

SYLLABUS - GEOGRAPHY

GS-I : Geography of World & Society

- Salient Features of World's Physical Geography
- Distribution of key natural resources across the world (including South Asia & Indian Subcontinent); factors responsible for the location of primary, secondary and Tertiary sector industries in various parts of world (Inc. Ind.)
- Important Geophysical phenomena such as EQs, Tsunami, Volcanic activity, Cyclone etc., geographical features & their location - changes in critical geographical features (including waterbodies & Ice-caps) and in Flora and Fauna and the effects of such changes

Prelims GS :

India & World Geography - Physical, Social, Economic
Geography of India and the World

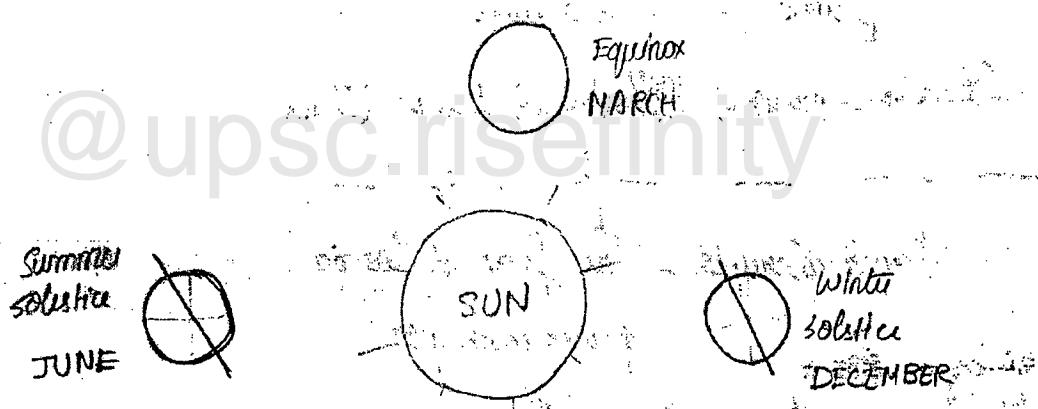
GEOGRAPHY - G.S (Prel & Mains)

(Physical Geography)

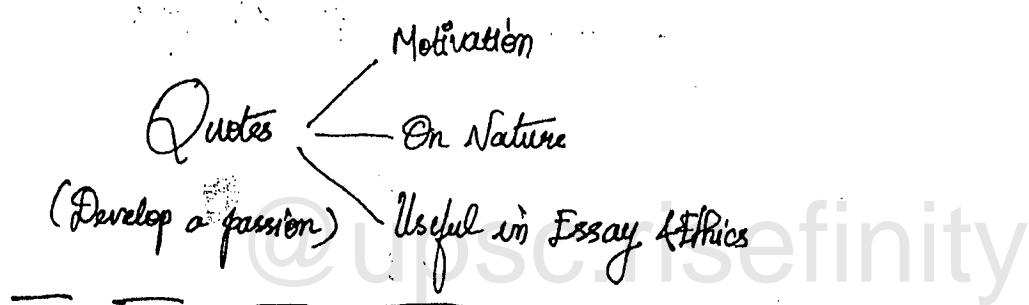
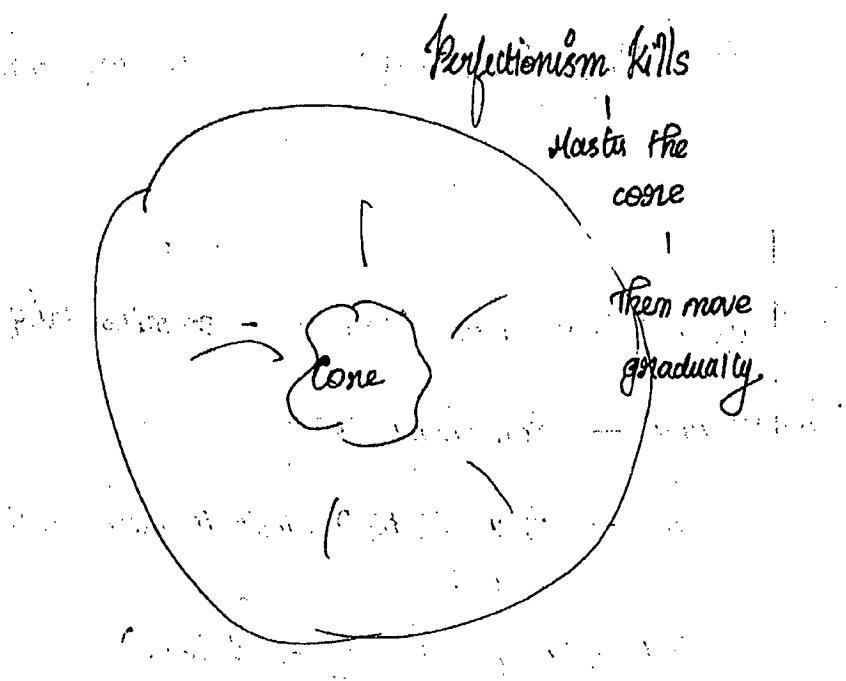
- Geo
1. ATLAS - Orient Black Swan (2018) - 30 mins daily
 2. Physical Geography - Goh Cheng Leong
 3. Indian Geography - VI-XII (later) - don't do mechanically
NCERTs

India - Physical Environment (XII - 2nd Sem)

India - People & Economy (XII - 4th Sem)



EQUATOR \Rightarrow same length for day & night always



~~Power corrupts~~ - The fear of losing
 power corrupts

Chinese - Practical ppl - Plan for 20-30 yrs
 ahead - unlike us

Basement

25/5/18	Economics	Vibush
26/5/18	Economics	Shyam Sunder
27/5/18	Geography	S.K. Narocha

* QUOTE TIME :

1. Chinese = "Talk does not Cook Rice"

- Indian P → W

- Japanese W → P

2. If you want to be happy,

Get a goal that commands your thoughts,
Liberates your energy &
Inspires your hopes.

3. "While we are postponing life speeds by"

4. "You have to think anyway"

So why not think BIG? - Trump

5. "Life is Beautiful"

* - Conditions Apply

* GUIDELINES :

Pne - Maine - PI

1. Don't compartmentalize preparation

- Integrated Preparation

2. Make Synoptic Notes of whole syllabus -
for Proper Revision

- Getting 55% in all papers in same
attempt is the crucial thing

Plan → Work
Work → Plan

Love what you do
& you don't have
to work for a
single day

Don't be serious
But be Sincere
With a Smile

Smart Hard Work

+
Disciplined Hard Work
Routine

Japanese -

Continuous

Improvement

It's no wrong
on Building
castles in the air
but provide
foundation for it

"Life is too short
to make all
mistakes oneself,
learn from others!"

NEWSPAPER

- Backbone of the Examination
- We can do most of Essay of Ethics by newspaper alone (Min. 5 Essays before Exam)
- Ethics - Back the concepts of class with Newspaper - Illustrations from society
- 50% - 60% of GS from Newspaper
- "THE HINDU"
- know what to Read & what not to

'Shortcuts most often lead to delays'

- Read newspaper yourself - No booklets or classes -

DO TODAY

- ✓ Head copy of SYLLABUS & Previous P.V. Papers
- keep with you always
- Look at it often

4 things to be in Bag

- ✓ ATLAS
- ✓ Syllabus
- ✓ Newspaper
- ✓ P.V. On papers

* Pg: 2-5

- Carries Regional news

- Generally not *, unless it has a national bearing

* Pg: 6-7

National News - may/may not *

* Pg: 8:

Editorial

1. Generally important

2. Depends

Critical View pts

Why Hindu Edit

is Good

Background

Way Forward

- It is most often the most important page

1st editorial - generally relevant

2nd editorial - may/may not be

* Pg: 9

OP-ED

- Look for articles relevant for exam

* Pg: 10, 11

National news items

Genuinely more important

* Pg: 12

World News

Genuinely important

SPORTS

Power Monthly Magazines from Institute

Special Columns

i) BUSINESS REVIEW COLUMN - Pg: 14 - every Monday

ii) WEDNESDAY INTERVIEW - Pg: 9 - genuinely important

iii) SINGLE FILE COLUMN - Pg: 9 - M to F - Important

iv) 3-D DISCUSSION of a current issue - Pg: 9 - Every Friday

v) S & TECH - Pg: 14 - Sunday - Important

vi) GROUND ZERO - Pg: 7 - Saturday - Analysis & Facts - Important

vii) HOW, WHO, WHAT, WHY, WHEN, WHERE - Pg: 12 - Sunday

PORTAL

- it is daily

Topics Crit. Analy Background

- Weekly MCQs

- Answer Writing Practice

If you are going through hell, keep going

- W. Churchill

"If you are dealing with, break/divide it into parts, deal them separately"

- H. Ford

GEOGRAPHY

* Geo + Graphien - The word literally means:

'Description of Earth'

* Greeks are supposed to be the 1st Geographers

* Eratosthenes coined the word 'GEOGRAPHY'

defined it as, "the study of the Earth as the Home of Man"

"Science is the Deadly Enemy
of Uniqueness" - BUNGE

- Science gives us 'Generalization'

'Pattern' — 'Order' — 'Theories'
↳ 'Design'

Geography is governed by a
method rather by a specific body of
knowledge and this method is

'SPATIAL ANALYSIS'

Anything which is in 'NON-UNIFORM'
distribution can be subjected to Sp. Ana.

'GEO-POLITICS' - Refers to geographical
causation of international politics

Geography, Geology

Predominantly | Predominantly
the study of the | the study of interior
earth's surface | layers of earth

Nonetheless, they overlap

"Order behind the apparent
chaos"

→ Finding that order behind
any seeming chaos is what
will make things simple & easy

- Science does exactly that

↓
Geography - SPATIAL SCIENCE

And anything under spatial
analysis is a subject matter
of Geography

- which is almost everything

* QUOTES TIME *

* "Nature nurtures us; we must nurture Nature"

* "Nature to be commanded; must be obeyed"

GEOODESY The science that attempts to determine Earth's shape and size by surveys and mathematical calculations.

Earth's Shape:

- ✓ In 1687, Sir Isaac Newton postulated that round Earth along with other planets couldn't be perfectly spherical.
- ✓ Until this time (From 5th cen B.C.) Spherical = Perfection model was the basic assumption of Geodesy.
- ✓ Newton reasoned that Earth is slightly misshapened by its spinning, making it bulge through the Equator & flatten at poles - This shape he called Oblate Spheroid.
- ✓ Today the Earth is called "GEOID".
- ✓ 'Geoid' means that the shape of the Earth is uniquely Earth shape.

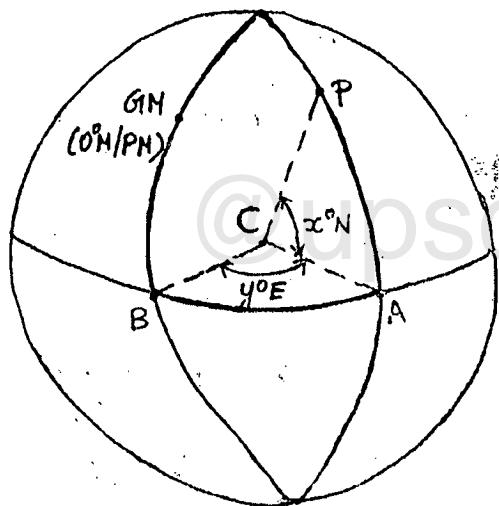
Slightly flattened Polar Diameter - 12,714 km

Slightly Bulging Equatorial Diameter - 12,756 km

Percentage Difference = 0.3%

For most practical purposes, Earth may be properly considered as a sphere!

Indeed it is a more nearly perfect sphere than most of the spheres (nearly) with which we come in frequent contact with (Footballs, Basketballs, etc.)



Fundamental to any Geography analysis is the development of a comprehensive & logical framework to establish accurate location of any spot on Earth Surface.

1884 I.N.C
(2-1 original)

- I. D. L - 180° E/W
- 0° Greenwich mer.
- 3 readings
- D. Brit. influe
- 2) Royal observat
- 3) I. D. L

CA - Horizontal line
on Equatorial plane.

Latitude - Angle
Parallel - line

meridians (lines)
high st. of sun in a day

Greek - Ptolemy
Simplicius - business minded
Pure science - dev. TIME
- sun dials.

The imaginary grid system is anchored by the position of the poles and Equator which are determined by the Earth's slight variance from a perfectly spherical shape.

LATITUDE is the angular distance measured North or South of the Equator.

→ we can project a line from a given point (P) on the earth surface to the centre (C) of the earth. the angle between this line (PC) and the Equatorial plane is the measure of latitude of the given point.

→ Latitude varies from 0° to 90° N & S of Equator

Parallel: It is a line connecting all points of same latitude.

→ A parallel is called so because all lines of latitudes are parallel to each other.

→ 0° parallel is called EQUATOR.

LONGITUDE is the angular distance between the meridian passing through a given point and [Greenwich Meridian [0° N or Prime Meridian]

→ It is measured 0° to 180° E & W of GM.

Meridian: It is a line joining places with same longitude.

The word "Meridian" was given by Roman emperors to refer to the moment of the day when the sun is highest in the sky.
(i.e - 12 NOON moment)

GREAT CIRCLE (Mathematical concept)

Any plane that is passed through the centre of the sphere bisects that sphere & creates a great circle where it intersects the surface of the sphere.

A great circle is the largest circle that can be drawn to a sphere and it represents the circumference of that sphere.

of all the parallels. Equator alone makes a Great circle. All other parallels make small circles.

Ex, Each meridian makes a semi-Great Circle.

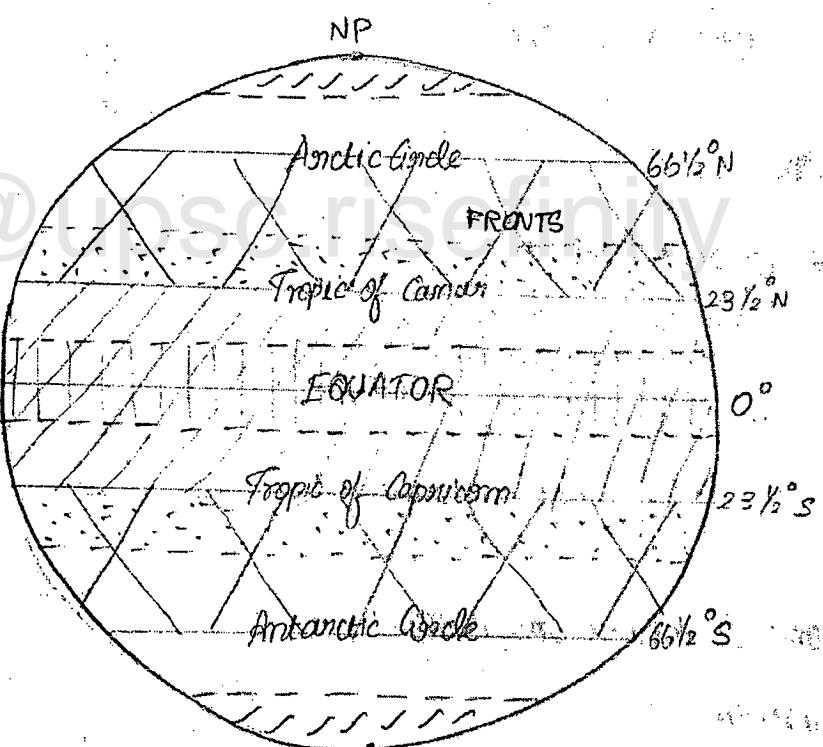
Circle of Illumination

Circle of Illumination:

The Sun illuminates one-half of the Earth at any given moment. The edge of the sunlit hemisphere, called Circle of Illumination is a great circle that divides the Earth into Light & Dark Half.

Arc of the great circle joining any 2 pts on the Earth's surface is always the shortest route b/w the points.

Important Parallel:



- Equatorial region (0° - 10° N/S)
- Polar region
- Tropical region (0° - $23\frac{1}{2}^{\circ}$ N/S)
- Sub-polar region
- Sub-tropical region ($23\frac{1}{2}^{\circ}$ N/S - 40° N/S)
- Temperate region ($23\frac{1}{2}^{\circ}$ N/S - $66\frac{1}{2}^{\circ}$ N/S)

The term "Tropic" comes from Latin word "Tropicus" meaning 'twin' & refers to the parallel from where the sun appears to take the form.

The two tropics represent the
farthest limits of the vertical rays
of the sun.

Latitudinal Regions / Zones / Belts

* QUOTES TIME *

"We are handicapped by what we think we can't do"

"Failure is an event, not a person"

* Grisolation: It means incoming solar radiation.

"Climate is what you expect,
Weather is what you get"

- Mark Twain

"It is climate that attracts ppl & it is weather that makes them leave" - sir.

Variability due to

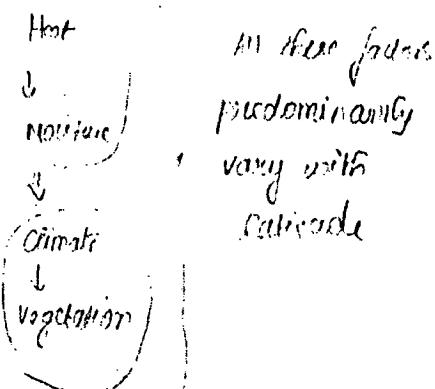
Fronts → Temperature cyclones

- Q: i) Cricket matches in England
ii) When a Britisher meet they talk about wealth.
iii) Sifirne - actors carry sticks.
iv) 4 seasons in one day.

0-25° N \Rightarrow Middle latitudes

↳ Max. variability of weather conditions in the world.

-So 'modulus' word is not appropriate
 ↑
 'temperali'



"We never experience climate".

Weather vs Climate

i) Equatorial Region:

→ 0° - 10° N & S

→ Also subset of Tropical region.

ii) Tropical Region:

→ $23\frac{1}{2}^{\circ}$ N - $23\frac{1}{2}^{\circ}$ S

iii) Sub-tropical Region:

→ $23\frac{1}{2}^{\circ}$ N - 40° N &

$23\frac{1}{2}^{\circ}$ S - 40° S

iv) Temperate Region:

→ $23\frac{1}{2}^{\circ}$ N - $66\frac{1}{2}^{\circ}$ S &

$23\frac{1}{2}^{\circ}$ S - $66\frac{1}{2}^{\circ}$ S

v) Polar Region: ($\approx > 30^{\circ}$)

Areas around the poles

vi) Sub-Polar Region:

Higher latitudes. ($\approx 60^{\circ}$ to 70°)

Genuinely: Tropical, Temp & Polar.

CLIMATIC ZONES:

* Greeks divided the whole world into 3 climatic zones:

(i) Torrid zone:

- very hot

- refers to tropical zone / lower latitudes

(ii) Frigid Zone:

- very cold

- Polar zone / higher latitudes

(iii) Temperate zone:

- Areas with 'moderate' conditions

- middle latitudes / Temperate

Given by Greeks

Weather & Climate

⇒ The term weather

refers to the short term atmospheric conditions involving

HEAT, MOISTURE & FREQUENT MOTIONS

for a given time & specific area

⇒ The term climate refers to the

aggregation of atmospheric conditions involving heat, moisture & their motions over a long period of time (≈ 30 yrs)

& for a large area.

Why the term 'temperate' is inappropriate?

The term 'temperate' used for middle latitudes by Greeks is a misnomer. It suggests 'moderate' conditions whereas the middle lats have the max. variability of weather conditions of world.

A Front is a zone of transition formed in middle latitudes between two contrasting masses of air [the cold-dry polar air mass & the warm-moist tropical air mass]

Some of these fronts lead to the formation of temperate cyclones & these cyclones form a major reason for the high variability of weather conditions in middle latitudes.

LONGITUDE & TIME

- Local time refers to the time at a place which is fixed with reference to the path of the sun in the sky.
- It is 12 noon local time when the angle of inclination of sun is maximum. At that time the sun is crossing the longitude at that point.
- All places on a given longitude have the same local time
- Earth completes 1 spin in 24 hrs.

'Norwegian' scientists - very good in weather climate

"Tele-connections" - something happening in extremely distant locations influence each other.
(El Nino - La Niña)

"Tropical cyclones \Rightarrow Ocean \rightarrow land warm tropical"

In most of the atmospheric phenomena which kill ppl is 'heat'
↑
causes intense heat.

What time will scientists use @ poles when all meridians merge?

Depends on their rationality
- If no rational standard time

CHINA: 120°E meridian to Beijing
 $[60^{\circ}\text{mid}]\downarrow$ \downarrow \downarrow \downarrow \downarrow

- No certain regionalism, unity
- No diff. time zones - only 1..

360° of longitude = 24 hours.

1° of longitudinal difference = 4 minutes time diff.

→ As Earth rotates from W → E → Time diff is added for places on East

→ Time diff is subtracted

for places on West

Numericals:

i) when it is 12 noon Monday

@ GW, what is the local time

@ Tokyo ($140^\circ E$)? 9.20 p.m. Monday

$$\text{Ans: } \frac{140^\circ \times 4}{60 \text{ mins}} = \text{hours } 20 \text{ min}$$

ii) A cricket match commences @ Delhi ($77^\circ E$) @ 10 am on Sunday. What will be local times @

i) Sydney ($150^\circ E$) - 2:52 pm Sunday

$$\frac{(150-77) \times 4}{60} + 10 \rightarrow \text{subtract}$$

ii) New York ($74^\circ W$) - 11:56 pm Sat.

when radio commentary is received?

$$\begin{array}{r} 150 \\ - 77 \\ \hline 73 \end{array} \quad \begin{array}{r} 77 \\ - 74 \\ \hline 3 \end{array} \quad \begin{array}{r} 3 \times 4 \\ \hline 12 \end{array} \quad \begin{array}{r} 12 \\ - 11 \\ \hline 1 \end{array} \quad \begin{array}{r} 604 \\ - 604 \\ \hline 0 \end{array} \quad \begin{array}{r} 10 \text{ hrs } 4 \text{ min} \\ - 10 \text{ am } 4 \text{ min} \\ \hline \end{array}$$

$$592 = 4 \text{ hrs } 52 \text{ min}$$

Standard Time:

Before the middle of 19th century, 100s of different time systems were in use throughout the world based on the rising of the sun.

QUOTES TIME

"God sleeps on the minerals; awakens in plants; walks in animals and thinks in man."

"You always have two choices— your commitment Vs your fear"

INT'L STANDARD TIME

Samford Fleming led the fight in Canada for Standard time & for an international agreement upon a prime meridian.

His struggle led the US & Canada to adopt a ST in 1883. And in 1884, the ITC (Int'l Meridian Conference) was held in Washington DC. This conference selected the

GM (Greenwich meridian) as
the PM (Prime meridian) / 0° Meridian

3 reasons went in favour:

- i) the dominance of English empire
- ii) Royal observatory at Greenwich being in use as one of the reference points.
- iii) the convenient choice of intertropical date line.

⇒ To avoid confusion, we generally follow uniform time throughout a country or a region. Such uniform time is called the ST.

* The meridian on which the ST is based is called the **STANDARD MERIDIAN / CENTRAL MERIDIAN (SM)**

↳ In the selection of SM, we generally use the foll. norms:

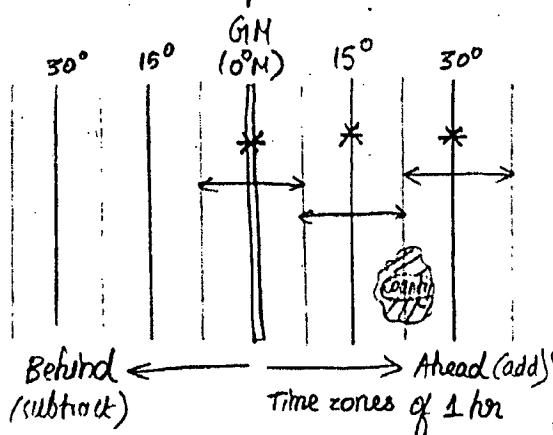
- 1) Central location.
- 2) Closeness to an important place.
- 3) The value is so chosen that it is exactly divisible by $7\frac{1}{2}^{\circ}$ so that

ST differs from GMT by multiples of $\frac{1}{2}$ an hour.

