSP → rice, wheat high sans millet
 - 2) Change in consumption pattern → cereals → rice + wheat; food processing + middle class
 - 3) Change from demand driven production pattern → reduce input cost; storage is poor
 - 4) Gov Measures → National food security mission → increasing production → pulses
 - 5) Increasing push towards oil seeds + oil palms; millet; fortification of crops; horticulture
 - 6) Rationalization of MSP; Soil health card scheme → improve soil fertility + organic farming
-

Population part 1 of 2

#1 What is population growth?

- 1) Change → number of inhabitants + specified territory + specified time; Might be +ve/-ve
- 2) Natural growth → Births – Deaths; Actual growth = Natural Growth + Net Migration
- 3) Density → number of people/size of the land → Persons/sq km

#2 What are the factors that influence population distribution?

- 1) **Geographical factors** → Availability of fresh water, Land forms (gentle slopes, plains), Climate (harsh climates → sparsely populated), Soils (agriculture soils)
- 2) **Economic Factors** → Minerals(mining), Urbanization (Migration), Social + Cultural factors, Industrialization, Ease of living, economic opportunities

#3 What are the different types of migration in India?

- 1) **Internal migration** → Inter + Intra regional; Long term + Short term; Construction;
- 2) Rural-Urban Migration → Economic reasons → Second five year plan → industries set up, Large growth → IT industry; increased by LPG based reforms
- 3) Seasonal migration → rural landless, agriculture, religious reasons → urban areas → Footloose industries; under employment; Tourism industry → Hilly areas in summer
- 4) Rural-Rural migration → social reasons → marriage, communal tensions, evictions, resettlement; Urban-Rural → reverse migration/counter current → largely old population

#4 What are the challenges of migration in India?

- 1) Urbanization → demographic explosion + poverty-induced → rural-urban migration
- 2) Inter state migration ~ 9 million annually; Climate change → Disaster induced migration
- 3) Distress migration → rural-agrarian crisis; pandemic induced → lock down; Vulnerability increases due to → lack negotiating power + lack social + political clout
- 4) Ghettos and urban slums; social impact → crime rate increase; poor social indicators
- 5) Environment degradation → urban ecology → urban heat island, eutrophication of urban water bodies, air pollution, land + water stress. Ex: Bengaluru

#5 How can the problem of increasing migration be resolved?

- 1) Structural gaps → circular migration → Opportunities in rural areas → Shift from primary to tertiary sectors; social security + formalization of economy → estimation of number
- 2) Development of satellite towns → alternate industry; absorb the excess migrant
- 3) Rural urbanization → RURBAN mission; MPLAD, Sansad Adarsh Gram Yojana, PURA
- 4) Developing → functional towns + functional specialization; reduce load on urban centres
- 5) Smart city mission → Affordable housing programs (PM AWAS yojana); Law enforcement needs to be sensitized → Looked with suspicion
- 6) Peace, stability, regional development, digital literacy → ASPIRE scheme, DISHA, CSC scheme, MGNREGA → Better remuneration and timely payments

Population part 2 of 2

#1 What is demographic transition?

- 1) Population of region → High birth/high death → low birth/low death → rural agrarian → urban industrial → cycle → demographic cycle
- 2) first stage → high fertility + high mortality; Growth → slow; Second stage → fertility → mortality; Third stage → decline in mortality (net addition); Last stage → fertility + mortality stabilizes; population either stable → grows slowly

#2 What is demographic dividend?

- 1) India → 62.5% → 15-59 years; Peak around 2041; share of working age population → 59%
- 2) Economic growth potential → shifts in a population's age structure → share of working-age population > non-working-age share
- 3) First → Working age population increases + % of dependents (young + old) decrease
- 4) Second → increase in adult longevity → savings increase → economic growth + investment

#3 Why India should focus on demographic dividend?