↳ Large countries with vast longitudinal extent generally go for more than ONE TIME ZONE - Each approx. 15° of longitude.

Case of China:

Although China extends across 4 'fifteen degree' zones, the entire nation, at least officially observes the time of 120°E meridian which is close to its capital.



■ - For such a country, this system is not comfortable - so will change but is followed in International waters.

i) World was divided into 24 standard time zones each extending over 15° longitude.

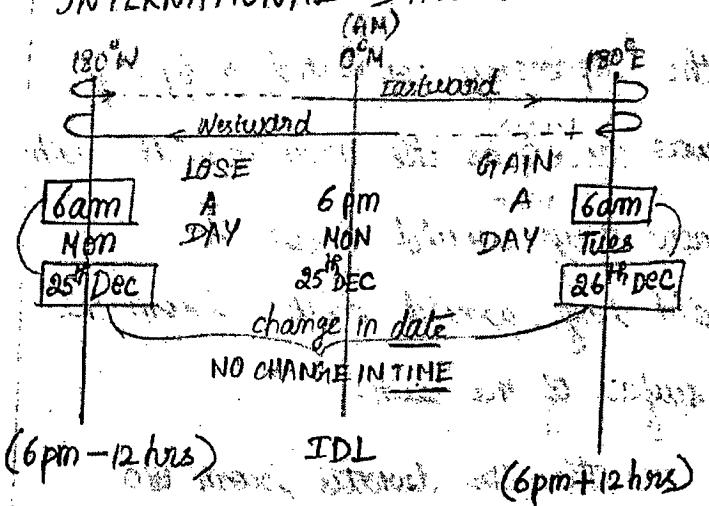
ii) the local solar time of the GM was chosen as the standard for the entire system.

iii) the PM/GM/ 0° N became the centre of a time zone that extends $7\frac{1}{2}^{\circ}$ of longitude both to West & East of PM. Similarly, the meridians that are multiples of 15° ($15^{\circ}, 30^{\circ}, \dots, 180^{\circ}$), both east and west of the PM, were set as the SNS for the 23 other time zones, each of which is 15° of longitude.

iv) 12 zones to the east of GM were designated to be ahead of time at GW by 1 hr./zone. Similarly, 12 zones to West of GM are behind.

v) In international waters, these time zones are shown exactly $7\frac{1}{2}^{\circ}$ to west & $7\frac{1}{2}^{\circ}$ to East of SNS. Over land areas, however, the actual eastern & western boundaries of time zones vary to coincide with appropriate political & economic constraints.

INTERNATIONAL DATE LINE



$$180^{\circ} \times 4 \text{ mins} = \frac{720}{60} = 12 \text{ hrs}$$

IDL is an imaginary line agreed internationally which follows the meridian of 180° with some deviations to accommodate certain land areas.

A traveller crossing the IDL from $W \rightarrow E$ gains a day & while crossing $E \rightarrow W$ loses a day.

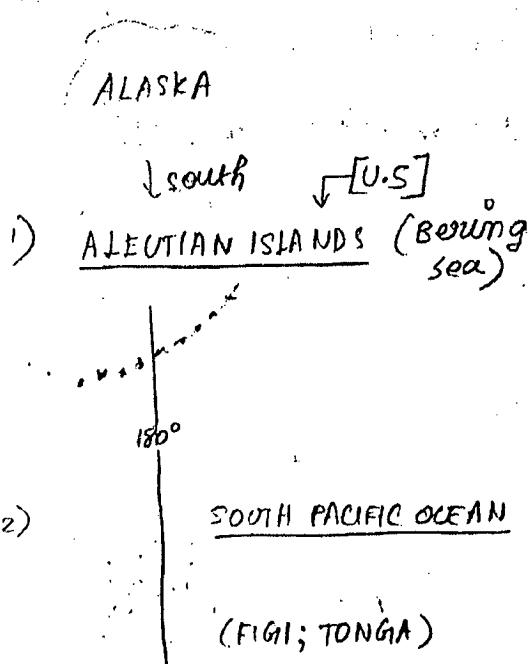
IDL was chosen at the INC 1884 in Washington DC.

One advantage of establishing the GM as PM is that its opposite arc is in the Pacific ocean.

The 180° meridian transiting the sparsely populated mid-Pacific was chosen as the meridian at which new days would begin & old days would exit from the surface of the earth.

The IDL deviates from 180° meridian in Bering sea off to include all Aleutian Islands of Alaska

Deviations in IDL:



① 48 hrs ← For a day starting at 00:00 @ 180°E to end / to reach its FINAL EXIT

on same day. It deviates again in south pacific to give islands in same group (Fiji, Tonga) within same day.

As Earth turns eastwards, the TIME/DAY moves westward.

The new day 1st appears on East @ midnight @ IDL.

For next 24 hrs, new day advances westward around the world finally covering entire surface @ the end of 24 hrs.

For next 24 hrs, this day leaves the Earth, ONE HOUR @ a time (per zone) making its FINAL EXIT 48 hours after its 1st appearance.

Since the IDL is in the middle of a time zone - as it is crossed, there is No change in TIME/CLOCK - Only change in DATE/CALENDAR.

Theoretically, along 180° meridian, it is both (6 am Monday & 6 am Tuesday) different days of same Hme.

DAYLIGHT SAVING TIME [DST]

(or) SPRING FORWARD (or) FALL BACK

India	Europe
Trees shed leaves March, April, May, sun ⇒ Dry hot - No moisture	AUTUMN called FALL Before winter - as they have no problem of moisture - due to frequent temperate cyclones (dusto front)

[The variation in length of the day from summer to winter is:

► Zero @ Equator

► Increases towards poles.

(i.e.) Summer day becomes longer as we go to higher latitudes.]

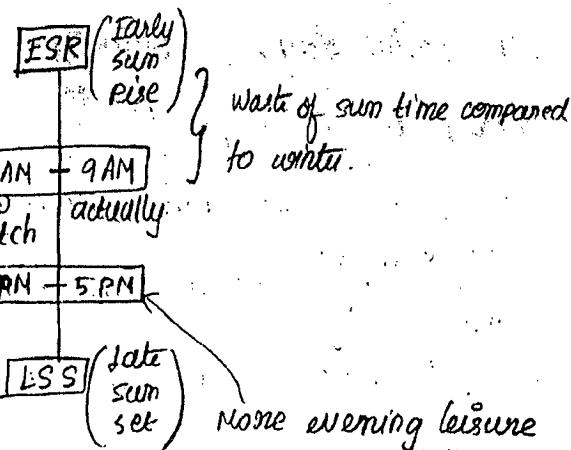
SLD - summer length of day

WLD - Winter length of Day

DST takes advantage of summer's extra day light hours.

Clocks are put forward usually by 1 hr in spring, thus gaining an hour's sunlight during conventional waking hours. The practice was first suggested half seriously in 1784 by the American statesman & scientist Benjamin Franklin.

It was not until first WW that several countries including AUSTRALIA, BRITAIN, GERMANY & U.S adopted DST as a means of conserving energy resources.



Waste of sun time compared to winter.
More evening leisure time - more time for entertainment - with sun's energy - Frugy consumption.

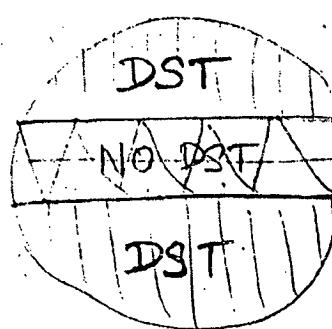
[Happens in U.S ; Europe]

Opposition to this practice:

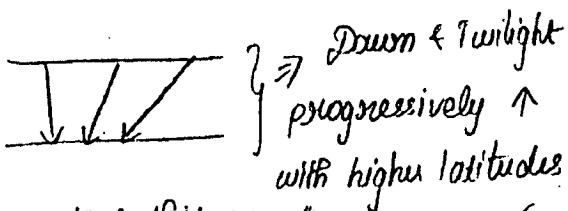
More alcohol consumption.
(due to increase in leisure time).

Why not change office time?

Only changing watch time can bring whole nation & international community in line. [A watch over watch]



No very longer days or twilights or dawns



Due to ↑ thickness of atmosphere crossing - more scattering & reflection / 63°N

EX: 10 PM - sunlight 2 Yrs - Twilight & Dawn

TWILIGHT: Diffused illumination after sunset

DAWN: Diffused illumination before sunrise
(Due to scattering, reflection)

QUOTES

"ONLY COMPARABLES : MUST BE COMPARED"
- form logical inferences.

1) "Destiny is no. matter of chance. It is a matter of choice.
It is not a thing to be waited for; it is a thing to be achieved."

2) "You may delay but time will not" "STOP THINKING IN

3) "The Earth is One, the world is not" "ABSOLUTE SENSE"
→ No rigid thinking.

⇒ Besides energy conservation, there is not much Twilight.

the other benefits are:

- Increased leisure time

- Safer journeys on highways

(for school children)

consequently DST would offer little or no savings for Tropical region.

JET LAG

⇒ In Northern hemisphere, many countries like US begin DST early Sunday morning of the last weekend in April (spring) & resume standard time early Sunday morning of last weekend of October (Autumn - Fall).

⇒ In the tropical belt, the lengths of day & night change little seasonally &

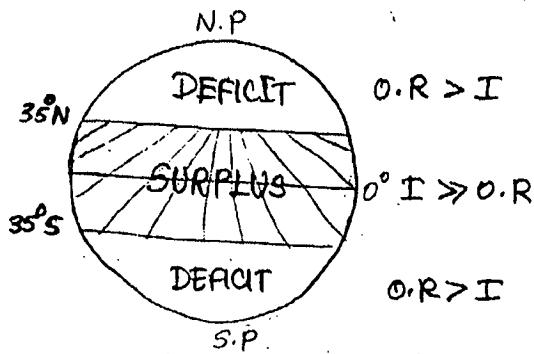
the effect of sudden switch of time zones in Air travel resulting in Tiredness & getting out of step with day & night.

Circadian Rhythm:

- Metabolic rhythm found in organisms, which generally coincides with 24 hrs day
- its most evident manifestation is regular cycle of sleeping & waking.

ATMOSPHERE

i) Global Heat Imbalance:



i) Between $\approx 35^{\circ}\text{N}$ & 35°S , there is a surplus of energy because INSOLATION exceeds OUT RADIATION.

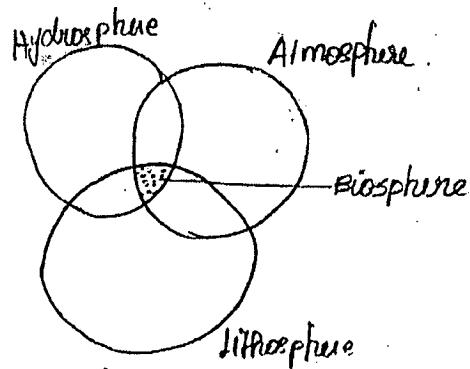
ii) Polewards from 35°N & 35°S , there is a deficit of energy because OUTRADIATION exceeds INSOLATION.

iii) Theoretically such an imbalance in energy distribution could result in the higher latitudes becoming ever colder and lower latitudes becoming warmer.

iv) In reality, however, energy is TRANSFERRED from areas of surplus to areas of deficit through 2 related ways:

▷ ATMOSPHERIC CIRCULATION (about 80% heat transfer)

▷ OCEANIC CIRCULATION (about 20% heat transfer)



ECOSYSTEMS

\uparrow Diversity \Rightarrow \uparrow Resilience.

"Man has simplified nature"

produced multiculture to monoculture

\hookrightarrow that is why we need pesticide, chemicals

Atmosphere held to Earth by Gravity

\Rightarrow Mass is hence held towards

50° - 5.6 km

90° - 30 km

99° - 40 km

Traces of ~ 10,000 km
atmosphere

400-500 km

ATMOS

Earth.

Atmosphere

Atmosphere, a blanket of gases, is held to the Earth by force of gravity & as a result most of the atmospheric mass is confined towards the Earth surface.

though, the atmosphere can be traced to a height of as much as 10,000 km, But:

Atmospheric mass	Found within
50%.	1st - 5.6 km
90%.	1st - 30 km
99%.	1st - 40 km

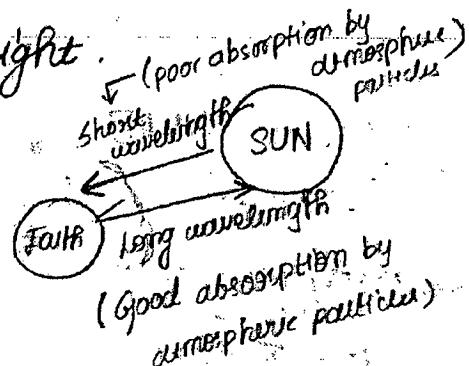
For all practical considerations, the height of atmosphere is taken somewhere between 400-500 km.

(Dia-back)

Earth's atmosphere is primarily heated not by direct sunlight but by Earth's out-radiation.

∴ As we go up in

atmosphere, we expect a decline in temperature with increase in height.



"European Author in book"

→ ↑H, ↑T ↑H, ↓T

This happens if Happens for
there is a reason no reason.

ALBEDO — Albus (white)



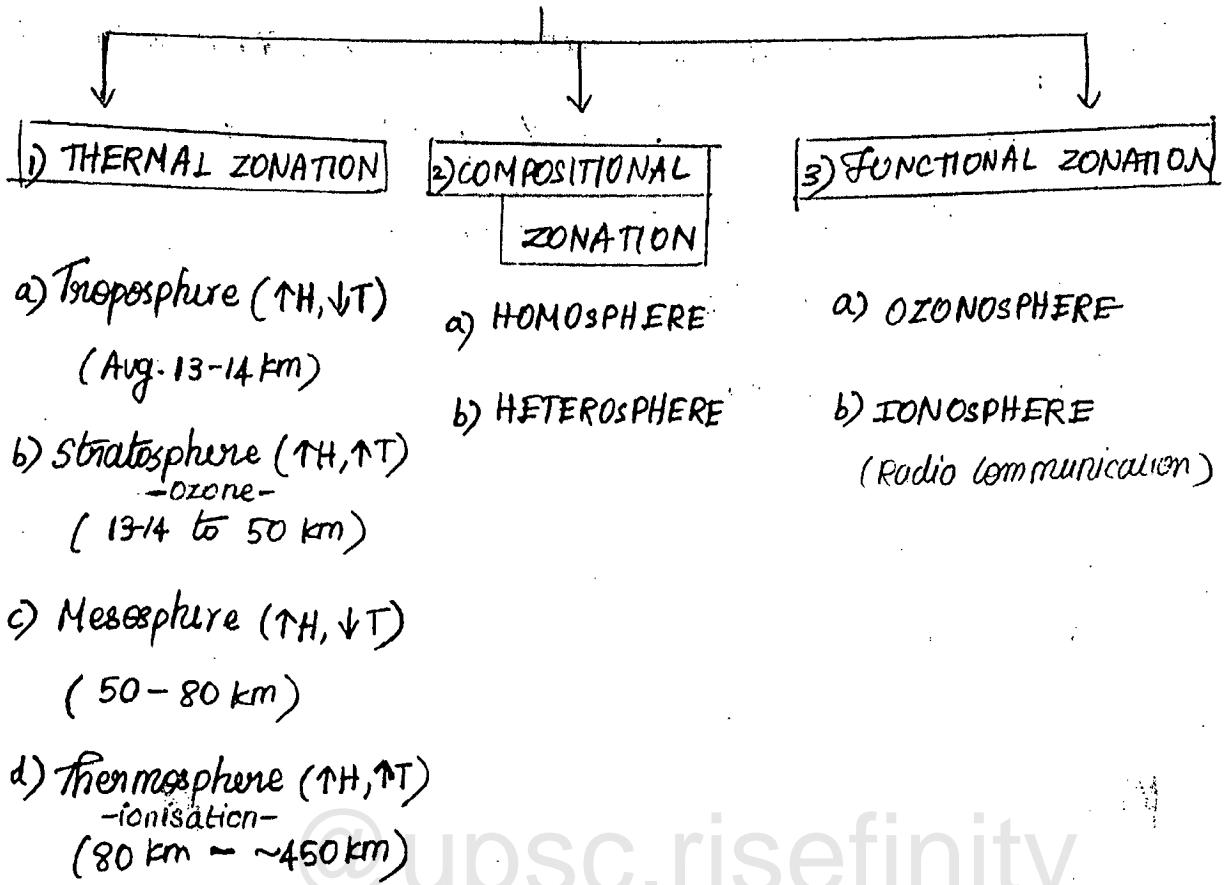
Energy reflection

BRIGHT : High reflection

Colours, as
well as
people?

DULL : Low reflection

Atmosphere



1. a) Troposphere:

- ⇒ the term 'wind' refers to the horizontal movement of Air.
- ⇒ the air near earth's surface moves from higher pressure to lower
- ⇒ Wind represents nature's attempt to balance out the uneven distribution

"Nature doesn't give ends but always transition zones"

"Moving air is wind"

⇒ Air in 'hurry' is wind

↑ Temp — ↓ Pressure → Air movement

↓ Temp — ↑ Pressure → Horizontal — Wind

Ascending current
— gives clouds

of air pressure over the Earth's surface.

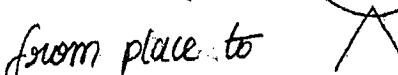
→ the vertical movement of air from place to place is called current:

- ✓ Ascending currents

- ✓ Descending currents

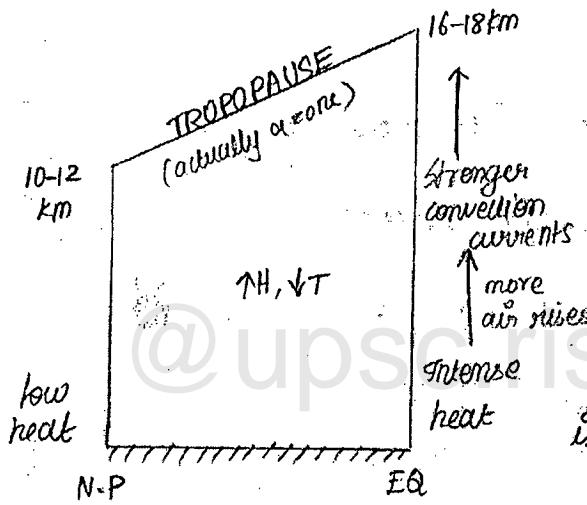
* Convection is a process of

heat transfer



place within a fluid caused by the movement of fluid itself

⇒ In atmospheric science, convection as a process of heat transfer plays a major role.



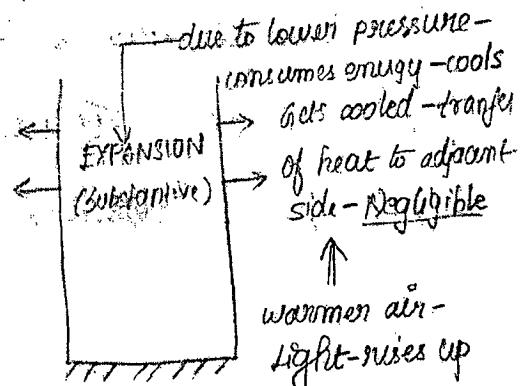
Addiabatic change in Temperature

It is a change in body which is without actual heat transfer.

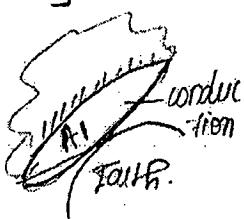
'column of air' - the vertical

atmosphere over a particular area.

* Conduction as a process of heat transfer is not much significant in atmospheric science [except in the lower part of troposphere where air is in contact with ground]



Air is a poor conductor of heat



- * "Warmer air is lighter, therefore it rises;
As it rises, it adiabatically cools
because of expansion." } RULE 1
- * "Colder air is denser, therefore it sinks;
As it sinks, it adiabatically warms
because of compression." } RULE 2

- > Lower latitude areas are the most intensely heated areas (i.e) these areas have strong convectional currents — this explains the higher elevation of Tropopause over lower latitudes.
- > At a given place, summer is a time for higher elevation of Tropopause.
- > The height of tropopause has spatial (lattitude-fixation) and temporal variations. (season-season)

Temperature Inversion

It refers to an atmospheric situation in which with increase in height there is an increase of temperature (instead of decline). It is primarily meant for Troposphere.

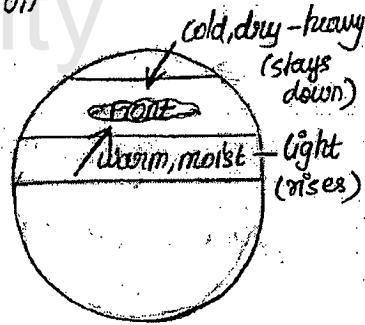
- Not applicable to stratosphere & thermosphere
- Only applicable to Troposphere (situations where $\uparrow H, \uparrow T$)

QUOTES TIME

- 1] "Life is like riding a bicycle. To keep your balance you must keep moving"
- 2] "What may be done at any time, will be done at no time."

Ex: 1 ⇒ A front is a zone of transition formed in middle latitudes between contrasting air masses:

- cold dry polar air mass
- warm moist tropical air mass



In a frontal situation, the warm air rises over cold air resulting in a case of TEMPERATURE INVERSION.

"DON'T ANSWER ON
BASIS OF 'FEEL'
but on LOGIC/FACT/
REASON'

ELR (Environmental Lapse Rate):

⇒ ELR refers to the ACTUAL rate of decline of temperature with increase in height in atmosphere at particular place and particular time.

⇒ ELR is found to have complex variations:

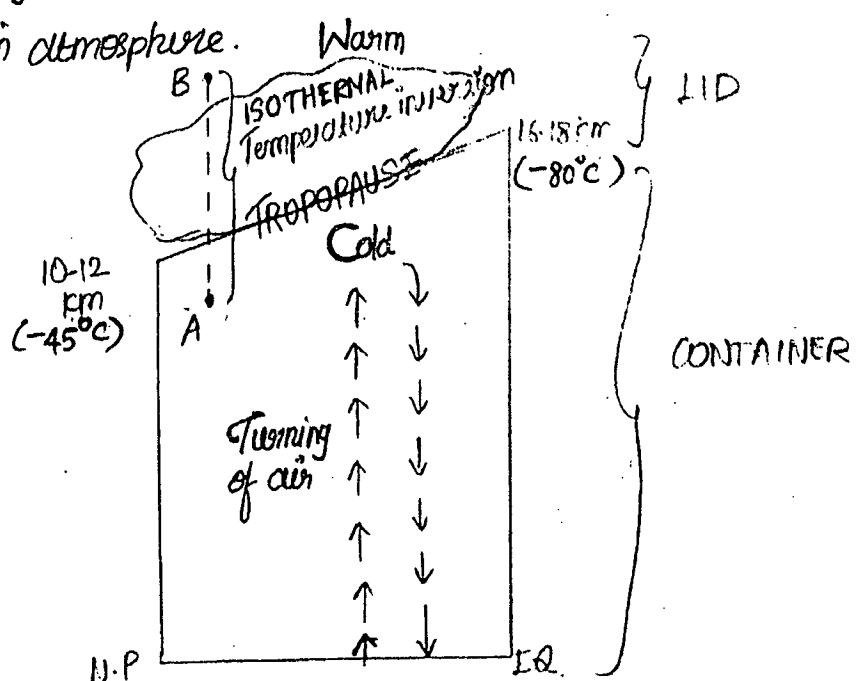
a) Spatial

b) Temporal

⇒ Generally it is seen to vary between a decline of $[5^{\circ}\text{C} - 10^{\circ}\text{C}/\text{km}]$ 5°C to decline of 10°C per km rise in height.

NLR (Normal Lapse Rate):

⇒ NLR is the AVERAGE concept for ELRs and is generally estimated to be a decline of about $6.4^{\circ}\text{C}/\text{km}$ rise in atmosphere.



Why Atmosphere means Troposphere to a Geography student?

Most of what comprises weather is confined within TROPOSPHERE, so much so that Troposphere is referred to as the "WEATHER SPHERE OF NATURE".

The TROPOAUSE acts as "THE LID" of the "container" called TROPOSPHERE - which contains most of the weather elements.

The tropopause becomes the lid for the reason that there is a TEMPERATURE INVERSION across it (i.e) colder conditions lie beneath the warmer conditions.

Since Geography students are interested in Atmosphere for the study of weather conditions therefore the term Atmosphere unless until qualified otherwise, refers to TROPOSPHERE only.

ISO THERMAL ZONE:

It is a zone in the atmosphere in which with increase in height, there is a relative constancy of temperature [i.e] no significant increase or decrease in temperature with increase in height.

The lower part of the stratosphere, just above the TROPOAUSE, in general represents ISO THERMAL conditions.

→ In this zone temperature does not increase with height bcos there is not much OZONE.

↳ In this zone, temperature does not decrease with height,
bcos there is not much CONVECTIONAL CURRENTS.

Troposphere - NAME Reason:

In troposphere, the warm air rises and gets adiabatically cooled and descends back - it is a zone in the atmosphere in which air keeps "TURNING" itself.

The word 'TROPOSPHERE' comes from Latin word 'Tropos' meaning 'TURNING' (i.e) It is a region where air keeps turning itself.

COLDEST REGION / CONDITION IN ATMOSPHERE - MESOPAUSE
(-95°C)

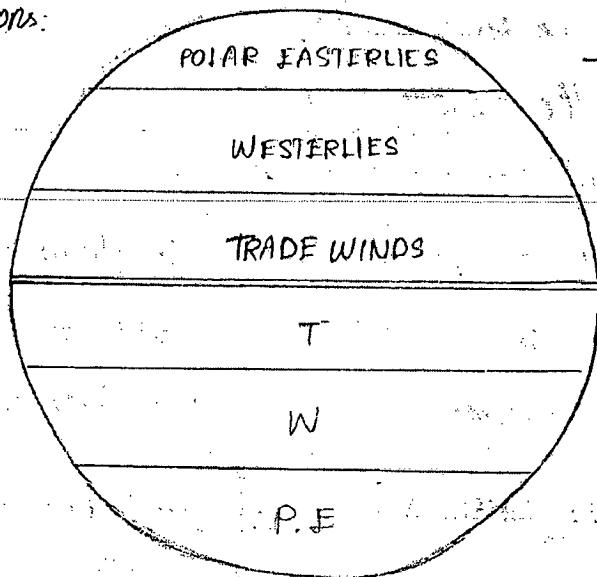
The lower part of Stratosphere, just above Tropopause

* provides ideal conditions for flying AIRCRAFT bcos of following three reasons:

- ① In general, ABSENCE OF CLOUDS (70-80% of journey)
- ② In general, ABSENCE OF STRONG CONVECTIONAL CURRENTS
- ③ In general, PRESENCE OF ISOTHERMAL CONDITIONS.

PLANETARY / PREVAILING WINDS

Primary circulations:



Secondary circulations:

1. Cyclones
2. Anticyclones
3. Monsoons

- A wind as per convention is NAMED on the basis of its DIRECTION OF ORIGIN. -

* The • TRADES

- WESTERLIES
- POLAR EASTERLIES

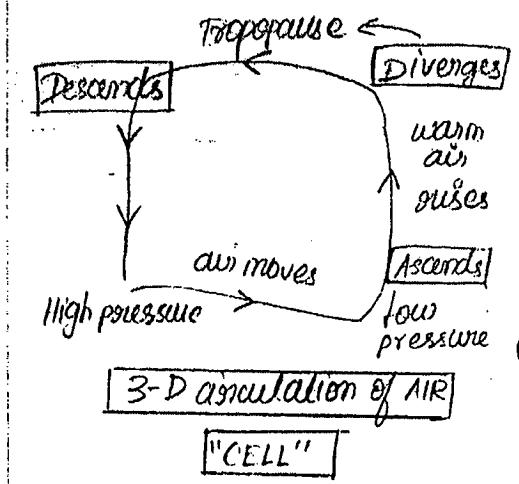
- (i) Are together referred to as 'PLANETARY' winds as they are almost Global in extent.
- (ii) Are together called as 'PREVAILING' winds as they blow almost throughout the year.

THREE FORCES ACTING ON MOVING AIR NEAR EARTH'S SURFACE (Lower Troposphere) :

① Pressure Gradient Force (PGF) :

PGF initiates the movement of air.
(i.e.) It is the basic ACTIVATING FORCE for the wind. PGF attempts to take the air from Higher Pressure (H.P) to Lower pressure (L.P) right across the ISOBARS on a perpendicular direction.

[Lines joining places of same pressure]

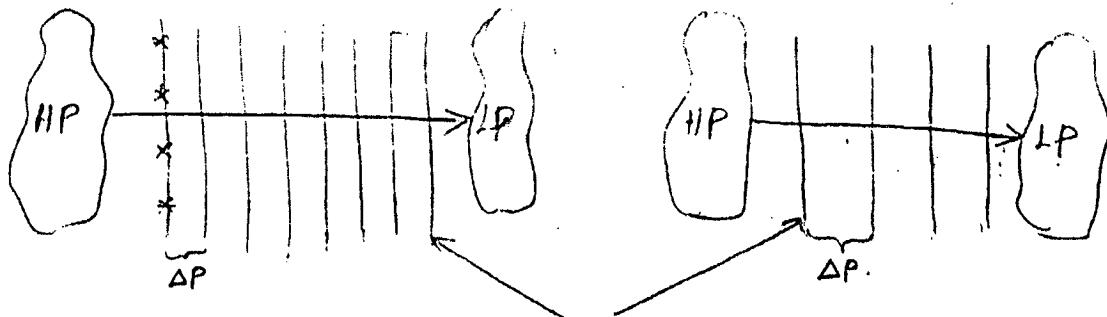


a) STEEP PRESSURE GRADIENT

- ✓ Faster wind
- ✓ closely spaced isobars

b) GENTLE PRESSURE GRADIENT

- ✓ Slower wind
- ✓ widely spaced isobars



② Coriolis Force (CF) : Normally there are waves.

Because of Earth's Rotation, all moving objects on the Earth, appear to be deflected from their true paths.

To account for this apparent deflection, scientists 'INVENTED' a force called CORIOLIS FORCE.

It is named after a French Mathematician
GASPARD CORIOLIS.

* Ferrel's law of Deflection:

QUOTES TIME

- * "If there is no struggle, there is no progress in life"
- * "Your progress in life begins in mind and it ends in the same place"

(i) → This law states the effect of CORIOLIS FORCE on a moving body. There is an apparent deflection of a moving body to its right in the Northern hemisphere & to its left in the Southern hemisphere.

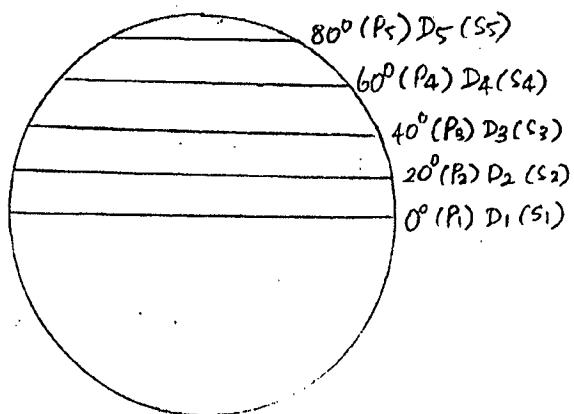
(ii) Earth's Rotation:

- * EQUATORIAL PERSPECTIVE - Earth rotates west to east
 - * NORTH POLE PERSPECTIVE - Earth rotates counter/anti-clockwise.
 - * SOUTH POLE PERSPECTIVE - Earth rotates clockwise.
- (iii) Coriolis force / effect is Negligible near Equator & it increases as we go towards poles

Earth's speed - [a) Angular Speed
 b) Rotational speed]

→ Angular speed: Earth spins once in 24 hrs (i.e) All places have uniform angular speed of $15^\circ/\text{hr}$.

→ Rotational speed: $\Rightarrow \frac{\text{Distance Travelled}}{\text{Time taken}}$



✓ The distance to be travelled by earth to complete one spin in 24 hrs decrease as we move from equator to poles.

$$D_1 > D_2 > D_3 > D_4 > D_5$$

✓ The earth's rotation speed is maximum @ equator & it decreases towards the poles. $[S_1 > S_2 > S_3 > S_4 > S_5]$

✓ Since earth is spherical in shape therefore it gets INCREASINGLY smaller in size from equator to poles (i.e) Distances to be travelled by Earth to complete a spin in 24 hrs decrease PROGRESSIVELY (@ an increasing rate) as we go from equator to the poles $(D_1 - D_2) < (D_2 - D_3) < (D_3 - D_4) < (D_4 - D_5)$

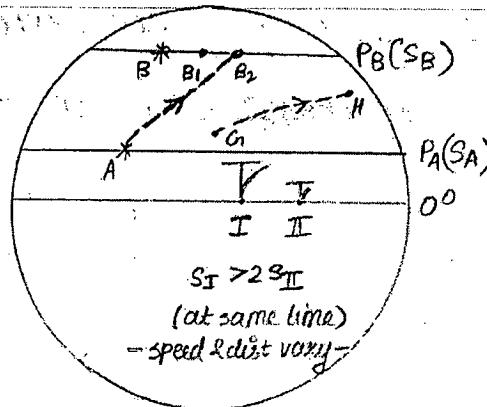
✓ Since earth is spherical, the earth's rotation speed decreases PROGRESSIVELY (@ an increasing rate) as we go from equator to poles. $(S_1 - S_2) < (S_2 - S_3) < (S_3 - S_4) < (S_4 - S_5)$

Because of this, coriolis force is negligible near equator & it increases towards the poles.

P_A, P_B = Parallels A & B.

$S_A > S_B$

$$S_A = 2S_B$$



$$\begin{array}{c} B \xrightarrow{@S_B} B_1 \\ A \xrightarrow{@S_A} B_2 \end{array}$$

AB ₂	dist	Deflection
G/H	Some	less

Due to no. of parallels crossed —

The speed of the moving object also affects coriolis force/effect. Faster moving objects experience more coriolis effect.

③ Force of Friction (FF):

The frictional drag of the earth's surface acts both to:

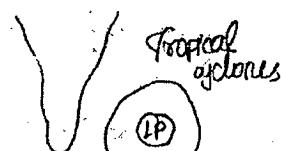
(i) Slowdown wind movement

(ii) Modify its direction of flow

Zones of Convergence & Divergence of Air:

(c) Zone of convergence of air is a zone where there is NET INFLOW OF AIR.

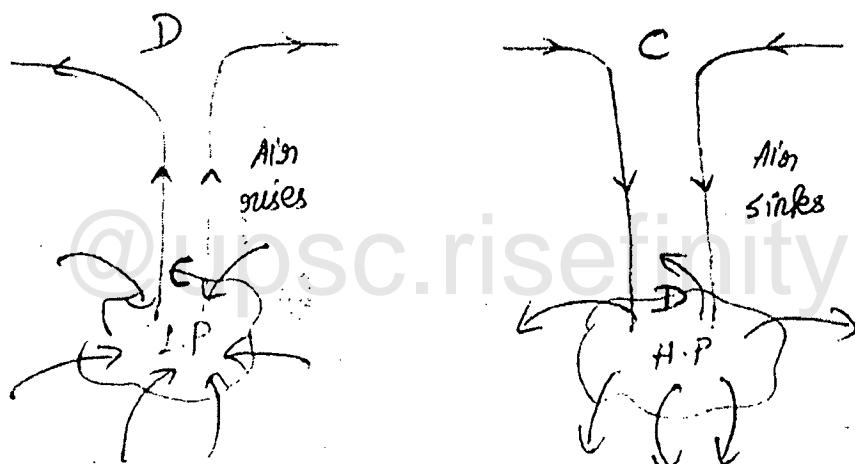
- 1) PGF $\rightarrow d \rightarrow d'$
- 2) $\downarrow CF$ \leftarrow direction
- 3) $\uparrow FF \rightarrow \downarrow \text{speed}$



(D) Zone of Divergence of air is a zone where there is NET OUTFLOW OF AIR

"For a zone of convergence near (earth's atmosphere) lower TROPOSPHERE there is always a zone of DIVERGENCE in UPPER Troposphere?"

"For a zone of divergence in LOWER Troposphere, there is always a zone of CONVERGENCE in UPPER troposphere?"



GLOBAL PRESSURE DISTRIBUTION:

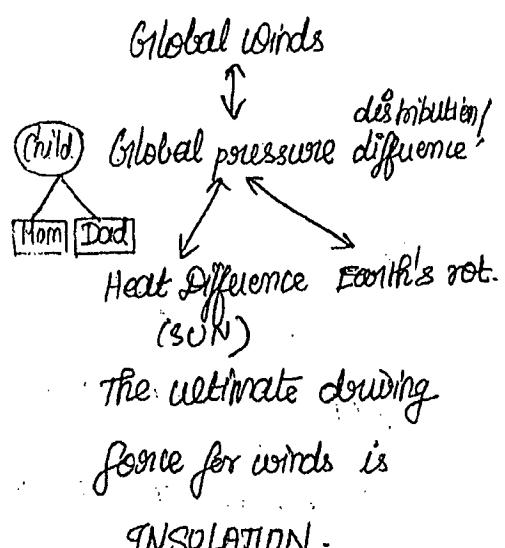
* It is the combined effect of:

(i) Heat distribution in earth's surface

(ii) Earth's rotation. (can't quantify each's role - Nature)

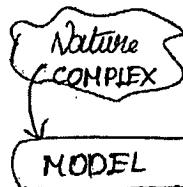
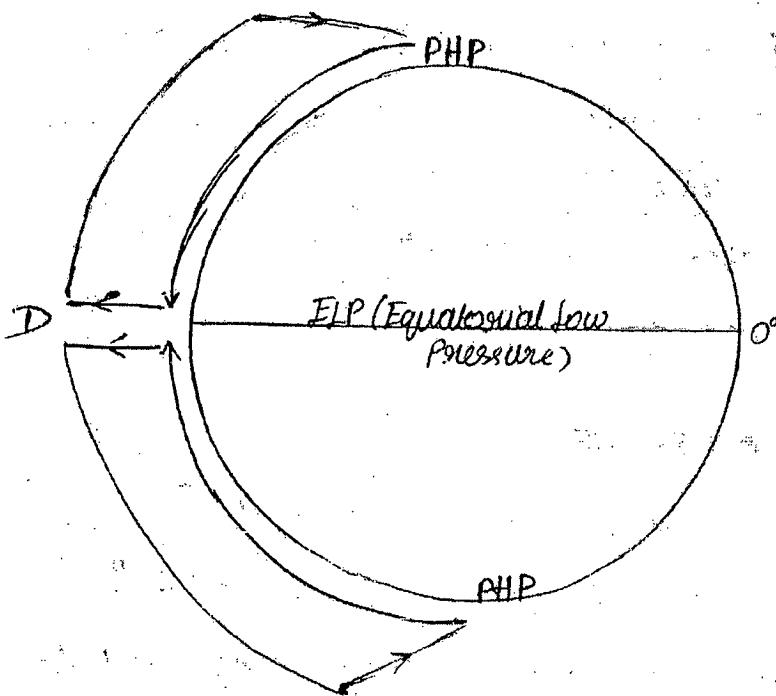
* It is very COMPLEX and it is

highly DYNAMIC in nature.



(1735)

GEORGE HADLEY - ONE CELL MODEL OF TROPOSPHERIC CIRCULATIONS



A simplified version
of a complex reality
(Assumptions) - TOOL

⇒ George Hadley's model is based on the assumptions of:

✓ Non-rotating earth

✓ Uniform earth surface (either land/water)

⇒ Hadley's model is based on CONVECTION CURRENTS

(upward movement of warm air)

→ Acc. to Hadley in each Hemisphere, there is a large CONVECTION CELL POWERED by the HEATING OF EQUATORIAL REGIONS. By means of these convection cells, the surplus energy is TRANSFERRED POLEWARDS.

— Since, he didn't consider E. rotation, model got OVER-SIMPLIFIED & failed to describe & explain the COMPLEXITIES of Tropospheric Circulations

(1856)

WILLIAM FERREL - A 3 CELL MODEL OF TROPOSPHERIC CIRCULATIONS

It is based on 3 considerations:

i) Uniform Earth's surface (land/water) - Assumption.

ii) Earth's rotation $W \rightarrow E$ - fact

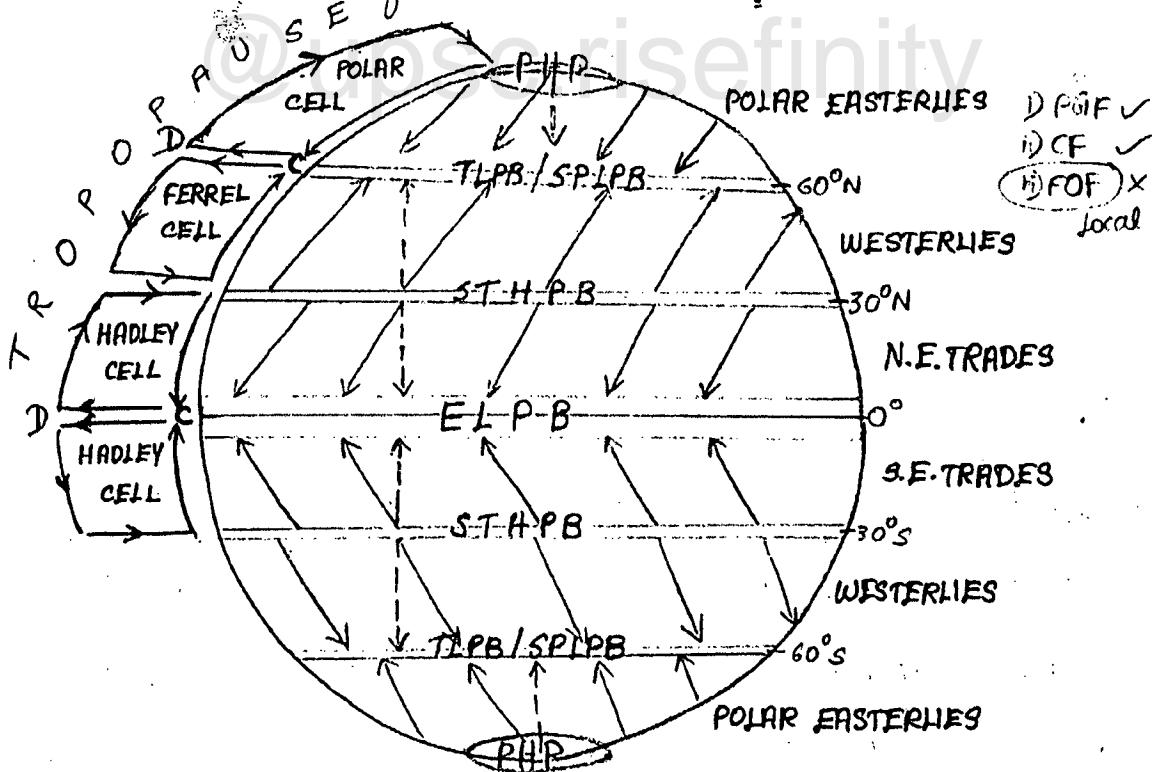
(i.e.) Coriolis effect taken into account

iii) Sun being stationary at Equator - Assumption.

(i.e.) Equinox position.

QUOTES TIME

- * "If you give up on your dreams, what's left?"
- * "If you think education is expensive; try ignorance."
- * "The whole purpose of education is to turn mirrors into windows."



- i) The pressure distribution shown in dia. is due to the combined effect of → **HEAT DISTRIBUTION** & **EARTH'S ROTATION**
- ii) Equatorial Low & Polar High Pressure Belts are thermally induced PB.
ELPB & PHPB → THERMALLY INDUCED
- iii) Sub-Tropical High & Temperate Low pressure belts are dynamically induced PB.
STHPB & TLPB → DYNAMICALLY INDUCED

Tropospheric Air circulation makes a closed system of air circulation - with neither a beginning nor an End.

WESTERN DISTURBANCES

Temperate cyclones in all part of world

Frontal origin @ TIPB with 2 air masses

✓ Cold air - North India (Delhi)

✓ Snowfall - HP & S&E

✓ Rainfall - Pan & Hawa

↳ Good for Rabi (wheat)

✓ Hail - sometimes

similar to the HYDROLOGICAL CYCLE of water:

Solid stored @ places &

Liquid Also in movement

Gas around us always

Evaporation

Condensation

Precipitation

No end nor Beginning

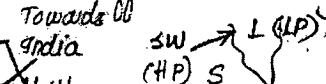
Ex: George Bush & Bin Laden may have inhaled each other's exhaled air.

Why NE trades drastically change direction in summer in South Asia? - To be done by SHIV SPB

① Complex & not complete

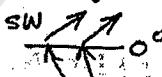
i) HALLEY - 1680s

Differential heating of Land & Sea



ii) HADLEY - 1750s

Rotation of Earth



But this may not be acceptable to all....

iii) El Nino & La Nina

iv) Indian Ocean Dipole /

NJO / PDO

→ Circulation of atmosphere in E-W direction/differences

G. WALKER → Meteorology

scientist in Brit. India - studies E-W differences.

(TELE CONNECTIONS)

Thermally Direct Cells:

HADLEY & POLAR CELLS are driven directly by different effects of SURFACE HEATING & are therefore called as THERMALLY DIRECT CELLS.

Thermally Indirect Cells:

FERREL CELLS are THERMALLY INDIRECT CELLS because they are powered by other two. This allows them to transfer warm air from Hadley cell to higher latitudes & cold air back to lower latitudes.

Idealized Air Assumption Model:

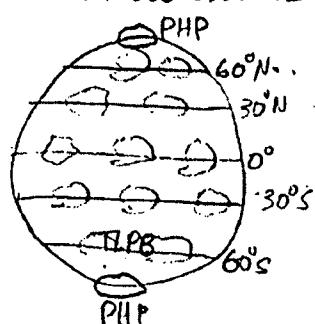
FERREL's model represents the long term average of the MERIDIONAL (North-South) CIRCULATIONS of AIR over the globe. In reality, the air circulations are much more complex than this model suggests.

BREAKING THE ASSUMPTIONS:

Now, FERREL will break both his assumptions & attempt understanding the complexities of Tropospheric circulation.

Since Earth's surface is not uniform, therefore in nature we don't have uniform pressure belts - Instead of Pressure Belts we have systems of Low & High Pressure Cells.

Pressure cell → Refers to a large area with more or less uniform high or low pressure.



The Tropospheric circulations are represented by the three major cells - HADLEY, FERREL & POLAR - & these cells have MERIDIONAL (North-South) CIRCULATIONS.

Because of the presence of numerous EAST WEST PRESSURE CELLS [WALKER CELLS], the atmospheric circulations become very complex.

SHIFTING OF PRESSURE BELTS/CELLS

Assumption - sun at equinox. But

In summer - sun moves \rightarrow T. of. cancer (North)

Pressure cells shift North

so, winds will shift North too

Hence, weather will also change

In winter - sun moves \rightarrow T. of. capricorn (South) pressure belts

Similarly, pressure cells, winds & weather will shift to south.

'HAUSIN' - Analogic

'Season' = Monsoon

↑
seasonal reversal
of winds. -- reversal

sw \nearrow } NE
(summer) (winter)

wind systems

weather conditions

5°-10° Belt shifts

2°-20°

NH / SH

shift more - tropical areas
(\sim similar heating)

Impact more - Middle latitudes

(Front formation)

No shift \rightarrow Northern Hemisphere (NH)

southern Hemisphere \rightarrow similar to Ferrel's cell.

in NH

Impact of shift / influence is more in middle latitudes

QUOTES TIME

- * "If you don't climb the mountain, you can't view the plain"
- * "You don't have to be great to start but you have to start to be great"
- * "You cannot cross the sea merely by standing & staring @ water"

SHIFTING OF PRESSURE BELTS/ CELLS

If the sun is overhead at midday in different parts of Earth at different seasons. The movement of pressure & wind belts follow the movement of sun.

In JUNE: when overhead sun is at TROPIC OF CANCER

All belts shift about 5° - 10° North of their average positions.