- 1) Economic growth → increasing economic activity → domestic demand → higher working population → per capita GDP increase → consumption increase
- 2) Human capital → Potential workforce → advanced economy + self reliant India
- 3) Increased labor supply → Productivity + skill; Capital formation → Increase stock of capital
- 4) Accelerate shift → knowledge economy + disruption → innovation economy → unicorns
- 5) Creation → social goods → health + education → resource divert → infrastructure
- 6) **NFHS 5** → TFR → Replacement rate (2.1) → 19 states; Demographic shift → 1020 women / 1000 men; Sex ratio at birth → 929; More than 50% → anaemic child + women; Significance → Urban (1.6)-Rural divide (2.1) in TFR; North (younger + male)-South divide; Challenges → Women → translate → economic freedom + autonomy; literacy rate; overcoming divide

#4 What are the challenges of demographic dividend?

- 1) Enhancing skill → human capital → unproductive + under employed
- 2) Low human development → Nutritional deficiency + Life expectancy + stunting + wasting
- 3) Informal economy → low wages + little social security → seasonal employment
- 4) Jobless growth → deindustrialization, de-globalization, 4th industrial revolution, technology
- 5) Asymmetric demography → Concentrated poor state → Southern states → replacement rate
- 6) Skewed gender ratio → Declining female labor force participation → 27%
- 7) **Demographic disaster** → Digital technology substituting current jobs + lack of skills → increase old population → economic insecurity → state burden → social security

#5 What can India do maximize the outcomes from it's demographic dividend?

- 1) Addressing social evil → child marriage, access → quality sexual + reproductive health services + family planning services + contraceptives → reducing fertility
- 2) Building human capital → Investing → healthcare + education + job + skill → NSDC + PM kaushal vikas yojana + digital literacy; inclusive society → fighting erosion of opportunity

- 3) Nutritional security → RMNCH + A → ICDS scheme → Start up + Stand up India scheme
- 4) Urbanisation → Planned + safe sustainable cities; Smart City Mission, AMRUT mission
- 5) Job creation → formal + white collared → EODB → Business interest + entrepreneurship



Pulses and Millet Cultivation

#1 What is the status of production of pulses and millet in India?

- 1) Pulses → High quality protein + complement cereal protein; Low cost → Dietary habit suited
- 2) Leguminous crops → restoring → soil fertility; Source of Protein; Less moisture → dry conditions; Major states → Madhya Pradesh, Uttar Pradesh, Rajasthan, Maharashtra, Gram → 40% share; Tur/Arhar → 20%; Cultivated → Marginal + sub marginal land
- 3) 2023 → International year of Millet. Common millet grown → Jowar(sorghum), Bajra, Ragi etc. Millet → 60% less coverage area; Important source → Nutritional security

#2 Why is the government pushing towards increasing pulses and millet production?

- 1) Famine reserves → non-acid forming, non-glutinous, highly nutritious, easily digestible, low glycaemic index (GI) → slow release of glucose; good amount of dietary fiber
- 2) 'Miracle grains' + 'crops of the future' → Wider adaptability → coastal → dry areas → withstand → moisture + temperature variability + drought resistant
- 3) Dual purpose → Food + Fodder → livelihood + livestock; low use of chemical fertilizers
- 4) Curbing the life style disease → important to fight changing disease burden of India
- 5) Environmentally sustainable agriculture → reduce atmospheric carbon pressure

#3 What are the issues with production of pulses and millets?

- 1) Climate resilient staple food crops → dry land agriculture; Rain fed area → most cultivated
- 2) Supply – demand mismatch; Decreasing production; low demand due to look + taste
- 3) Short–shelf life → storage → primary processed product; Lack of awareness → health benefit
- 4) Higher incidence of pest + fungal infection → rainy season; Absence of production support
- 5) Competition → market friendly remunerative crop + preference pattern in consumption
- 6) Huge import bill; Policy bias towards → Rice + wheat; Low yield → seeding + milling loss

#4 What are the steps that have been taken to increase pulse and millet production?