In DECEMBER: when overhead sun is at TROPIC OF CAPRICORN

All belts shift 5° - 10° South of their average positions.

iii) In reality, the shift of pressure belts/ pressure cells has its SPATIAL & TEMPORAL variations.

The shift varies from as low as 2° - 20°

[During summer in South Asia, the Equatorial low pressure shifts to the North by as much as 20° - esp. India]

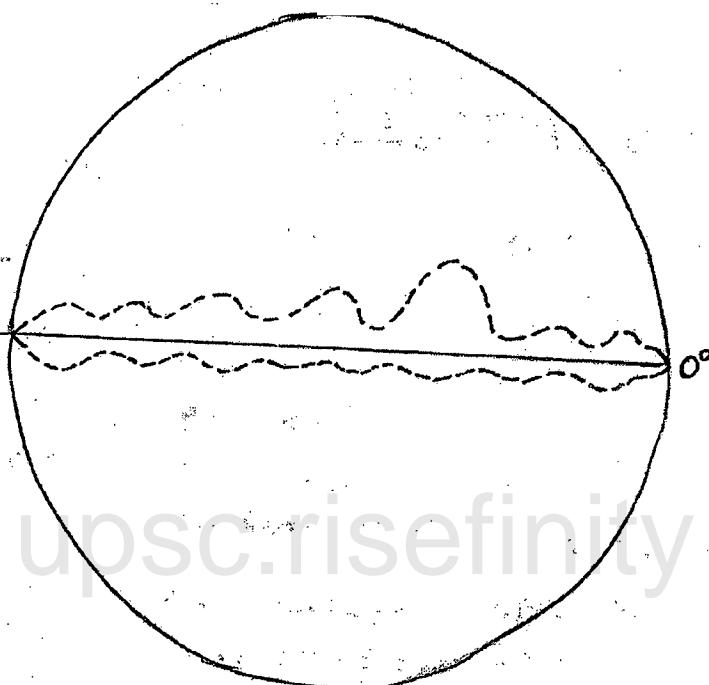
iii) The shift is greatest in lower latitudes
least in polar regions.

The impact of shift of pressure conditions on weather systems is maximum in middle latitudes

Because these areas are zones of convergence of contrasting tropical & polar air masses

The shift of pressure condition is more in NORTHERN HEMISPHERE
Bcos of complex mix of land and water

I.T.C.Z [INTER TROPICAL CONVERGENCE ZONE]



It is a zone where the Trade winds converge.

READ

It is also referred to as THERMAL EQUATOR / METEOROLOGICAL EQUATOR.

T.E.R.LS - Thumba

Equatorial rocket launch centre

* MAGNETIC EQUATOR

EQUATORS

a) 0° Parallel

- Geographic Equator

b) I.T.C.Z

- Thermal / Meteorolo
Equator

c) Magnetic Equator

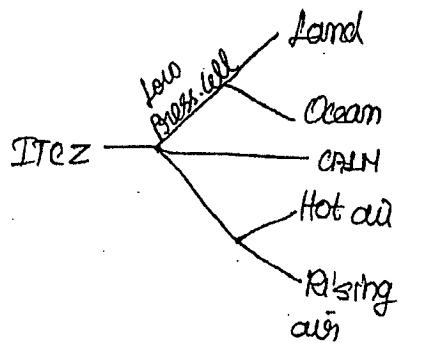
It is a zone of CALMNESS (weak winds), Hot
rising air and low pressure.

In the world ocean, this calm area is
called Doldrums.

Why is it called DOLDRUMS?

Sailors in olden days used to get BECALMED here.

It is a region of SMALL PRESSURE GRADIENT (i.e. weak winds), HIGH HUMIDITY & HIGH TEMPERATURES occurring near the Equator.



DOLDRUMS

DOLD & HL

- ✓ Low pressure - world ocean
- ✓ Semi-permanent
- ✓ never uniform
- ✓ By ancient sailors who entirely depended on winds
- ✓ Confused state

why? they got stuck up due to calm/weak winds near Equator - hot sun + Humidity

WHY THE AREA IS CALM?

- Doldrums
- Zones of convergence of Trade winds and not zones of Trade winds
- Zones of Trade winds helps sailors

what makes air move?

- PGIF - diffin. HP & LP.
- The gradient is weak due to similar system of low pressure cells
- Hence, PGIF is weak
- In turn, winds are also weak.
- ⇒ Potential for cyclone
- ⇒ But not stuck up for more than 7 days

HORSE LATITUDES

problem in world ocean

Location

Ancient sailors

$30^{\circ}N$ & $30^{\circ}S$

stuck up.

→ Pressure belt

→ Weak PGIF due to less gradient

In those days,

→ Hence weak winds

one important trouble item was HORSE - certain locations were famous for it.

PLANNING FOR TRAVEL: (By ancient sailors)

Weight - of items & ppl

Distance

Past experience - speed + No. of days

Food for survival + water for drinking

when they get stuck up - days ↑ ; life/death

@ Horse Latitudes

why severe conditions here from Doldrums?

Cyclones & anticyclones

Extr. Low press. systems - Tropical cyclone - 7 to 8 days
[Ex: Florence]

→ Anti-cyclones are much persistent - 2 to 3 weeks

So stuck up for more time - ↓ Food ↓ Water

[Near equator - air keeps rising, adiabatic cooling, condensation -
So it rains everyday at 3pm or 4pm - 3' o'clock or 4' o'clock showers
So in Doldrums - no problem of water]

But, in Horse Latitudes, air settles, warms, dry conditions, No rain.

Solution? Only way out to survive is to reduce the load of vessel.

But weak winds can sail only vessels which are light.

So the SPANISH SAILORS would throw away the HORSES (or)
Consume the HORSES to reduce the weight of vessel.

Cyclonic systems are less persistent than Anti-cyclones.

Not because of gradient as gradient is low in LP/HP in depressions.

But: There are 5/6 pre-requisites for cyclone formation, so
they can't persist for long unlike anti-cyclones which
do not need much pre-conditions.

In olden days, the zones about 30°N & 30°S were known
as Horse latitudes.

When ships were becalmed, horses were thrown to
reduce the load.

Here the air is comparatively dry & winds are calm & light
(because of low PGF).

It is a region of DESCENDING AIR CURRENTS or Wind Divergence
and ANTI-CYCLONIC conditions.

The sailors used to get stuck up longer as Anti-cyclonic conditions
are more persistent.

sailors could not hope for rain to happen as there is have Descending currents.

REAL CASE: SUMMER IN SOUTH ASIA

20° shift in S. Asia?

geographical conditions.

Alayus - Tibetan plateau (continuous land chain) - single continuous land mass. East west - 2000 km length
600-1000 km in width - 4 km height

Winter - Huge heating of Tibetan plateau
Huge glacier melting
Huge thermodynamics.

During SOUTH ASIAN Summer Season,
ITCZ shifts by as much as 20°N of Equator.
exceptional shift is found to play a major role in causation of South Asian summer monsoon.

4 prominent Monsoon areas in world

SOUTH ASIA

EAST ASIA

NORTHERN AUSTRALIA

WEST AFRICA

are all areas of Tropical locations.
In these areas, the shift of pressure cells from summer to winter plays an important role in causation of monsoon.



Holley was 1st man to talk of monsoon of South Asia - 17th cen
then Hadley continued
But still not fully understood due to complexities.

Flohn - talks of 1 season of monsoon
- shift of ITCZ by 20°

Monsoon - seasonal reversal of winds
BEST Monsoons of World

1. SOUTH ASIA
2. EAST ASIA
3. WEST AFRICA
4. NORTH AUSTRALIA

All TROPICAL AREAS

Why best monsoons?

$$\text{AY} = \text{H.P} \rightarrow \text{L.P}$$

Monsoon = seas. rev. of wind

A place X with 3-4° shift only - No change of monsoon

The heating of TIBETAN PLATEAU in summer season plays a important role in changing the thermodynamics of SOUTH ASIAN Atmosphere.

TRADE WINDS

Deserts in AUSTRALIA:

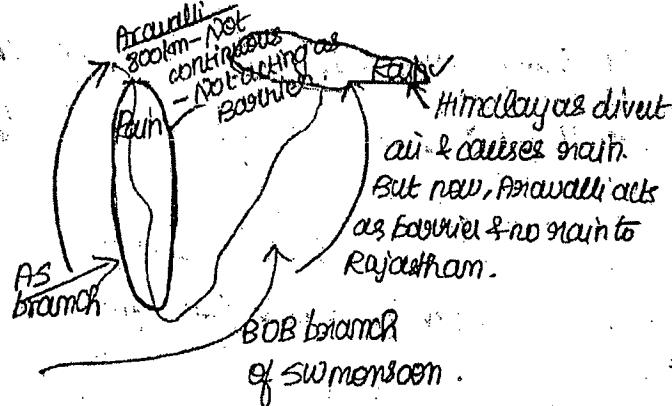
Australia's population is what India produces in a year.

Most ppl are in Eastern areas.

Great Australian Deserts are also called OUTBACK Areas (too hot & dry)
(Interior & western areas)

THAR DESERTS [Mongolian]
Dead land

3/4th of India's moisture comes from SW monsoon & not from Trade winds.
So, Trade winds can't be attributed for that deserts in India.

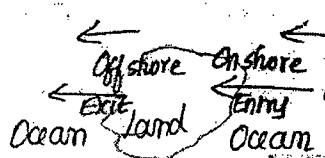


Aravalli-Boundary

Upper topography of Rajasthan

Trade winds

more consistent here.
helps traders - Trade
Good speed; constant &
But Nature is not AB
so trade winds too are
completely consistent.
They do change, in
some areas very dia
too. Ex: India - change
from NE to SW - so h
Broadly they come fro
SO, EASTERLIES.



So, central & western
areas all - DESERTS
Only eastern areas
get - MOISTURE

Ex: 1. Sahara

2. Atacama - W of:

[But this is not only:
for them being deserts]

3. Kalahari - On - g

4. Desert in Australia

Artifacts in ancient times show that this desert was not desert in those times - but green areas. So, due to MISMANAGEMENT - Anthropogenic desert - Overgrazing, deforestation.

TRADE WINDS

- These are most regular of all planetary winds.
- These blow with GREAT FORCE & in relatively constant direction.
 - [These winds do change in terms of speed & direction & broadly speaking, these are EASTERLIES].
- [During summer in South Asia, these winds change drastically to result in SOUTH ASIAN SUMMER MONSOON or SOUTH WEST MONSOON].
- Since they blow from SUB-TROPICAL latitudes to further lower latitudes (Equator), they have great capacity for HOLDING MOISTURE.
- In their passage across oceans, they gather more moisture & bring heavy rainfall to the East coast of continents.
- As they are OFFSHORE on west coast, these regions suffer from Great ARIDITY & form the hot deserts of the world.

Examples: SAHARA - largest tropical desert

ATACAMA - one of the driest (no rain even once in 10 yrs)

KALAHARI - semi-dry

GREAT AUSTRALIAN DESERTS [the term OUTBACK in

Australia refers to arid areas & it means NEVER-NEVER suggesting

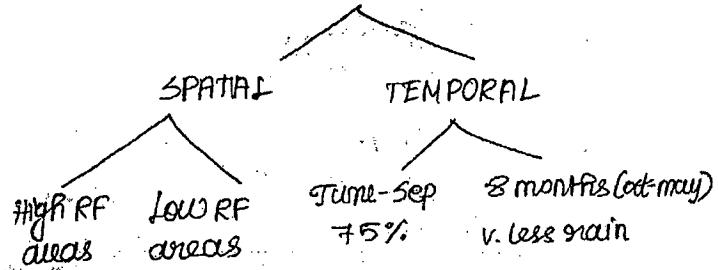
never-ever go there]

WESTERLIES

Middle Latitudes's Natural Advantages

① Rainfall/precipitation - distribution
is more uniform in space & time.

Ex: India $\approx 110 \text{ cm/year}$



High Rainfall areas have - low CV
Low RF areas have - High CV.
 $CV = \frac{\sigma}{\text{mean}}$ (chance of getting low RF is also less + prone to drought)

Note: These both can be compared to rich & poor use in GIS against rainfall

but, middle latitudes don't have fire problems. So FRONTS \rightarrow RAINFALL
fire wood is more strong.

Grasses also strong - Nutritious - light

so, Animals - less in no. - eat good grass - good productivity
(short, soft)

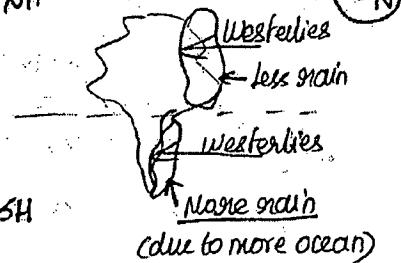
so, Europeans coupled Natural advantages + Technology

- Fronts
- Temperate cyclones
- Low pressure, warm air rise
- Uniform grain - 12 months - all areas
→ Time & Space

Intensity more in south hem.
due to large expanse of ocean

Variability more in North
due to land-water complexity

NH



NH

More rain
(due to more ocean)

RULES

1. No absolute
2. Comparables must be comparables.
3. Most phenomena are due to multiple factors in combined way so can't quantify separately
4. Don't apply one reason or factor to uniformly across diff areas/ conditions.

Industrial Revolution \rightarrow Colonisation

\Rightarrow Backed strongly by Mastering World Ocean

India - 18% of Bosom cows but only 13% of milk production

SOUTH HEMISPHERE

Westerlies very strong over oceans. sailors called it:

- ✓ Roaring Forties (@ 40° latitude)
- ✓ Furious Fifties (@ 50° S)
- ✓ Shrieking/Screaming Sixties (@ 60° S)

why? Due to PRESSURE GRADIENTS.

Speed comes from PGF.

why PGF strong here?

30° S - STHPB → 60° TLPB.

Gradient is decreasing continuously as it is almost ocean uniform.

→ Westerlies are MUCH LESS CONSTANT & PERSISTENT than the Trade winds.

→ These are MORE VARIABLE in NORTHERN Hemisphere - because of complex mix of land & water.

→ Westerlies play a valuable role in carrying WARM TROPICAL WATER & AIR to western coasts of Temperate lands.

Ex: North Atlantic Drift

→ Westerlies bring much Precipitation to western coast of Temperate lands - Especially b/wn 40° & 60° because of Huge Ocean's expanse.

NORTH HEMISPHERE

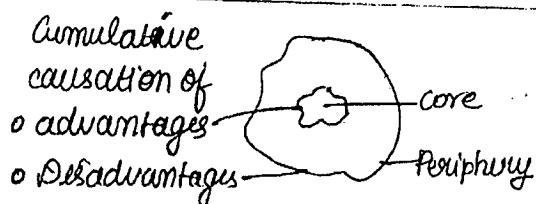
Complex Land + water.

Variability - too many pressure gradients - no continuity for winds to gain strength.

More obstacles,

congested.

Broken gradients.



Core - Adv. of initial start

so, it will always be ahead.

use in GIS, Essay

→ In southern hemisphere, westerlies blow with much greater force & regularity throughout the year.

✓ In southern hemisphere, the

> weather is cloudy (due to more ocean)

In south hemisphere,
waters are rough.

> seas are violent (rough).

more clouds.

✓ It is usual for the sailors to refer to the westerlies as

► Roaring forties

► Furious fifties

► Shrieking / screaming sixties

POLAR EASTERLIES

Driving ATLAS

Why polar easterlies are variable from Trade winds?

Lower Lat Insolation is driving force for winds

EAST: Cause (consistency of heat) is consistent leading to constant Trades

Polar Lat (i) But in here, larger fluctuation of insolation

(ii) Weak winds here

Least amount of insolation

Mass of air is less (due to shrinking earth towards top)

(iii) cold winds are dry.

SECONDARY CIRCULATIONS / ATMOSPHERIC DISTURBANCES

Monsoons, cyclones, anti-cyclones, thunderstorms, tornadoes

Spatial & Temporal variations caused over & above

PRIMARY CIRCULATIONS [Planetary winds - Trades (Easterlies), Westerlies, Polar westerlies]

3 basic, indispensable ingredients of all other variety of dishes mom cooks.

* QUOTES *

- * Be a voice, not an Echo
- * Great minds have purposes, others have wishes.
- * Marriages are made in heaven, so are thunder & lightning.
- * Never let a fool kiss you or a kiss fool you.

POLAR EASTERLIES

- They are typically COLD & DRY winds.
- These are highly VARIABLE winds - because of large seasonal fluctuations of insolation in higher latitudes.
- These are very WEAK WINDS - & reasons being
 - a) lesser amount of Insolation
 - b) smaller mass of air in higher latitudes.
- These winds are more variable in Northern hemisphere because of complex mix of land & water.

Conclusion (for Planetary Winds)

The Trade, Westerlies & Polar Easterlies constitute the PRIMARY CIRCULATIONS of globe. Over & above these primary circulations, there take place many SPATIAL & TEMPORAL variations called SECONDARY CIRCULATIONS / ATMOSPHERIC DISTURBANCES

Ex: Cyclones, Monsoons, etc..

* All Tropical cyclones being embedded

in Trade winds, in general, move from

E → W.

* Temperate cyclones being part & parcel of Westerlies, in general, move from

W → E

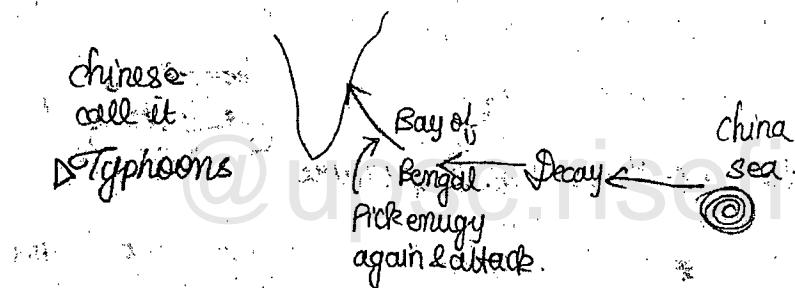
Note: Weather forecasting in Europe is a west facing vocation.

Some cases of cyclones:

Chinese

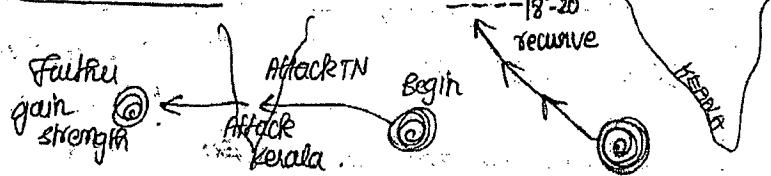
call it

Typhoons



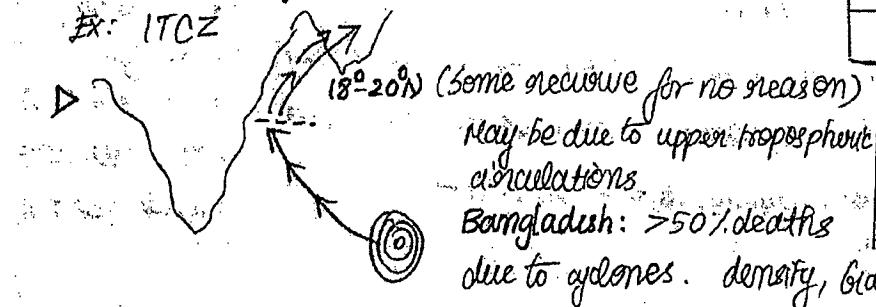
In this case, KERALA escapes.

another case:



[When low pressure moves away from Equator, cyclones are formed.]

Ex: ITCZ



(Some receive for no reason)

May be due to upper tropospheric circulations.

Bangladesh: >50% deaths due to cyclones. density, Ganga-Brahmap belt

CYCLOCLES

Tropical Temperate

- Thermal - Frontal

in origin (land/water/energy from partly in both warm water)

SST $\geq 27^{\circ}\text{C}$

- Die on land (but potent to kill many before that)
o Energy cut
o Frictional loss due to land.

ONLY PLAN TO FACE IT:

Evacuation of people

Location

Path of cyclone

But, every cyclone is governed by environmental conditions of that time

May even decided by Upper tropospheric circulations. Hard to tell.

TROPICAL CYCLONES

part & parcel of Easterlies

Trade wind - Vehicle

Cyclone - passenger

TEMPERATE CYCLONES

part of Westerlies

Cyclones will move away from Equator

? Curved winds - Coriolis force

OCEAN CURRENTS

Like the atmosphere, the world ocean also plays a significant role in moderating the global heat imbalance.

Ocean currents are the large scale movements of water which form the OCEANIC COUNTERPART to atmospheric circulations.

In general, the term Ocean current is used for HORIZONTAL MOVEMENT on the uppermost 100 m of ocean called SURFACE LAYER.

I On basis of Relative consideration of Temperature

* WARM CURRENTS * COLD CURRENTS

3 rules to be followed are:

In general, near Equator, warm currents from lower to higher latitudes, warm currents from higher to lower latitudes, cold currents

OCs → Drift Current Stream → Based on: Relative consideration of speed direction Identify

Slow, erratic, not well defined - DRIFT - 16 to 24 km/day
 More rapid, defined, discernable - CURRENT - 6 to 8 km/hr
 Good speed with big body, defined, clear - STREAM - size

Movements in Ocean

Horizontal movements

- Surface layer & Deep
 - ↳ OCs Deep OCs

Vertical movements

UPWELLING: Rivers carry nutrition-settle on ocean floor - during upwelling nutrition comes up - good for fishing.

DOWNWELLING: Takes cold surface water to floor thus sustaining life in deep ocean.



- only w.r.t. relative temperature of the water it visits.
- relative difference only $2^{\circ}/3^{\circ}/4^{\circ}\text{C}$ but still is able to impact weather there.

Ex: NAD → Europe

Mild winter to London
 Port cities of N. Europe
 are prevented from freezing

But, in USA (N.A)
 Labrador current
 freezes over

The so-called warm and cold currents usually exhibit temperatures that differ by only a few degrees from those of surrounding waters.

Yet, these small temperature differences are often sufficient to have a significant effect over atmospheric conditions in a wide area.

2] On basis of Relative Consideration of:

Speed Direction Identity

1] DRIFT:

Term refers to slow motion (16-24 km/day)

Erratic direction

No clear boundary / Identity

26 OCs
in class
- ATLAS

2] CURRENT

Term refers to surface movement which is

More rapid (6 to 8 km/hr)

More defined in direction } from drift

More defined in identity }

3] STREAM

Term refers to huge body of surface water

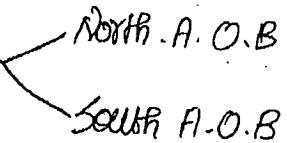
Good speed

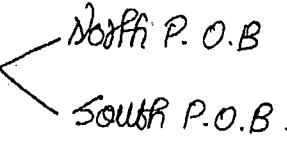
Very well defined direction } like a river

" " " Identity } on continent

ATLAS

5 OCEAN BASINS

Atlantic 
North A.O.B
South A.O.B.

Pacific 
North P.O.B
South P.O.B.

Indian Ocean Basin

WARM CURRENTS

1. NEC (North Equatorial Current)
2. SEC (South Equatorial Current)
3. ECC (Equatorial Counter Current)
4. GS (Gulf Stream)
5. NAD (North Atlantic Drift)
6. NPC (North Pacific Current)
7. KC/SC (Kuroshio Current / Japan Current)
8. BC (Brazil Current)
9. EAC (East Australian Current)
10. ACMC (Agulhas / Mozambique Current)
11. FC (Flosida Current) - not in map.

COLD CURRENTS

1. LC - Labrador Current - bringing iceberg with it (Titanic)
 - ↳ It mixes with Gulf Stream - GS [Warm C + Cold C - Fishing]
 2. CC - Canaries Current [NAD coming back to Equator]
 3. OC - Oyashio Current / Kamchatka Current - Mix with kuroshio
 - ↳ Closer to Kamchatka (Russia)
 - ↳ 2 currents (diverse) meet.
 - ↳ conducive temperature
 - ↳ cold current - nutrients
 - ↳ Dense fog
 4. PC - Peru Current / Humboldt Current
 5. BC - Benguela Current
 6. WAC - West Australian Current
 7. FC - Falkland Current - small
 8. C.C - California Current
 9. E.G.C - East Greenland Current
 10. Ok.C - Okhotsk Current - not in map
 - ↳ near Kamchatka, Russia - R. Okhotsk
 - ↳ Those coastal areas which are cold, dry
 - ↳ PERU current
 - ↳ don't cause Atacama
 - ↳ But helps maintain the dryness.
 - ↳ W.A.C.
 - ↳ Also desert.
 11. W.W.D - West Wind Drift.
 - ↳ Greatest ocean current (\uparrow volume, global)
 - (or) location Global
 - A.C.P.C - Antarctic Circum Polar Current
 - ↳ Response to strong westerlies
 - Then \downarrow slow? Enormous volume
- SOUTH
- West of continent, East of Ocean
- ↳ Cold currents
- East of continent, West of ocean
- ↳ Warm currents

West Wind Drift / Antarctic Circum Polar Current

> Greatest Ocean Current of the world

* Only such current > This flows unimpeded around the globe from W → E

> Primarily a response to the strong westerlies of the Southern hemisphere

Roaring 40°, WESTERLIES
Furious 50°
Shrieking 60°

Note: Water moves slow despite strong winds because of enormous volume involved.

Drake's Passage (in World Map)

→ Btwn South America & Antarctica

→ Very rough waters due to & reasons

> strong westerlies

> W.W.D having big space on left when entering this passage gets squeezed

(i.e) Huge volume of west wind drift gets squeezed here.

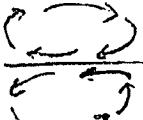
OCEAN CURRENTS FORM LOOPS / GYRES

Northern Hemisphere - Clockwise

Southern Hemisphere - Anti-clockwise

Earth rotation
Coriolis force +
other factors

GYRES



The continuously moving loops of currents in various ocean basins are called Gyres. They are clockwise in northern hemisphere & anti-clockwise in southern hemisphere.

Note: HUMBOLDT

Biome → largest subdivision of Terrestrial ecosystem with an assemblage & association of plants & animals which puts it apart from the rest of the world.

{ Tropical Rainforest - Near equator - Ex: Amazon Rain Fo.

Tropical deciduous forests - Little away from Equator

Tropical Grasslands / savannahs (Africa) - Scattered trees,
Near Middle Latitudes so not pure gro
like Temperate

Mediterranean type biomes (small)

Australia, South Africa, Central Chile of SA.

Temperate deciduous forests

Temperate coniferous forests

Fall trees, evergreen

Ex: TAIGA in Russia / BOREAL in Canada

Temperate Grasslands

Ex: Prairies in North America; Steppes in Russia

Tundra Biome

After this only ice cover further.

→ Latitudinal Zonation of life on Earth

(i-e) Latitudinal zonation of Biome on Earth.

Ice cover in Equator? overgrowing Earth

Possible in case of high altitude mountains

o Mt. KENYA, East Africa

o Mt. CHIMBORAZO, South America

→ Altitudinal Zonation of Biome on Earth too

Ex: UK in India is similar to Tundra Biome altitude wise.
So, Temperate conditions also in India despite
of Tropical & sub-tropical latitudes.

⇒ There is a close parallel between Latitudinal &
Altitudinal Zonation of life.

(i-e) ALTITUDE MIMICKS LATITUDINATION

Why? Heat ↓ ; Moisture ↓ - in both cases as we move up.

Who proved this to the world? HUMBOLDT

He travelled up & down ANDES in South America for this.

Hence Peru current also called Humboldt current

⇒ Altitude mimicks latitude

(i-e) There exists a close parallelism between Latitudinal & Altitudinal zonation of Biomes.

⇒ Mt. KENYA in East Africa

Mt. CHIMBORAZO in Ecuador

Have their feet almost on Equator, but peaks are snow-covered

FACTORS AFFECTING OCEAN CURRENTS OF WORLD

The pattern of ocean currents as seen in world oceans
is due to combined effect of following 4 SETS OF FACTORS

SET OF FACTORS relating to

- ① Earth's Rotation
- ② Oceans (properties of ocean water)
- ③ Atmosphere
- ④ Modifying factors

CAUSATION
Factors

→ No role in gen.
but may mod
speed, direct
of existing C.

MODIFYING FACTORS

* Nature & shape of Coast

* Ocean Bottom Topography

↳ Mid Oceanic ridges + Sea mounts, etc.

They don't help generation of ocean currents but do have a role in modifying existing currents.

Note:

⇒ Nature & Shape of Coast

Ex: i) Indian coast's role in OCs in Indian ocean

ii) Brazilian landmass bifurcating South Equatorial current into NEC & Brazil current feeding loops of N & S.

⇒ Ocean Bottom Topography

Mid Oceanic ridges - mountain systems from ocean floor

Ex: MID ATLANTIC RIDGE | near surface, some even protruding
S shaped from N Atlantic to out as Islands - in S L of ocean - affected by S. Atlantic with only 1 break near Equator ; Volcanic islands;

SEA MOUNTS - individual mountains

Hot Spot Volcanism (High temp conditions in mantle) - volcanic eruptions

QUOTES TIME

- * 'It is better to wear out than to rust out'
- * 'You are where you are because of your habits of thought'
- * 'Success is not the result of spontaneous combustion.
You must set yourself on fire.'

To be Remembered:

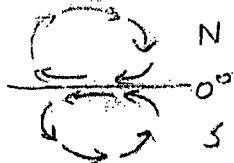
Ocean currents are a combined effect of a large no. of factors.

Winds constitute the dominant factor of causation of Ocean Currents

II Set of factors relating to EARTH'S ROTATION

As earth rotates from W → E, the water near the equator tends to move from E → W. [in context of a equatorial currents NEC & SEC]

Note: The equatorial currents NEC & SEC are primarily caused by Trade winds which generally blow from E → W.



CORIOLIS FORCE has some role to play

② Earth's rotation from $W \rightarrow E$ leads to an apparent deflection to moving waters. The deflection is clockwise in Northern Hemisphere & anti-clockwise in Southern Hemisphere.

③ NEC & SEC lead to piling/convergence of water on western part of ocean basin.

One part of piled up water gets deflected to Right/North \rightarrow TO loop and left/South because of Coriolis force & this water feeds the loops in both hemispheres.

Another part of this piled up water, because of Gravity, moves back from west to east, near the equator resulting in CEC - Counter Equatorial Current.

Set of Factors relating to Oceans
[Temperature & Salinity]

$$\begin{cases} L. Density \rightarrow H. Density \\ Ar(HT) \rightarrow Ar(LT) \\ Ar(±S) \rightarrow Ar(HS) \end{cases}$$

As a rule: the surface water on ocean moves from areas of lower density to areas of higher density.

Set of factors relating to Atmosphere

To be remembered

There are more currents from lower to higher latitudes than from higher to lower latitudes, the primary reasons being

- ✓ Higher temperature ↗ in lower latitudes.
- ✓ Higher precipitation ↗ (net after considering evaporation rate also)

Currents like Labrador & Oyashio are primarily because of large amounts of melt water.

- Note:
- o Atmospheric pressure difference
 - o Amount of RF (coupled with rate of evaporation)
 - o Amount of melt water

All affect the Ocean currents. But the leading role is played by the

O Frictional Drag on water surface by planetary winds.

Most OCs of world tend to follow the directions of planetary winds. The

INDIAN OCEAN most clearly illustrates the dominant role played by planetary winds

↑ Water ↓ Water
L. lost → H. lost

↑ Temp.
↑ Precip + Evap.

less water H. lost
more water L. lost
then why?
Salinity variation from N to S

MELT WATER

- ✗ Wind - pol. eas weak.
- ✗ Salinity - <
- ✗ Evaporation - <

Atmosp
Pressure difference

Ar (cp) → Ar (>p)

✓ Precip + Evap

✓ Atmos melt water

WINDS

NEC SEC WWD - Pr/Fr/ss
Trade NAD - westlies.

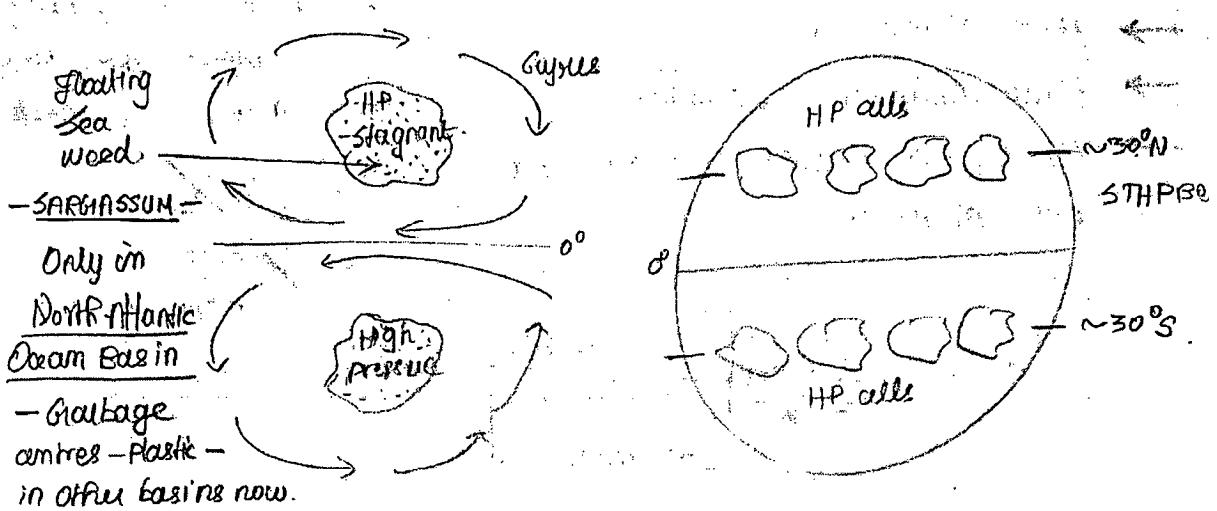
Best: Indian Ocean

↙ NE (winter)
SW (summer)
Reversal

as we find that, with seasonal reversal of winds the OCs also get reversed.

SONALI CURRENT

SUB-TROPICAL GYRES & SARGASSO SEA



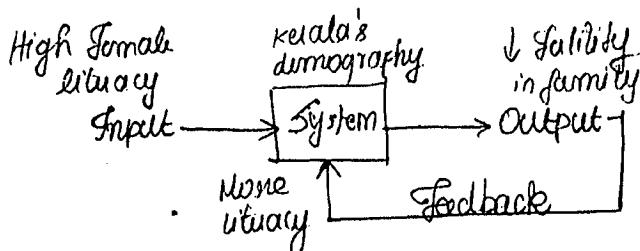
In central areas of 5 ocean basins, the waters are stagnant or move very slow, the reason being that these are the \Rightarrow locations of sub-Tropical High Pressure Cells

In central area of North Atlantic ocean basin, because of stagnant water, there is a huge collection of SEA WEED belonging to SARGASSUM SPECIES - hence the name SARGASSO SEA.

Feed Back

Systems Approach: (can use for understanding any topic)

- | | | |
|---------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------------------------|
| Eco System | - 'Eco' → 'Oicos' - house
[Bout-Tansley] | Exam - Mental stuckness
→ Train <u>ourselves</u> for thinking about thinking in exam hall. |
| → Elements comprising | | TOOLS: ① Systems approach |
| → Relationships among elements | | |
| → Relationships between elements and environment. | | <u>SOLUTIONS</u> |



⇒ The term Feedback in System's analysis refers to the output or part of output which influences system's operations.

2 types of Feedback:

if Positive feedback → one which amplifies the change

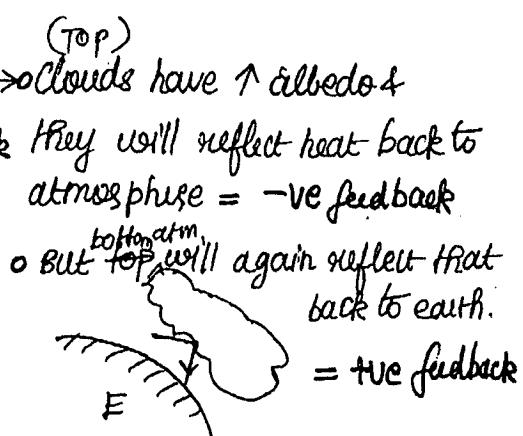
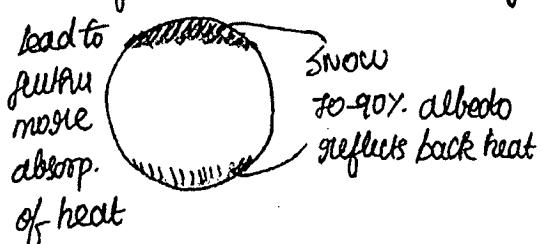
if Negative feedback → one which dampens the change.

Ex: Drug rehabs are -ve feedback as they ~~amplify~~ dampen the drug effects.

✓ Albedo - 'Albus' - white, reflective

* Global Warming → ↑ clouds → clouds have ↑ albedo &

o Abs. of snow due to gw will +ve feedback They will reflect heat back to atmosphere = -ve feedback



o But ^{bottom atm.} will again reflect that back to earth.
= +ve feedback

* QUOTES TIME *

- * 'Forests precede people, deserts succeed them'
- * 'Worrying is like a rocking chair, it gives you something to do but gets you nowhere'

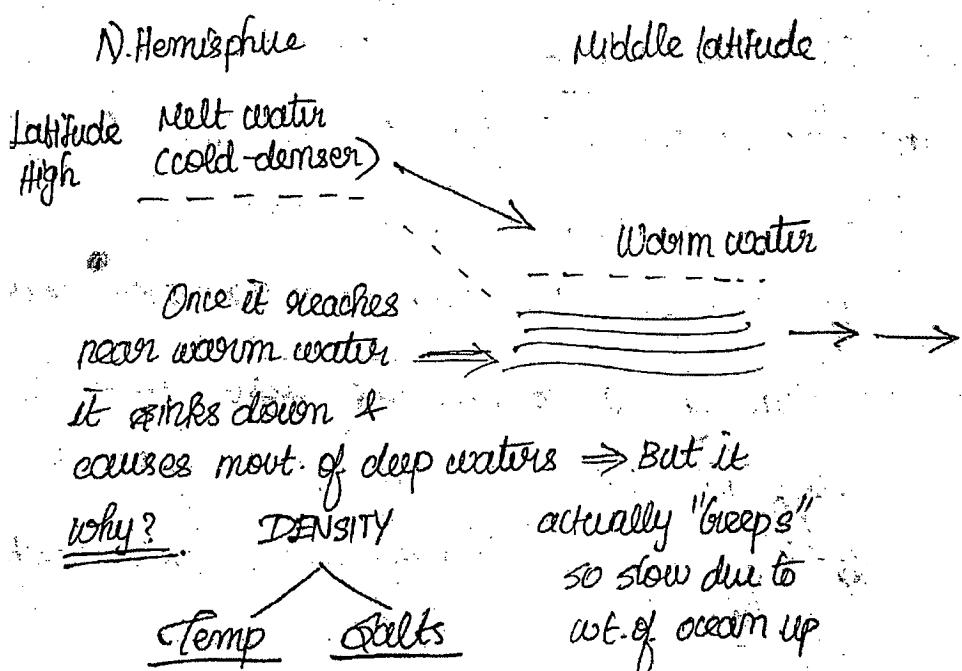
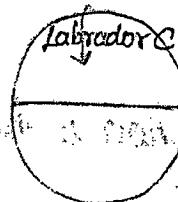
THERMO HALINE CIRCULATIONS

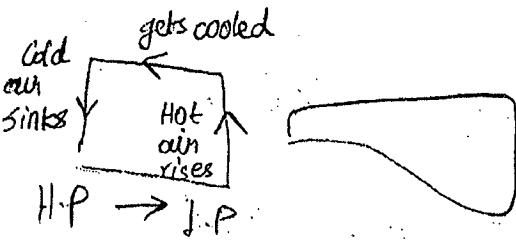
Ocean Current Horizontal
 Surface layer $\approx 100m$

Deep Ocean Current - Here we learn this

Thermo - Haline
Temp Halogens - salts in ocean.

LABRADOR CURRENT



<u>Hadley-Ferrel</u>	<u>O.C movement</u>	<u>O.C</u>	<u>D.O.C</u>
		Causation: Wind	Density diff.
		Volume: $\approx 100 \text{ m}$	Much bigger volume.
		speed: 6-8 km/hr	10-20 km/year not even moves but "CREEPS"

Heat & Cold transfer.

@upsc.risefinity

Thermo-haline Circulation:

Density differences create Deep currents

Deep water currents move larger volumes of water and are much slower than surface currents.

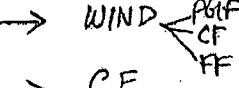
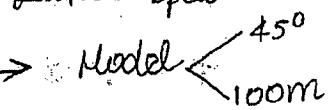
Typical speed of deep currents range from 10-20 km/year.

Because the density variations that cause deep O.C are caused by diff in TEMP & SALINITY, therefore D.O.C circulation is also referred to as THERMO-HALINE CIRCULATION.

EKMAN SPIRAL & EKMAN TRANSPORT

Not in
NCERT &
G.C.Leong

Assumptions:

- 'SL' 
- WIND 
- C.E.
- Latitude Speed
- Model 

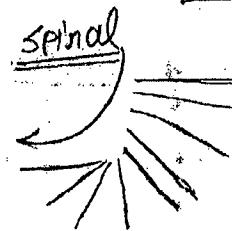
why model?

A phenomenon

Every next layer

- ✓ Speed ↓
- ✓ Progress. too. $\frac{N}{R/I}$
(turn/def) due
to C.F.

- ✓ Last layer exactly
opposite to 1st



Transport

Avg = 90°

@upsc.risefinity

Ekman Spiral:

EKMAN SPIRAL describes the Speed & Direction of flow of surface water at various depths.

EKMAN'S MODEL assumes that a uniform column of water is set in motion at a progressively by wind blowing across its surface.

Because of CORIOLIS EFFECT, the immediate surface water moves in the direction 45° to right of wind (in Northern Hemisphere)

The surface water moves as a thin layer on top of deeper layers of water.

As surface layer moves, other layers beneath it are set in motion thus passing the energy of the wind down through the water column.

Awrent speed decreases with increasing depth & because of coriolis effect, the curvature increases towards right [like a SPIRAL]. Thus, each successive layer of water is set in motion at a progressively lower speed & in a direction progressive towards the right of the one above it.

At some depth, a layer of water may move in a direction exactly opposite from wind direction that initiated it.

If the water is deep enough, friction will consume the energy imparted by the wind & no motion will occur below

that depth. Although it depends on wind speed and latitude, this stillness normally occurs at a depth of about 100m.

Eckman Transport → It is the average water movement of entire column & it is taken at right angle to the wind direction.

UPWELLING

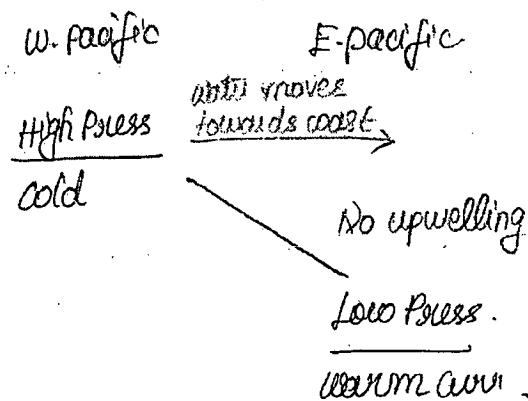
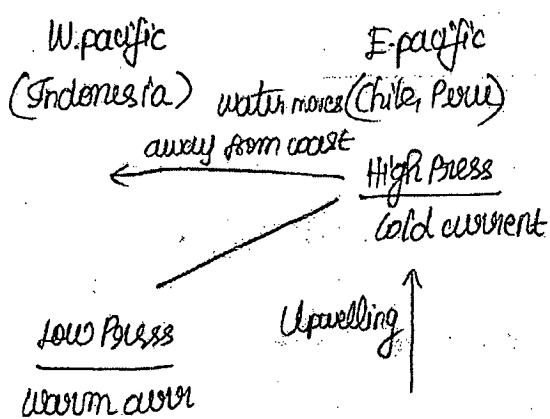
Generally this is discussed w.r.t:

West coast of S. America → Chile Peru due to El-Nino

Upwelling ← -ve impact → Desiccation / Dry conditions
+ve impact → Fishing (+ Birds droppings)

Normal yrs

El Nino years



Seesaw effect
of Southern Oscillations

El Niño - Teleconnections

@upsc.risefinity

Upwelling:

Upwelling refers to the rise of cold, Nutrient Rich ocean bottom water on to the surface.

Whenever on surface of the ocean a vacancy gets created - to fill that vacancy, the ocean bottom water rises up.

Some of the DRIEST COASTAL AREAS on the EARTH are associated with upwelling particularly on latitudes under the influence of Semi-permanent high pressure cells.

These areas are :

N. W. Mexico

N. Chile & Peru. [W. Coast of S.A]

N. W. & S. W. Africa

Upwelling can result in Desiccation on nearby coast.

It also does produce one important human benefit:

It carries to the surface the nutrients that support some of the most productive fishing grounds on the world ocean.

Equatorial Upwelling:

The diverging waters of NEC & SEC create a vacancy on the ocean surface resulting in the rise of ocean bottom water on to the surface, referred to as Equatorial upwelling.

SUB-TROPICAL GYRES

NAMES

I. N.A Sub-Tropical Gyre:

Columbus Gyre

1st one to exploit its currents on a big way

II. S.A Sub-tropical Gyre:

Navigator Gyre

Portugal's Prince Henry The Navigator

He founded Europe's 1st Navigation school & launched OCEANOGRAPHY'S

AGE OF DISCOVERY.

III. N.P. Subtropical Gyre

Turtle Gyre

In honour of turtles that cross the widest ocean basin to visit their ancient breeding beaches in Japan.

IV. S. P. Subtropical Gyre

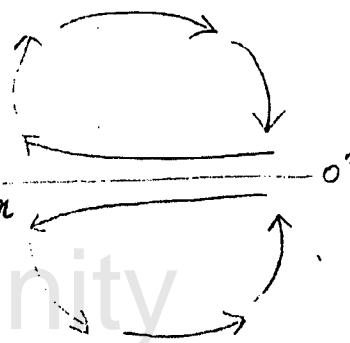
Heyerdahl Gyre

Fearless explorer scientist who proved an ancient journey from S. America to Polynesia by re-enacting it.

Recall

5 Ocean Basins

1. N.A.O
2. S.A.O
3. N.P.O
4. S.P.O
5. S.O



Logic + fact
Fact.

* Quotes Time *

* Nothing that is natural is dangerous

* We are the authors of our own disasters

15th century Arab sailor - AHMAD BIN NASID

Greeks - Inquisitive, versatility, pure sciences

Romans - To make big empire, application oriented explorations.

DARK AGE - church became the supreme;
(Europe)

All scientific explanations rejected; books burnt

Flat earth - church claimed

ILLUMINATION - ARABS ↗

(other parts) link b/w past & future

They perfected the old books & translated them
scientific outlook; Religion, Trade, for Empire

Mastered the Oceans - TRAVELED a lot

Best maps of those days.

Handed over their knowledge to Europeans
during RENAISSANCE

Familiarity with Indian ocean.

Arabic word 'Nausim' → Monsoon

V. S.O. Subtropical Gyre

Majid Gyre

A great 13th century Arab sailor & scholar
Abu'l-Maqdis Bin Majid - his maps guided europeans in
the world Ocean.

Heyerdahl

Read abt him.

Polynesia

Easter Islands

→ remote

→ 4000 km from

west of S. America

→ ppl migrated
from S. America

→ stone monuments
mysteries of history

→ Hot spot
volcanism

Ex: Yellow stone

→ Civilization
got extinct due
to over exploitation
of resources.