- 1) Inclusion in (Targeted) Public Distribution System → **sub-mission 'Nutri-cereals'** → high nutritive value + anti-diabetic properties
- 2) Nutritional Security through Intensive Millet Promotion → under RKVY → integrate improved production + post harvest technology; NFSM → enhance production
- 3) Pricing support → MSP + price realization + procurement + inclusion under NFSM, PDS
- 4) Short duration → Pest resistant crop; Seed multiplication → increase per capita availability
- 5) Area expansion → change cropping system → cereal-based cropping, inter-cropping
- 6) Buffer stock → overcome seasonal variability → Food + nutritional security → Protein; Low carbon + water footprint → sustainable farming system + dietary diversification
- 7) Small holder centric crop → Efficient market system → FPO+ electronic National Agriculture Market → value chain integration

Horticulture Crops

#1 What are the various components of Horticulture?

- 1) Agriculture → related → fruits, vegetables, flowers, ornamental plants, spices, cashew, cocoa
- 2) Capital + labor intensive → India's share → fruit → 10%; vegetable → 14%; 2nd largest producer
- 3) **Fruits** → Banana top produced fruit (Tamil Nadu); Mango → Largest area cultivated (U.P)
- 4) **Vegetables** → highest share cultivation → Potato; Uttar Pradesh → highest in production
- 5) **Flowers** → Increase well being + affluence; diverse agro-climatic condition; Floriculture → increasing area → loose + cut flowers; Tamil Nadu → highest share of production

#2 What is the status of horticulture sector in India?

- 1) Contributes → 30.4% → India's agriculture GDP; Improving income → rural sector → employment; Doubling farmers income; smaller scale of cultivation
- 2) Food security + Hidden hunger → reduce; Nutrition → POSHAN abhiyan; roughage+ fibre
- 3) Increased production → export; Value addition → Food processing industry → raw material
- 4) Horticulture growth → agriculture; Low per capita consumption → low (46gms, 130gm)
- 5) Cultivable wasteland → Horticulture crop → without diverting agricultural land

#3 What are the challenges to horticulture sector in India?

- 1) Price realization → dumping of farm produce → distress sale → dip in production cycle
- 2) Market inefficiencies → short shelf life + poor storage capacity; poor government policies
- 3) High input cost + initial capital high → Small+ marginal farmer → lack resources
- 4) Volatility → price fluctuations; Export oriented → WTO norms → phyto sanitary measures
- 5) Limited availability → market intelligence + hedging risk → future trading
- 6) Climate change variability → Ex: loss of apple production → hailstorm, landslide

#4 What are the steps that have been taken to increase horticulture production?

- 1) **MIDH** → Mission for Integrated Development of Horticulture → Integrate → Horticulture+ Bamboo+ Coconut → (a) Holistic development; area based regionally differentiated strategy; (b) Encourage aggregation of farmers → FPO, SFAC, Co-operatives; (c) Improve productivity → germplasm, water use efficiency → Micro Irrigation; (d) skill development + employment generation → post harvest management + value addition + cold storage
- 2) Remote sensing + Geographic Information System → planning + monitoring; Ex: Bhuvan
- 3) Technology driven program → High Density Plantation+ Bee-keeping for crop pollination
- 4) **National Horticulture Mission** → Rejuvenation, replacement senile plantations → canopy management → low productivity farms; Integrated Pest Management; Post harvest management + processing; Cluster based development
- 5) Construction of green houses, shade net house, plastic mulching, plastic tunnels, anti bird/hail nets → construction cost to be minimal
- 6) TOPS/Operation Greens → enlarged → 22 perishable products → Subsidy on transportation + storage → TOP → TOTAL → increase market availability → avoid distress sale
- 7) **National Bamboo Mission** → Yield + new variety + coverage area for bamboo; Promotion of marketing → handicrafts; Develop technology → scientific + traditional; Employment