Ecologists:

CONSUMERISM
warning

> Ecological
footprint

> AFFLUENZA

> 2006: IWI
Survey

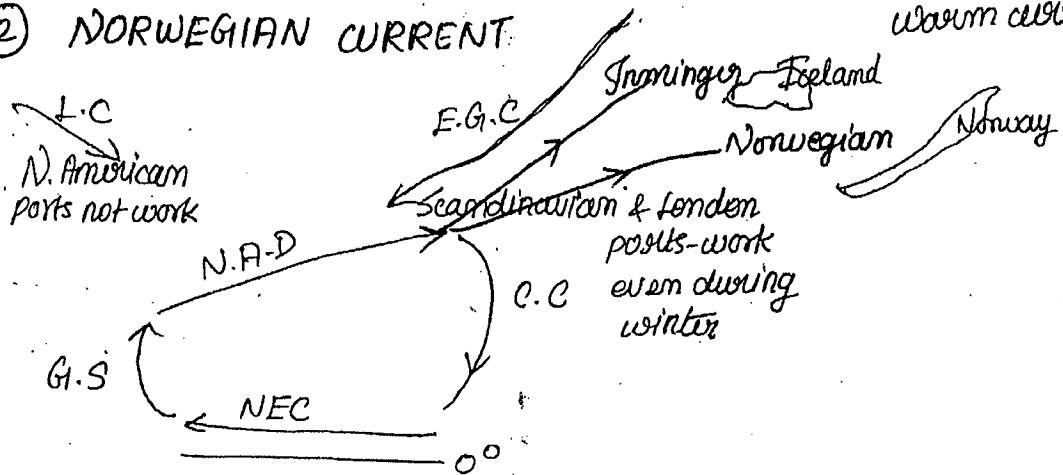
3.5 Earths to
achieve American
way of life

Incl Brazil China

Some Other Currents (Warm)

① IRMINGIER CURRENT

② NORWEGIAN CURRENT



Irminger Current is a warm current along the west coast of Iceland.

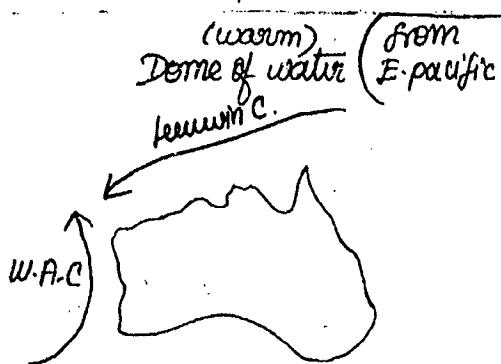
Norwegian current is a warm current along the coast of Norway.

These both are extensions of GULF STREAM / N.A.D.

③ LEEUWIN CURRENT

In Normal yrs — I.C. negates the W.A.C & hence not much droughts in W.Aus.

In El Nino yrs — No dome of w. water
W.A.C will dominate the weak I.C.
& hence bearing droughts.



→ L.C is a warm current along W.coast of Australia.

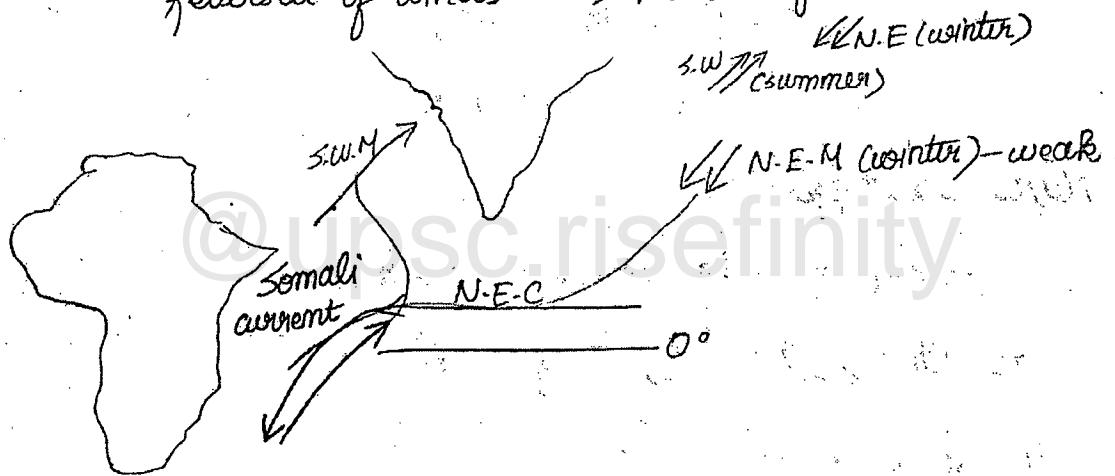
It comes from the dome of warm water piled up on Eddies by the Pacific Equatorial current.

→ During El Niño, L.C weakens & therefore the cold W.A-C brings droughts.

④ SOMALI CURRENT

Though wind is the most dominant factor for currents in general, it is best evident in Indian ocean.

Reversal of winds → reversal of currents



↑ S.W. (Summer)

Somali Current is a warm current along the coast of Africa in Indian Ocean.

It is an extension of NEC bcs of N.E. Monsoonal winds. During S.W.M season (summer), the winds reverse, causing the NEC to be replaced by S.W.M current which flows in opposite directions.

The winds cause Somali current to reverse as well, which flows rapidly northward & feeds the S.W.N current.

Ocean Currents for Human Beings

Some of the world's great fishing areas occur in regions where contrasting currents meet.

L + G.S

O + K

Cold + warm currents

The mixing that develops creates a favourable habitat for PLANKTONS.

✓ Fishing

✗ Fog.

The temperature becomes conducive & cold currents bearing more nutrients.

2 Major examples:

East Central Coast of North America :

Labrador $\xleftarrow{\text{mixes}}$ Gulf Stream

North West Pacific

Ogashia $\xleftarrow{\text{mixes}}$ Kuroshio around HONSHU island of Japan

The same temp. contrast often create foggy conditions that make fishing & shipping in such areas hazardous.

Cold Currents

Ex: Peru current

- (i) They cool the onshore winds.
This lowers temperature & shortens growing seasons in the coastal regions.

The chance of frozen harbours and icebergs is increased by cold currents like LABRADOR.

- (ii) They maintain the aridity of coastal deserts by cooling the onshore winds. Ex: Coastal winds crossing the Peru current to the ATACAMA desert.

Warm Currents

Ex: North Atlantic Drift

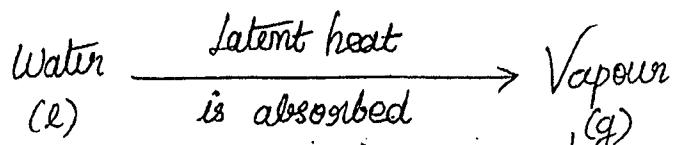
- (i) They warm the prevailing onshore winds.
This ensures that for its latitude, NW Europe has a mild climate & harbours in Norway & Iceland are ice-free.

- (ii) They help to increase precipitation in adjoining coastal regions. Ex: S.E. Trades passing over the warm Brazilian current.

CLOUDS & PRECIPITATIONS

The moisture holding capacity of air is a function of its temperature. Warmer air holds more moisture.

Building blocks of ecology; global warming.



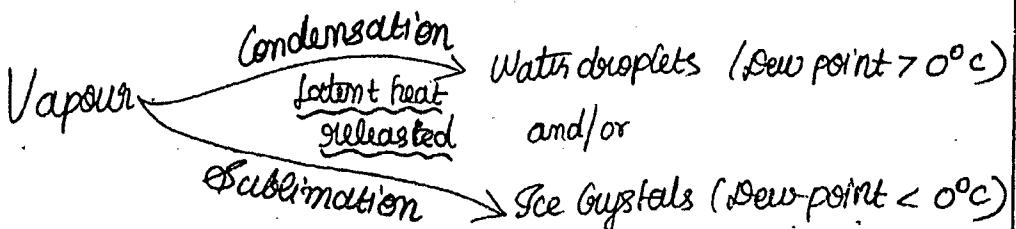
The destructive effect of Tropical cyclones is mainly due to latent heat release.

So lower latitudes are more prone than polar regions as lower lats. has more moisture & hence more latent heat.

CLOUDS



CLOUD FORMATION



If air hold vapour less than its capacity, no conversion or release takes place.

Also there must be some space/particle over which vapour can go and condense or sublime.

Pre-requisites for cloud formation

* AIR- SATURATION

* Particles - CONDENSATION NUCLEI

→ Clouds represent the visible manifestation of condensation on a fairly large scale in nature.

→ Clouds form when air happens to cool to dew point & vapour condenses into water droplets and/or ice crystals.

→ 2 conditions necessary for cloud formation:

i) Air must be saturated.

ii) There must be a substantial quantity of small particles called condensation nuclei around which liquid droplets can form when vapour condenses.

→ Clouds indicate the state of the atmosphere & give hints about future weather.

→ The science of cloud formation is well understood but what happens in a cloud to result into precipitation is still not completely understood.

→ All precipitation originates from clouds but all clouds do not produce precipitation.

Relative Humidity (RH)

RH is the best known means of describing the content of water vapour in the atmosphere

It is simply the ratio b/w the amount of water vapour in air @ given temperature

Max amount of vapour air could hold at that temperature

Saturation

When air of given temp holds all of w-vapour that it possibly can, it is said to be the case of saturation.

In general, for a given place, RH reaches its: (If numerator held constant)

Least value \rightarrow @ late afternoon

Highest value \rightarrow @ Dawn

The air of tropical desert MAY HAVE more absolute moisture than the air of a non-desert in the temperate region.

Humidity

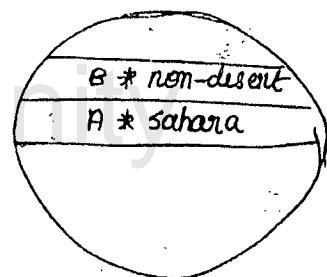
- Absolute hum
- Specific hum
- Relative humidity
(R.H.)

$$R.H = \frac{M_t}{M_s} \%$$

R.H \rightarrow \gg in oceans
 \ll on land or where less source of moisture present

R.H

Max \rightarrow Dawn
Min \rightarrow late afternoon



$$\frac{m_A}{M_A} \ll \frac{m_B}{M_B}$$

Absolute moisture is not much \otimes but context / where it is placed is \otimes

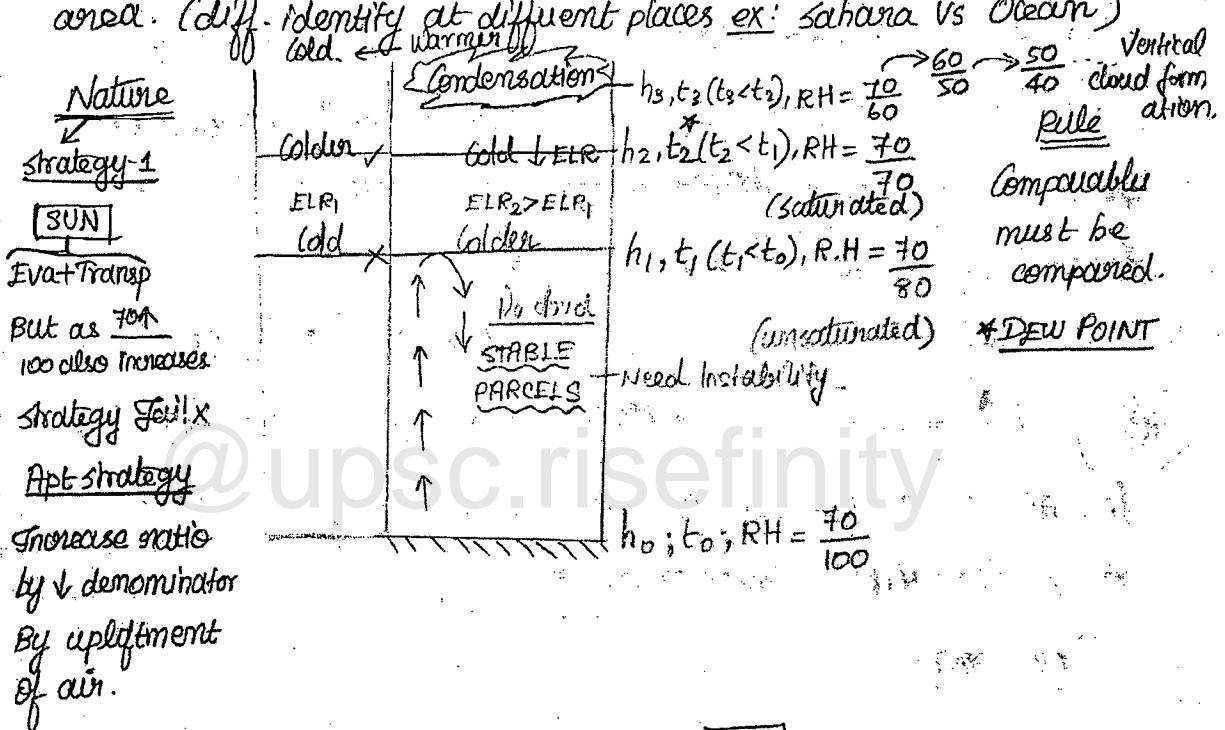
Clouds may not form in Sahara due to poor RH.

But clouds may form in Non-desert due to good RH.

* QUOTES TIME *

- * Humans have brought into being the mountains of hate, rivers of inflexible tradition & oceans of ignorance'
- * Hard work beats talent when talent does not work hard'

Column of air → The vertical atmosphere over a particular area. (diff. identify at different places ex: Sahara vs Ocean)



3 Mechanisms for Upliftment of air:

- ① CONVECTION (warm air ↑ rises)
- ② OROGRAPHIC

Types

Convectional - Lat, season, Time of day

Orographic - No restriction.

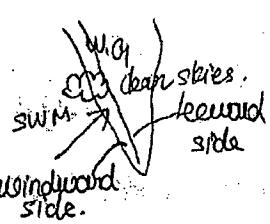
Simulations

Frontal - Lat,

(Delhi-Western disturbances comes from else where)

Forms

Rain
Haze
Snow etc..



③ FRONT



TYPES OF PRECIPITATION

The mechanism with which air gets uplifted to result in condensation & precipitation is called TYPE of precipitation

- ① CONVECTIONAL
- ② OROGRAPHIC
- ③ FRONTAL

STABLE PARCEL & Need for Instability:

In a given column of air, if the air cools faster than the adjoining air column, then at a particular height it may become colder (even if it is still unsaturated) than the adjoining column's air - as a result, it descends back w/o making clouds x.

Such a parcel of air is called a stable parcel.

This implies that for cloud formation, there must be INSTABILITY IN AIR so that air keeps rising to result in condensation (sublimation).

Dew Point:

Dew point is a temperature at which air, on cooling, gets saturated & below which, if there is further cooling, it results in condensation.

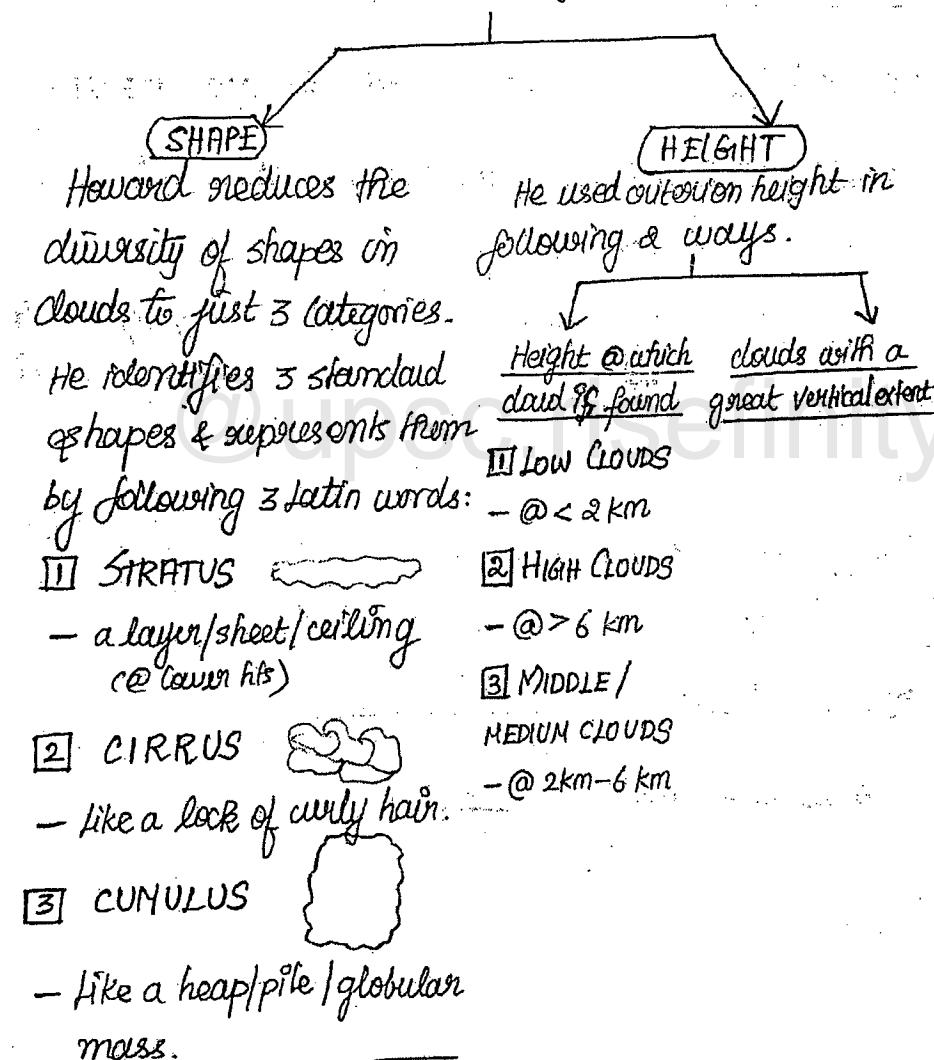
Vertical development of clouds:

Once condensation takes place, there is a release of latent heat. The release of latent heat is an additional & INDEPENDENT reason for the air to go further up & result in the vertical development of clouds.

Classification Of Clouds

A general classification of clouds was proposed by LUKE HOWARD in 1803. His classification was a Descriptive one and based on SHAPE & HEIGHT.

Descriptive classification



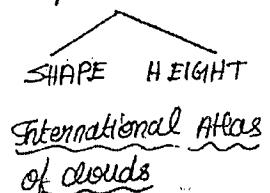
He used word NIMBUS in the name of cloud to suggest a - rain bearing cloud.

Genetic classification
(on basis of genesis or origin of formation)

Since most clouds are formed by upliftment of air, no Genetic classification

Descriptive classification

Describing features or parameters.



LUKE HOWARD, 1803

Complex variability

more no. of categories
less no. of categories

Luke Howard

Observations regarding Height @ which cloud is found :

- The heights used for demarcation do have their
Spatial & Temporal Variations.
- Low clouds are mainly STRATUS
- High clouds are mainly CIRRUS
- He uses word 'ALTO' as prefix on name of the cloud
to suggest a Middle or Medium height cloud.

Observations regarding clouds with a great VERTICAL EXTENT:

- Such clouds may grow from low bases + go to a height of as much as 15 km.
- Such clouds generally have limited or restricted horizontal spread as they are result of
 - * Intense Local Convective rising
 - for intense heat, smaller area would be preferable | enough moisture due to warmer air to rise to big ht.
- Such clouds are mainly CUMULUS

why vertically big clouds are not big in horizontal extent?

STRATUS

```
graph LR; STRATUS --> High["High → CIRRO-STRATUS"]; STRATUS --> Middle["Middle → ALTO-STRATUS"]; STRATUS --> Low["Low → STRATUS"]
```

PRE

Do

G.C Jeong
clouds topic
cloud

- 1) Mare's tails
- 2) Herring (Fish) sky
- 3) Halo
- 4) Dimly Sun/moon

@upsc.risefinity

Precipitation

Condensation easily forms clouds.

All precipitation originates in clouds. However, all clouds do not produce precipitation.

The science of cloud formation is well understood but what happens in a cloud to result in precipitation is still not well understood.

2 HYPOTHESIS :

There are 2 hypothesis which attempt explaining the process of precipitation.

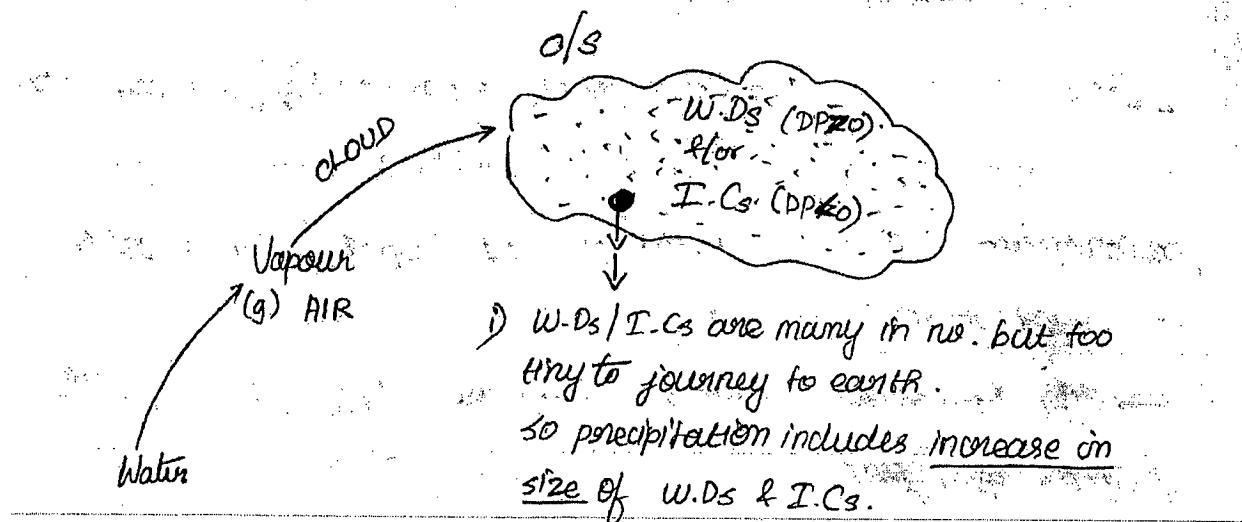
- 1) COLLISION-COALESCENCE Hypothesis
- 2) ICE-CRYSTAL FORMATION Hypothesis

(Bergeron-Findeisen Hypothesis)

Finnish
two dimensions
of precipitation.

* QUOTES TIME *

- * The first rule of intelligent tinkering is to save all the pieces. (B.D., D.M..)
- * The biggest human temptation is to settle for too little.
- * Nothing that is natural is disgraceful.



- i) W.Ds / I.Cs are many in no. but too tiny to journey to earth.
so precipitation includes increase in size of W.Ds & I.Cs.

- ii) That drop which has grown, while coming down must pass through warm layers b4 reaching earth which may again turn it into vapour. so, it must tackle the challenge of evaporation.
iii) Also, challenge of turbulence (i.e.) using convectional currents.

Condensation, once formed clouds - After that:

→ Great multitudes of cloud particles must join together in order to form a drop large enough to overcome both EVAPORATION & TURBULENCE and thus be able to fall to the earth.

① COLLISION - COALESCENCE HYPOTHESIS

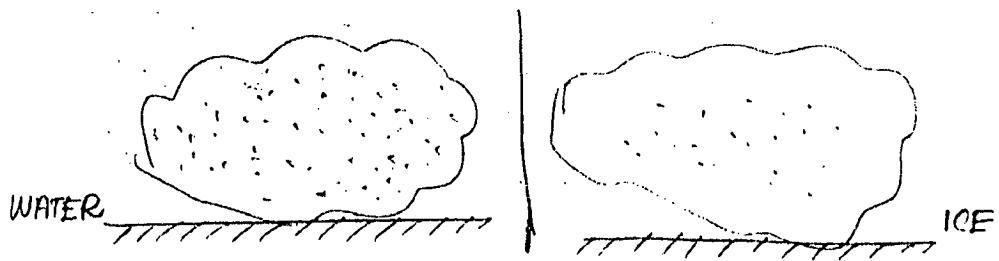
Limitations: It is for tropical areas; so only explains liquid ignores ice crystals. precipitation in tropics.

→ In many cases, particularly in tropics, clouds have temperatures too high for formation of ice crystals. In such clouds, rain is formed by collision & merging of water droplets. Condensation alone can't give rain bcos it produces lots of small droplets but no large drops.

→ Thus, coalescence is necessary. Apparently, coalescence is ensured / assured only if atmospheric electricity is favourable. (i.e) if a +vely charged droplet collides with a -vely charged droplet.

→ the larger the particles grow, the faster they grow & faster they fall

VAPOUR PRESSURE



The pressure exerted by a vapour on a substance is called VAPOUR PRESSURE. EX: Pressure exerted by water vapour in the atmosphere.

If the air is saturated, then it is referred to as SATURATION ^{VAPOUR} WATER PRESSURE (S.V.P.).

$$S.V.P \text{ (water)} > S.V.P \text{ (Ice)}$$

(i.e) It takes more water vapour molecules to saturate air above water than it does above ice.

① ICE CRYSTAL FORMATION HYPOTHESIS (1930s)

(Bengtsson - Findeisen hypothesis)

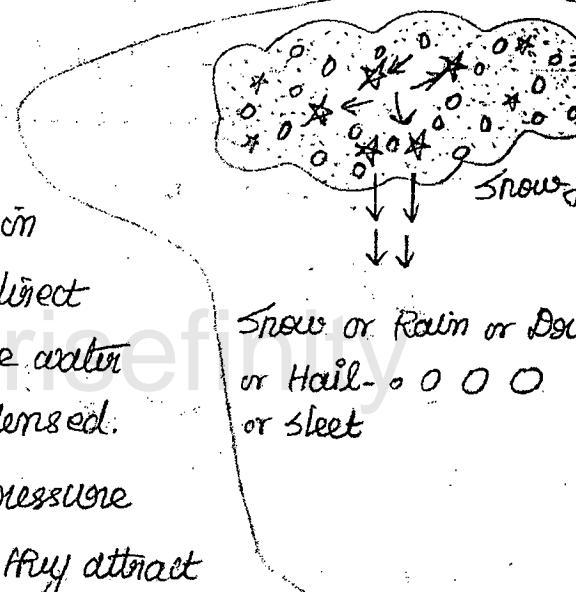
Observations based on conditions of middle latitudes
these scientists were Europeans. They say that in free

i) Ice crystals * ii) Water droplets o iii) Vapour yet to be
super-cooled droplets of water - microscopic in size but great
in number even at 0°C in atmosphere due to the different
pressure conditions.

Ice crystals & Supercooled
water droplets often co-exist in
the cloud. These two are in direct
competition for the available water
vapour that is not yet condensed.

There is lower vapour pressure
around the ice crystals, so they attract
most of the vapour, and the water droplets, in turn,
tend to evaporate to replenish the diminishing supply of
vapour. So, the ice crystals grow at the expense of water
droplets until they are large enough to fall.

As the ice crystals pass through the lower, warmer,
positions of cloud, they pick up more moisture & become
still larger, they may then precipitate from the cloud as
snow flakes or they may melt & fall as rain drops.



At present, it is believed that a more of these (I & II) hypothesis gives us better understanding of process of precipitation.

Cloud Burst

Reason is convection. But then why mountain regions are mostly in news?

Mountains aid in process of convection.

Urban climatology - Buildings aid in the process of convection. It has provided ~~sun~~ more area + time to heat.



Cloud Burst is a FANCIFUL term used for a sudden, very concentrated down pour of water.

Generally the area affected is quite small - for the reason that cloud burst is caused by Intense local Convectional Rising.

UK, HP, NE,
J&K, W.G., N, C

Intense local Conv. Rising

Uttarakhand case

- i) Cu-Ni - Heavy rain
- ii) Glacial lakes disturbed
- released water >;
Glacial lake outburst
- iii) Mass Movements
of loose sediments.
- iv) Steep slopes.

Governance

- I Lack of mapping of lakes on the region.
- II Nepal has better understanding.

CLOUD SEEDING

"Less Words, Better
Speech/Writing"

Objective to induce more precipitation.

It is believed by some scientists that solid CO_2 & silver iodide smoke can enhance cloud growth & hence increase precipitation.

But the results of cloud seeding are not predictable or reliable.

Ex: Karnataka ; Maharashtra.

Note: Team "GOVERNMENT RAIN"

-ve effects \rightarrow C-N introduction \rightarrow moisture divided into many tiny drops.

- i) Injection of pellets of solid CO_2 (Dry Ice -78°C)
- ii) Injection of moisture-catalyst (water droplets)
- iii) Chemicals to provide condensation Nuclei / sublimation nuclei - silver iodide smoke.

Results: Unpredictable

TYPES OF PRECIPITATION

The mechanism with which air gets condensation or precipitation is called types of precipitation.

There are 3 types of precipitation:

① CONVECTIONAL PRECIPITATION:

- \rightarrow It is due to unequal heating of different surface areas.
- \rightarrow It is restricted in forms of latitude, Season & time of the day.
- \rightarrow It is in general Torrential (showery), with large rain drops falling fast & furious but only for a short duration.

Cloud-Vertical

② OROGRAPHIC RAINFALL:

- It is due to a topographic barrier.
- On the windward side, as the air rises, it cools adiabatically, resulting in condensation & precipitation.
- On the leeward side, as the air descends, it gets adiabatically warmed & its R.H. decreases resulting in a **RAIN SHADOW ZONE**.
- Orographic precipitation can occur at :
any latitude any season any time of the day
if there is a barrier & moist air is forced to rise.
- It is more likely to be gentler & prolonged than showery & brief.

cloud
-horizontal

* QUOTES TIME *

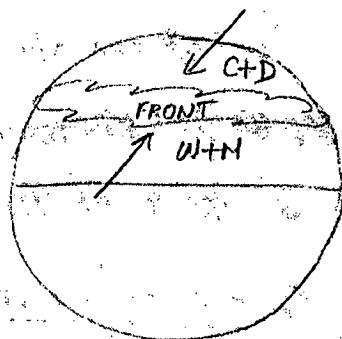
Mon - 11:01
Tue - 5:27 - P. Sun - 10:24
Wed - E. 11 - Geo. 11
Thu - 6:05 S (2-1:30)
Fri - 11:23 O
Sat - Sun 3

- * Live your life as an exclamation rather than an explanation.
- * Cauliflower is nothing but cabbage with a college education

③ FRONTAL PRECIPITATION

ITCZ - Summer

convergence of air masses.



So, Fronts are in middle latitudes

But, there is frontal precipitation in India sometimes - TEMPERATE CYCLONES.

Western disturbances - North India

A front is a zone of transition formed in the middle latitudes b/w contrasting air masses - the cold dry polar air mass & warm moist tropical air mass.

In a front, warm air moves over the cold air, gets cooled & results in condensation & precipitation.

Frontal precipitation is primarily restricted to middle latitudes. It is less significant in higher latitudes & rare in the Tropics because these regions contain air masses that tend to be like one another.

Characteristics of Frontal Precipitation:

It depends upon the type of front formed.

2 major types of fronts

⇒ Cold front → In which cold air mass is aggressive.

In this front, cold air cuts off the warm air from ground & forcibly lifts it up to great heights resulting in precipitation which is more or less similar to convectional type.

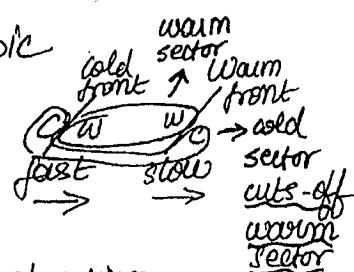
⇒ Warm front → In which warm air mass is aggressive. Warm air rises gradually & as it rises it also spreads horizontally resulting in precipitation which is more or less similar to orographic type.

An STATIONARY FRONT has no interaction b/w their air masses, hence no relevance in this topic

An OCCULDED FRONT →

Tropical — Thermal-ocean — destruction

Temperate — Frontal — frequent but no destruction
variability of weather conditions



FORMS OF PRECIPITATION

Factors:

→ Temperature of intermediate atmosphere

→ Degree of Turbulence in atmosphere

Several forms of Precipitation can result from collision-coalescence & ice

Cystal formation processes. The form that results depends largely on temperature of air & its degree of turbulence.

water droplets
and/or
ice crystals

- ✓ Rain / / / /
- ✓ Drizzle / /
- ✓ Snow $\delta \delta \delta$
- ✓ Hail O O O
- ✓ Sleet $\delta \delta \delta \delta$

- Fog
- Mist
- Haze

Not here as no air rise required here - but Radiational cooling.

RAIN

- Drops of water → 0.5mm - 6mm in dia.
- Most common & widespread form of precipitation.
- It forms when Dew point temperature is more than freezing & by the melting of ice crystals as they pass through the warmer air.

| $> 0.5\text{mm} - 6\text{mm}$

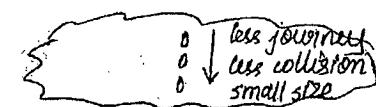
| $>$ Common-wide

| $> \text{D.P.} \geq 0^\circ\text{C}$

| $\text{D.P.} < 0^\circ\text{C} + \text{Meet.}$

DRIZZLE

- > The term drizzle refers to a spray like rainfall in water drops which are of extremely small size having a diameter $< 0.5\text{ mm}$ & fall at a very slow pace.
- > These drops have their origin in low, thin, stratus clouds (Drizzle is generally not associated with convection clouds)
- > Drizzle adversely affects visibility on ground.
(small size, not much gap in b/w)



✓ low thin stratus

↓
of high-might evaporate

✗ Generally ✗ convective clouds

SNOW

- Solid form of precipitation
- It is more a feature of middle & higher latitudes but it does occur at higher altitudes of lower latitudes.

Freshly fallen snow

• Powdery & Dry

For given volume,
the moisture content
is less. (cold+dry)

• It is too cold to snow

- But after falling,
becomes solid.

- Prism-white

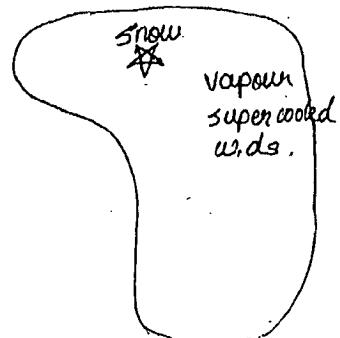
- albedo 20-10-90%

- It is usually dry & powdery.
- Snow flakes made of snow crystals act like prisms scattering light in all directions - (i.e) snow appears white
(Snow fl. have very high albedos: 70-90%. CC topic)

HAIL

It is the most complex form of precipitation in terms of origin.

It consists of rounded or irregular pellets of ice. Large hailstones are usually composed of concentric layers of clear & cloudy ice.



bubbles of air trapped
— opaque side of hail.

The opaque portion contains numerous small air bubbles among crystals of ice, whereas the clearer parts are made up of large ice crystals.

Hail is often produced in cumulonimbus clouds as a result of active turbulence & vertical air currents.

The hail stone normally continues to grow together it is rising or falling provided it passes through the portions of the cloud that contain super-cooled droplets.

SLEET

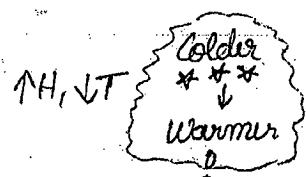
> In general, it refers to mixture of rain & snow/hail.

> In US, sleet refers to small rain drops that freeze as they come down.

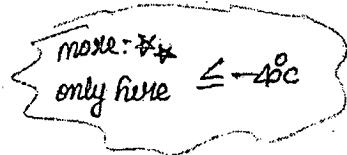
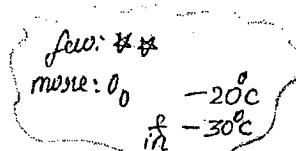
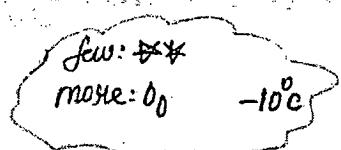
Amerithams

Special case
Temp. Inversion

Freeze of droplets



Complexities of Precipitation:



↓
Warmer
↓
* * *
colder
Low level Temp. Inversion

Up in the clouds, the ice crystals are seen in majority generally at very low temperatures \rightarrow around -40°C or beyond.

Why? ICs

- ↙ Cold conditions
- ↙ moisture in clouds
- ↙ particles for sublimation nuclei.

Earlier scientists thought, any particle is as good for sublimation as for condensation.

But now, they've found that only particles which are more similar in structure to that of ice crystals.

Hence, Silver iodide used in seeding of clouds.

Theoretical:

Clouds

Pre-requisites

Air Saturated: $RH \geq 100\%$.

Particles for C/S nuclei

What may happen actually?

In a city like Delhi, air may not be saturated but due to large no. of particles are in abundance — They are also HYDROSCOPIC (water loving) — Hence cloud may form even before air is fully saturated. — Urban climatology

($RH \approx 80\%$)

@upsc.risefinity

GEO MORPHOLOGY

(Study of Earth features configuration + lithosphere)

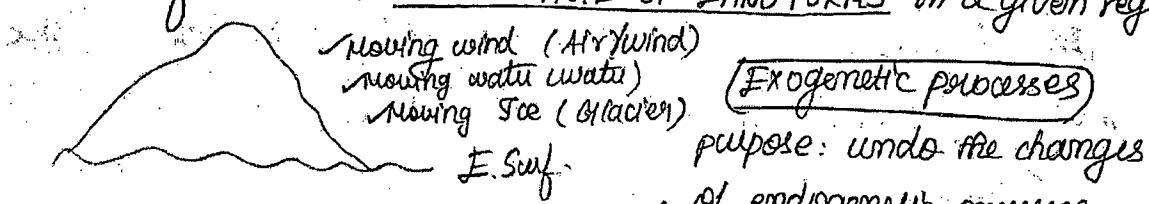
- iii) Plate tectonics
 - EQ
 - Volcanic activities
 - Him, Andes, Oceans, Trenches formation
- ii) Earth's internal structure
- i) Basic ideas

Land Form

The term refers to earth surface configuration ex: hill, valley, plateau, plain, etc. 

Land Scene

It refers to the ASSEMBLAGE OF LAND FORMS in a given region.



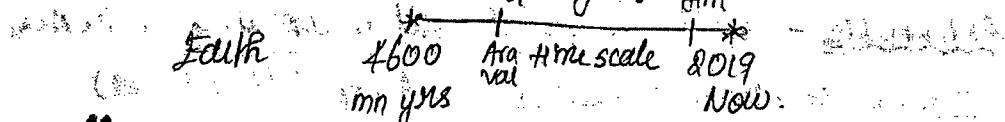
Pioneer Endogenous processes

purpose: change earth surface by giving new features

* Final fight

Dispose

Geological Hm



"Every landscape represents the stage of fight"

JUVILLE

Anavallis - one of oldest fold mts.

✓ Exogenetic - fight almost over

Himalayas - one of youngest fold mts

60 mn yrs back

✓ Endogenetic - fight beginning

now

↓ Altitude	↑ Altitude
Rounded peaks	Conical peaks
U shaped shallow valleys	Fresh rivers - immense energy
Rivers - old - ↓ energy → Senile	V good deep valleys Youthful.

→ The processes that operate from inside of Earth are called Endogenetic processes. Ex: Volcanoes.

→ The actions of external agents like WIND, RIVER, GLACIER, etc.. lead to Exogenetic processes.

* They both are collectively referred as Geomorphic Processes.

A given landscape on the nature represents the stage of ETERNAL FIGHT b/w Endo & Exo-genetic processes.

Ex: HIMALAYAS - all the youngest fold mountains & hence have a Youthful landscape characterised by :

- ✓ High elevation
- ✓ Conical peaks
- ✓ Deep, v shaped valleys
- ✓ Rivers with immense energy

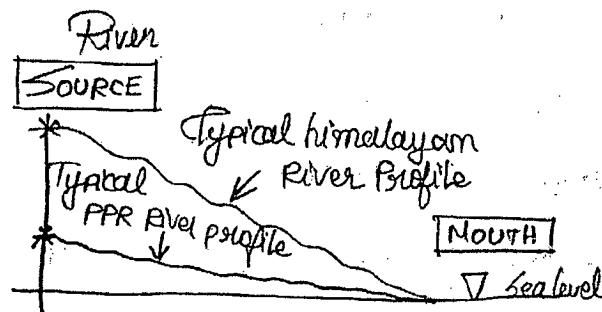
ARAVALLIS - one of the oldest fold mountains & hence have a Senile topography characterised by : (Relict mts)

- ✗ Lower elevation
- ✗ Rounded tops
- ✗ Broad U-shaped shallow valleys
- ✗ Rivers w/o much energy

Drainage - Surface flow of water. [Slope of shw]

Energy of Rivers:

Potential Energy \rightarrow ↑ on Himalayas
 \downarrow on Aravallis



Major areas

- ✓ Himalayas
- ✓ Great Northern Plains
- 3000 Bifurcs \rightarrow Peninsula Plateau Region
(4-6 Bifurcs earth)

Minor areas

- Coastal areas
- Islands

More vertical incisions due to ↑ PE.

Less load, so more energy on cutting rocks

Deep, V shaped valleys

More lateral incisions due to ↓ PE

More load, so energy mostly used to carry load

Broad, U shaped valleys

River Profile

It refers to cross-section of a river showing its heights at various points from the source to the mouth.

PENINSULAR PLATEAU REGION (PPR)

70% of India; One of oldest in world.

↓ PE; ↓ Elevation

> Exogenetic forces might

2 challenges of Geology:

① Not much tech to peer inside the depths of Earth.

\approx 400 km dia. \approx 13-14 km drilling
 \approx 4 km mining

— Even the present knowledge is only by indirect observation/sources (via seismic waves, etc)

? Energy source of endogenetic process?

Radioactive disintegration of elements of interior.
But not sure.

✓ Energy source of exogenic process? SUN.

→ At present we have very little knowledge about Earth's interior & most of this too is via indirect evidences like study of seismic waves

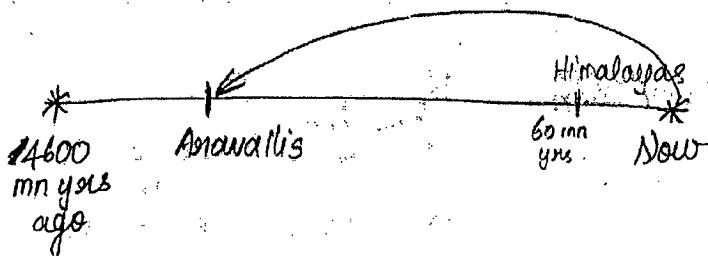
→ It is generally understood that RADIOACTIVE DISINTEGRATION OF ELEMENTS in earth's interior is major source of energy for endogenetic processes.

→ SUN is the major source of energy for Exogenetic processes.

Approach:

Look inside by inferring by study of outside manifestations on earth surface.

② Challenge of Time of mnyrs old.



Late 1960s
- Plate Tectonics

3 areas
- 99% EQS.
- But can't predict

Solution to this problem?

JAMES HUTTON (1795) → PRESENT IS THE KEY TO THE PAST?

* QUOTES TIME *

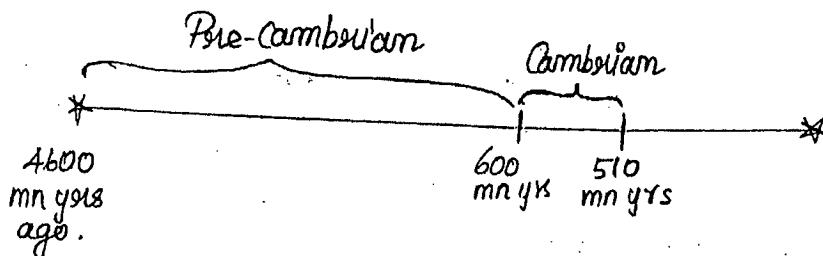
- * "Anger is short Madness"
- * "All sins are attempts to fill voids"

By 1820s, scientists understood his statement clearly & made it into a 'Principle of Uniformitarianism'. Till 1920s, this principle was the prime one for geologists. From 1920s, a revolutionary theory would begin - (Plate Tectonics)

In Hutton's statement, there is an implicit assumption that the Geomorphic processes which are taking place at present must have been happening in the geological past too. (i.e.) There has been a uniformity in nature's processes throughout the geological time scale.

The later day geologists (1820s) amplified his statement & referred to it as PRINCIPLE OF UNIFORMITARIANISM!

From 1820s - 1920s, this principle was the main guiding principle for all geological research worldwide.



Eon
Era
Period
Epochs

CAMBRIAN PERIOD

- Cambria (UK) - know better from this period.

PRE-CAMBRIAN PERIOD

- We don't know much

GEOLOGICAL TIME SCALE is the Relative Age Calendar of the Earth.

EXOGENETIC PROCESSES

There are 3 major Exogenetic processes ..

① Weathering:

It refers to disintegration & decomposition of a rock in-situ.

② Mass Movement or Mass Wasting:

It refers to movement of weathered material which is primarily because of gravity. In such movements WATER may act as lubricating agent (facilitator).

③ Erosion

It refers to movement of weathered material which is primarily because of an external agent like:
> Wind > River > Glacier, etc..

In such movements, gravity operates on the BG.

In practice, the term erosion is generally used more comprehensively & it includes:

- Transportation
- Reduction in size
- Deposition of sediments

ENDOGENETIC MOVEMENTS

(Based on Time of Manifestation & not preparation of movement)

A] Slow Movements

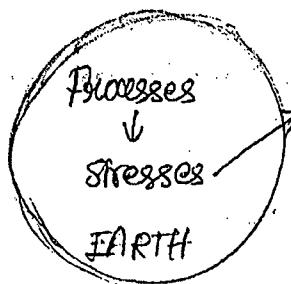
(Diastrophic movements)

- Orogenetic
 - Mountain building
 - FOLDING
 - FAULTING

◦ Epiautogenic

B] Sudden Movements

- Earthquakes
- Volcanic Eruptions



Manifestations - sustaining mechanisms of earth to continue living & not disintegrate.

Orogenetic Movements:

→ They are caused by TANGENTIAL STRESSES - Compression & Tension.

→ Orogenetic movements are of 2 Types:

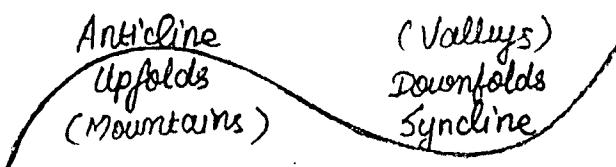
① FOLDING ② FAULTING

Folding → Refers to BUCKLING of earth's crust.

> It is because of COMPRESSION.

> It produces FOLD MOUNTAINS (Ex): Himalayas.

> Since fold mts. attain great elevation, therefore these are also called 'Mountains of Elevation'.



Note:
Can bend anything if & things are present

* FORCE

* TIME for force to act.

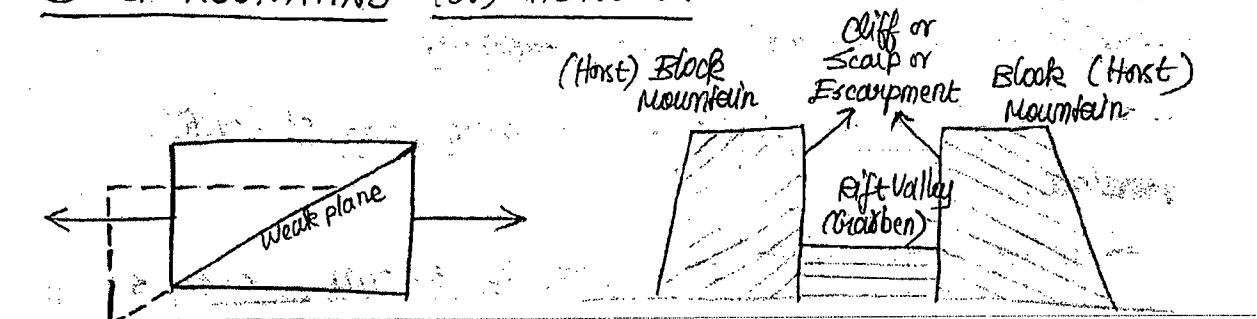
Note: folding & faulting concepts are applicable to all 3 - Igneous, Sedimentary, Metamorphic.