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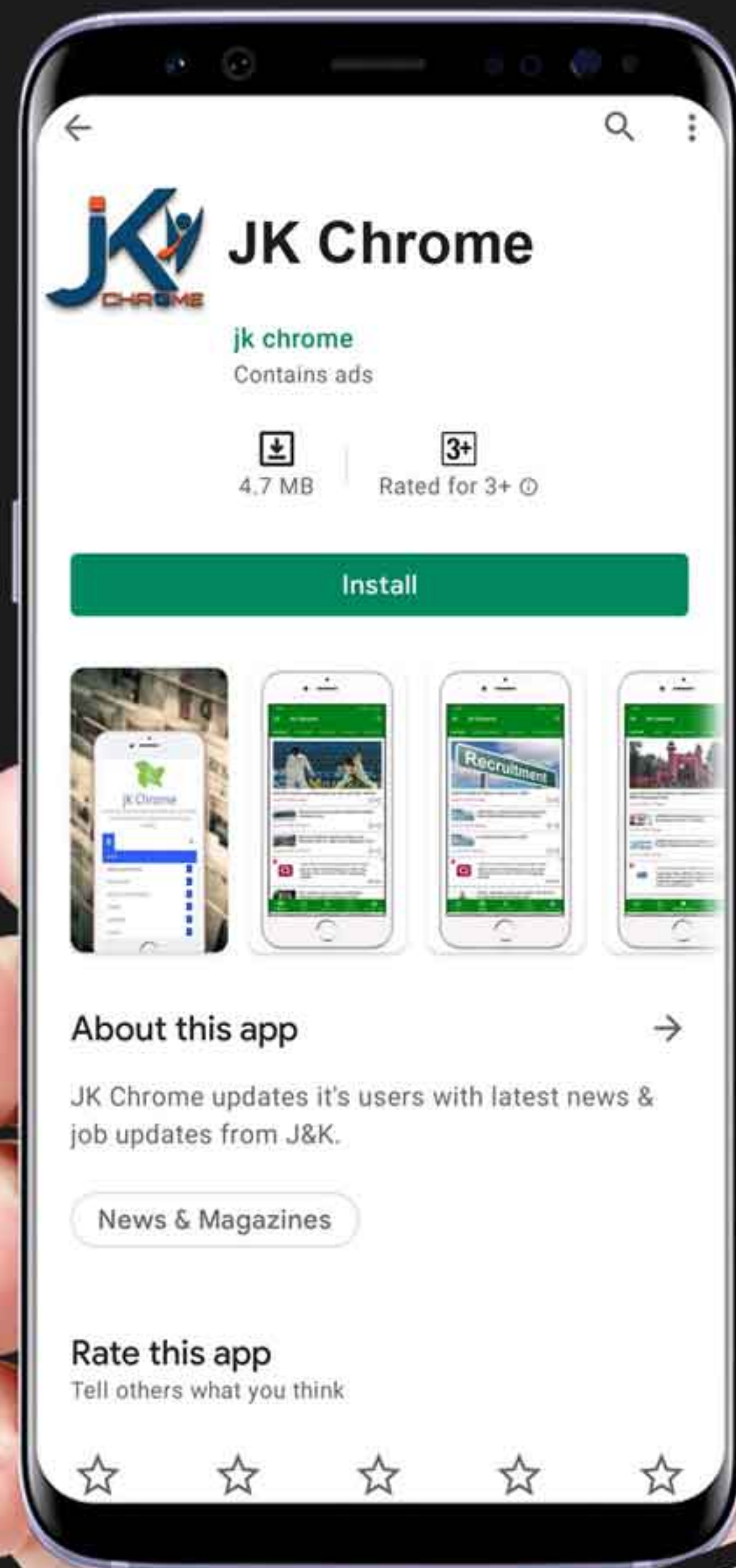
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