Faulting → It is said to take place when there is a MOVEMENT of a rock along the weak zone.

> The plane along which the movement takes place is 'FAULT'.

> It is primarily because of TENSION.

Faulting also produces mountains which are called
BLOCK MOUNTAINS (or) HORSTS.



① Normal Faulting

Genuinely rift valley rivers will have relatively less catchment area than others via plains.

Though faulting is primarily because of tension, it does also takes place because of EXTREME COMPRESSION.

Note: The word 'extreme' differs relatively from one block to another.



② Reverse Faulting

Epeirogenetic Movements

Note
None of causalational
nature

- The word 'Epeiro' means 'continent'.
- These movements affect a very large area of earth's surface.
- These movements are because of RADIAL STRESSES UP OR DOWN.
- They are of 2 TYPES:

① EMERGENCE

② SUBSIDENCE

(WARPING)

Note

None of referring to effect of that causation.

It is a slow deformation of a very large area of earth surface bcs of radial stresses - up or down.

2 types of warping

Upwarping
(EMERGENCE)

Down-warping
(SUBSIDENCE)

Note:

► Epeirogenetic movements can be best analysed through the evidences available in coastal locations.

► Two major types of coasts:

→ COASTS OF EMERGENCE
or Emergent Coasts

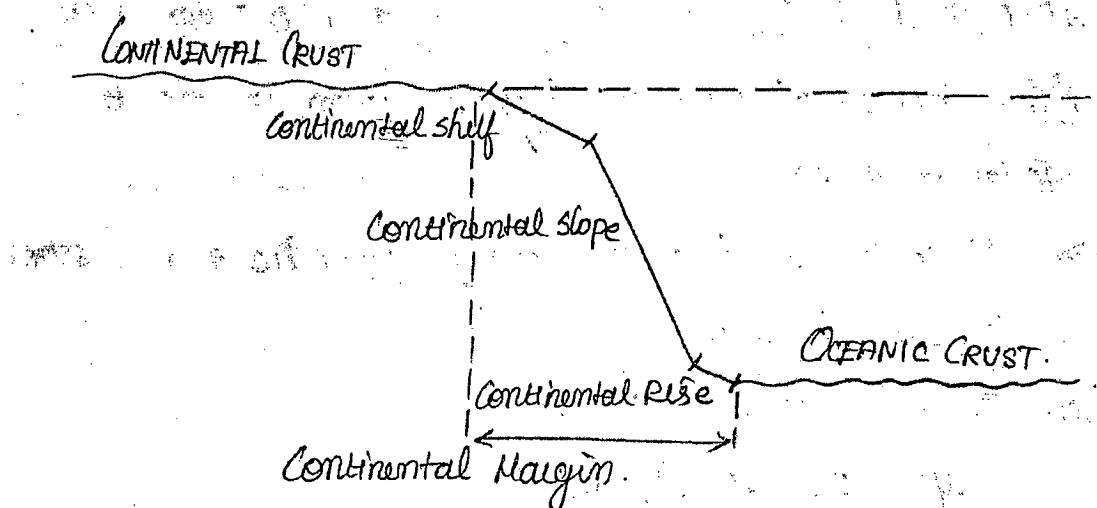
→ COASTS OF SUBMERGENCE
or Submergent Coasts.

(
✓ sea goes down (or)
✓ Land goes up.)

(
✓ sea level rises (or)
✓ Land goes down.)

EARTH'S INTERNAL STRUCTURE

I. CRUST



* Deep rivers run quiet

* Strike is to humanity what sunshine is to flowers

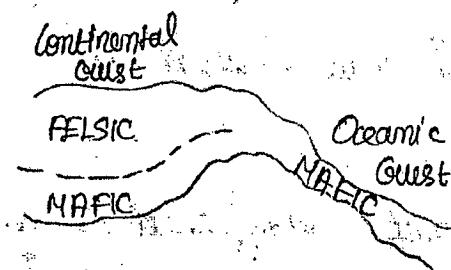
Avg. tk

Cont. Crust - 40 km ; Granitic \rightarrow SIAL (or) FELSIC

Silica+Alum. Feldspar (Silicates of Al)
+Silica

Crust

\rightarrow Oceanic Crust - 5 km ; Basaltic \rightarrow SIMA (or) MAFIC - [Relatively
Silica+Mag. Mg + Fe Dense]



SIAL \rightarrow Si + Al

SIMA \rightarrow Si + Mg

FELSIC \rightarrow Feldspar + Si

Mineral with silicates of Al

MAFIC \rightarrow Mg + Fe

- ⇒ Gneust accounts for only - 1.14% of Earth's Volume
- 0.53% of Earth's Mass.
- ⇒ Gneust beneath the continental interior averages about 40 km in tk & Oceanic Gneust average is only 5 km in tk.
Note: Continental crust in Tibetan region is about 70 km in thickness.
- ⇒ The continental Gneust is mainly Granitic in composition.
(i.e) SIAL / FELSIC
- ⇒ The C.C. has 2 layers:
 - Upper layer is FELSIC
 - Lower layer is MAFIC
- ⇒ Oceanic Gneust is mainly Basaltic - SIMA / MAFIC
- ⇒ Continental Gneust is much thicker but less denser than Oceanic Gneust.

ISOSTASY

According to geologists, Earth as a body is always in an attempt for some Equilibrium through its Endogenetic processes.

Following are some important manifestations of this attempt:

i) There appears to be an inverse relationship between HEIGHT & DENSITY of physical features.

Ex: Continental Gneiss - lighter in Density - stands Higher
Oceanic Gneiss - Denser - stands lower.

(Equal Areas must have equal Mass \leftarrow Basis.)

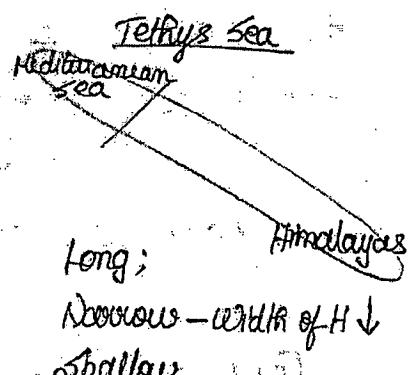
ii) SCANDINAVIAN ISOSTATIC REBOUND

The Scandinavian gneiss is showing evidence of isostatic rebound since the end of Pleistocene ice age ($\approx 10,000$ yrs ago - 1.8 mn yrs ago).

With load \rightarrow sag
w/o load \rightarrow rebound in process

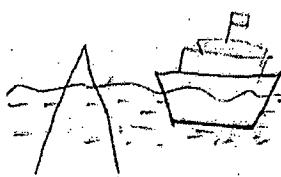
iii). According to some scientists, the presence of very old physical features like Aravallis on Earth surface is the manifestation of the attempt for equilibrium - Isostacy.

iv) The formation of himalayan mountains out of the deposits of a shallow sea (Tethys sea) can only be explained by assuming Earth's attempt for equilibrium - what is called Isostacy.

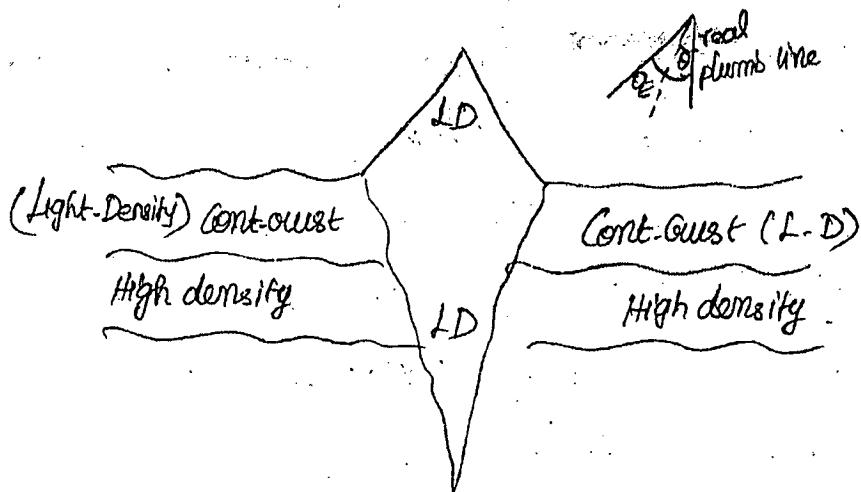


Floatation principle can be a good ex. of Isostacy.

So outer earth might well be floating on something in inner earth.



Ex: Municipal landfill sites - sag



J. Evidences suggest that beneath the high mountains of Himalayas we have 'Deep Roots' of lighter density materials. It appears that there is PRINCIPLE OF FLOATATION applicable in nature for physical features.

I. MANTLE

Upper mantle - a part of it on top is plastic
Equal Temp & pressure

- The mantle extends from the base of the crust to the core & is \approx 2900 km thick.
- It occupies \circ 82.54% of Earth's volume
 \circ 66% of its mass.

→ Mantle is rich in Oxides of ^{IRON (Fe)}
Silicate & ^{MAGNESIUM (Mg)}

[OLIVINE & PYROXENE are the representative minerals]

- It is more dense & highly packed at depth.
- The entire mantle experiences a gradual temperature increase with depth.

III. CORE

→ Radius: ~3500 km

→ It is subdivided into 2 parts:

> INNER Core

> OUTER Core

~1255 km

→ Composition

Fe - 89%; Ni - 6%; Rest 5% is traditionally

believed to be comprising

light elements - Sulphur & O₂

The latest results suggest that this might be Silica.

→ Core accounts for ~ 16.32% of Earth's volume.

~ 33.4% of Earth's Mass.

→ Core's temperature: 3000°C - 6650°C

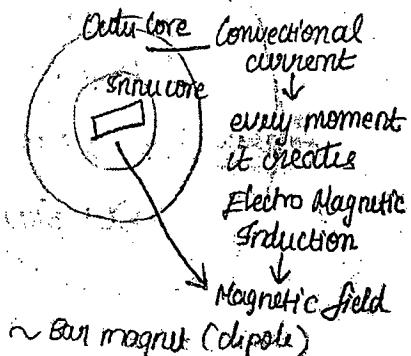
→ Core's Pressure: Scientists estimate that it may be 3 to 4 mn times the pressure of atmosphere @ Sea level.

→ The Inner core — Remains SOLID despite high temp because of immense PRESSURE

The Outer core — Is in MOLTEN (Liquid) state suggesting the dominance of TEMPERATURE over pressure.

Earth's Magnetism

It is traced to the convectional currents of hot materials in its outer core. (Electro Magnetic Induction principle) *SET - 10th NCERT*



Discontinuity

→ A SHARP BOUNDARY between the layers in earth's internal structure is called a discontinuity.

→ Here, seismic waves undergo abrupt changes in terms of their speed & direction.

The 2. Major ones are as follows:

1 Mohorovičić Discontinuity

Between CRUST & U. MANTLE

} Named after their discoverers.

2 Gutenberg Discontinuity

Between L. MANTLE & Outer CORE

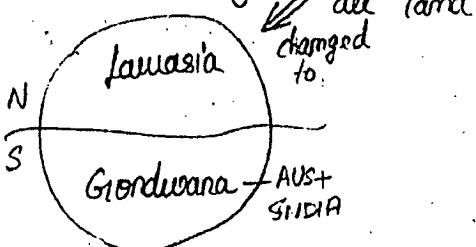
Factors leading to PLATE TECTONIC THEORY

I. 1915-16 - ALFRED WEGENER

✓ German Scholar.

✓ Continents are not static as it may appear but dynamic.

✓ 250 mn yrs ago - PANGAEA - whole world together.



Continental Drift

Hypothesis

Came to English in 1920s.

✓ Evidence: Edges of continents correlated, even Mountains

Analogy: Tom pieces of Newspaper ≈ Now Continents appear so.

(i.e.) Similarities at their margin.

But, actually it was known even 200 yrs bfr Wegener.

But, they thought it to be coincidence / God & lacked vision.

- 1) Findings of fossil remains of plants & animals.
- 2) Lot of coal in Europe, which would've not formed under today's cold location but of earlier location near equator.

But in 1920s, most geologists rejected this idea due to Hutton's philosophy.

2] ~1908 - F.B.TAYLOR (USA)

He wrote only a paper on CD.

Great mind - But just gave ideas but didn't try to get practical evidence which WEGENER did.

3] ARTHUR HOLMES (UK)

Wegener & Taylor's hypothesis makes sense but what they lack is the mechanism which could've made it possible.

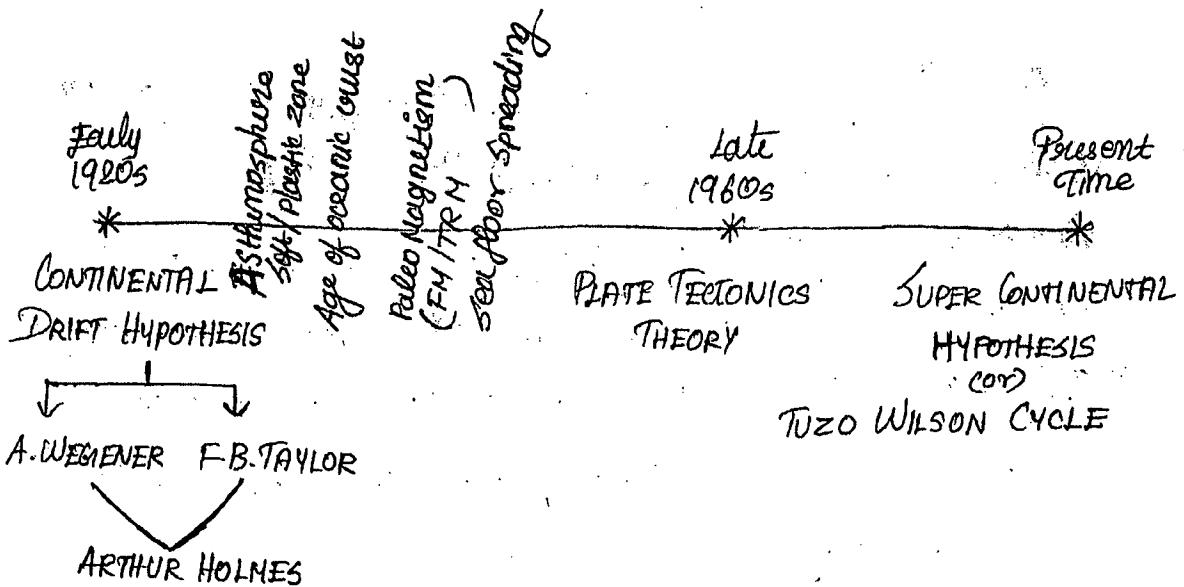
Wegener - He told his thesis was based on circumstantial evidence & no clear idea of earth's interior.

Taylor - told moon was near & it exerted the force to break.

Holmes - rejected moon idea telling if so earth would not be able to spin. He searched for other explanations.

& in late 60s, plate Tectonic theory got shape.

WW-II \Rightarrow war + science went hand in hand

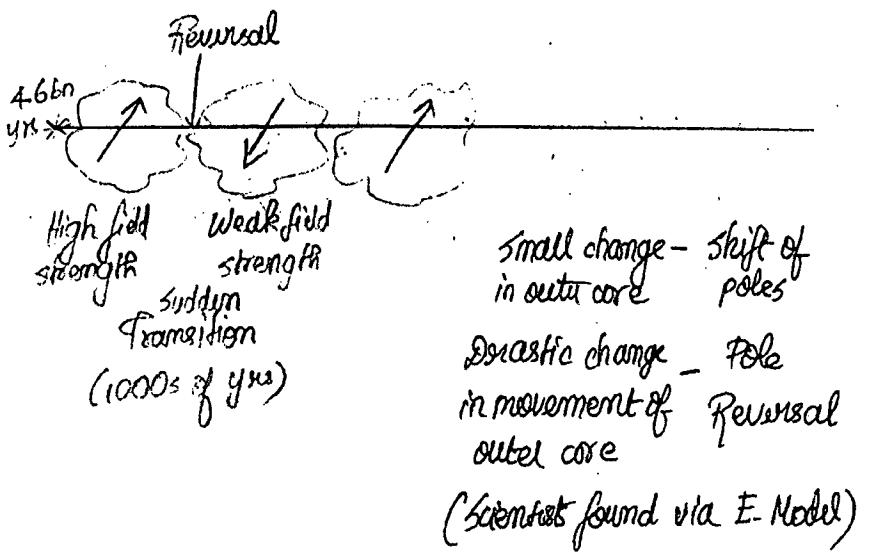


* QUOTES TIME *

* The only thing we have to fear is fear itself'

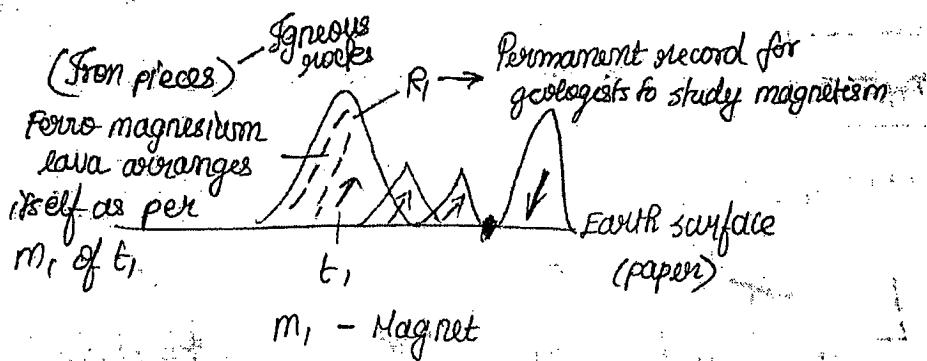
* 'the power of imagination makes us infinite'

In the 20th century, geologists came to discover that oceanic crust is much younger in age than continental crust. In general, oceanic crust is nowhere older than 200 mn years.



	<u>Age</u>
Earth -	4.6 bn yrs
C.C :	3.8-4 bn yrs
O.C :	> 200 mn yrs
	West. Australia Parts of Canada.

Geo Magnetism
Permanent in terms of magnetism.
But changes from time to time in terms of:
1) STRENGTH
2) POSITION SHIFT
Now: NP - Canada - shifting towards Russia due to changes in outer core material.
3) POLE REVERSAL



This past magnetism stored in rocks is called Paleomagnetism.

Only those sedimentary rocks with magnetic material would exhibit ^{paleo}magnetism. Also it takes very long time than igneous rocks to form, so it might have 1 or more magnetic time periods mixed hence difficult to assess.

- Metamorphic rock is mixture of Ig. & sed, hence losses its identity of mag. materials & is all mixed up & impossible to assess.
- Igneous rocks - instantaneous capture of magnetism of $m,$ & best quality of magnetism of that time period.

* **Paleomagnetism** is earth's past magnetism preserved in the rocks. Paleomagnetic studies have revealed that our Earth has experienced a no. of. reversals of its magnetic polarity over its geological timescale.

It can also be called > Fossil Magnetism

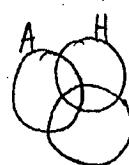
> Thermo-remanent Magnetism

ASTHENOSPHERE

EGG

ORANGE

In Geography

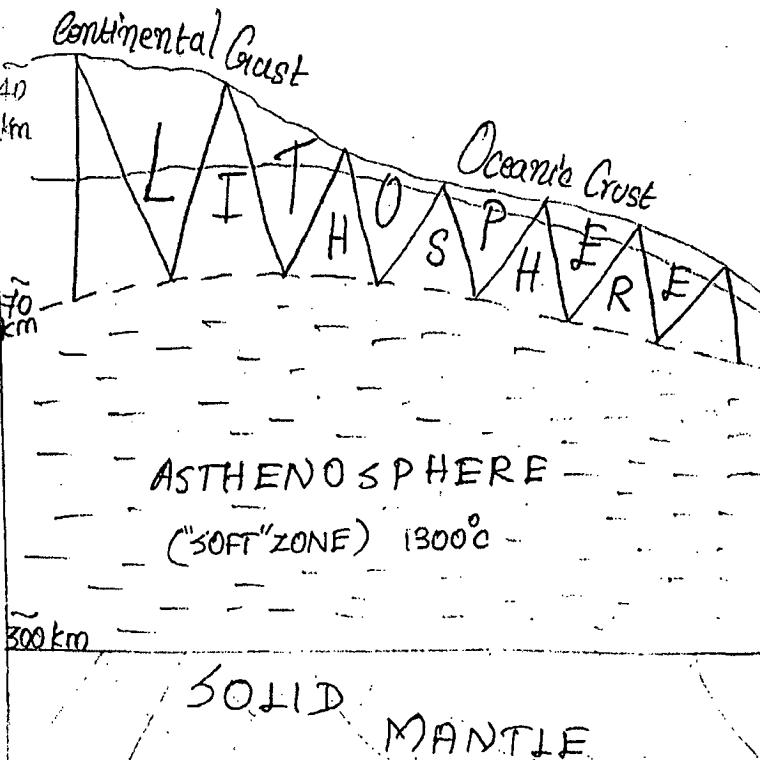


LITHOSPHERE
(L)

$$L = E - (A + H)$$

All that is
solid

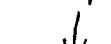
Surface-Crust
only



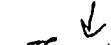
In Modern
Geology



Lithosphere



Not all solid but
only a restricted
portion of solid.



From 1920s,
for endogenic
processes:

Surface = Crust
+ solid portion
of mantle above
asthenosphere

LITHOSPHERE

@upsc.risefinity

* Below the earth surface, from about 70 km down to about 300 km, is the asthenosphere - PLASTIC / SOFT ZONE in the Upper Mantle.

This zone contains packets of increased heat from radioactive decay.

The avg. temp is 1300°C.

It is susceptible to slow convection currents in its hot materials.

In modern geological language, the rigid layer above the asthenosphere is called Lithosphere.

('Lithos' - 'solid')

* Lithosphere is sub-divided into many parts - major & minor - each referred to as Lithosphere's Plate / Plate.

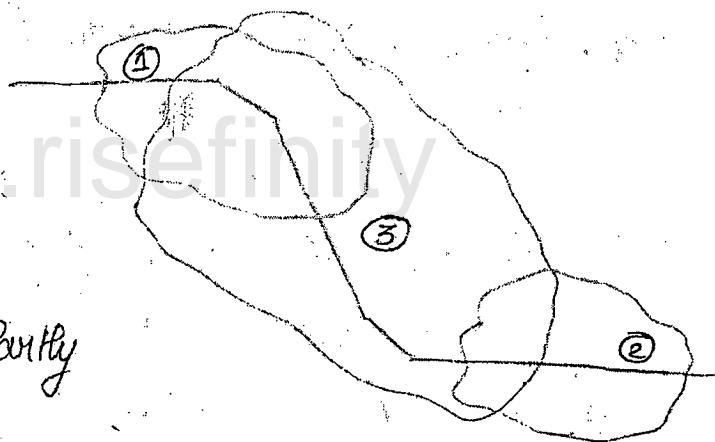
Asthenosphere has the characteristics of a plastic solid, meaning that it can easily deform & "flow" a few centimetres per year.

The material in asthenosphere flows both vertically & horizontally dragging the overlying lithospheric plates along with it.

* The term 'Tectonics' comes from Latin word 'Tecton' meaning 'builder' & by that we mean building activities on parts of earth.

3 TYPES OF PLATES:

- ① Continental Plate
- ② Oceanic Plate
- ③ Partly Continental & Partly Oceanic Plate



3 Types of Plate-Boundary Interactions:

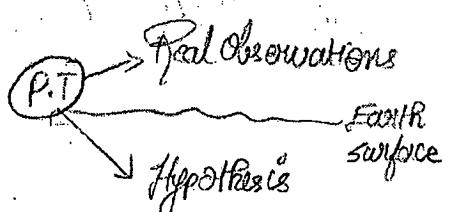
- ① Divergent Boundary Interactions
- ② Convergent Boundary Interactions

i) C-C Convergence : COLLISION TYPE

ii) C-O Convergence : SUBDUCTION TYPE

iii) O-O Convergence : SUBDUCTION TYPE

- ③ Transform Boundary Interactions - One plate glides past the other



The result which is common to all these boundary interactions is the occurrence of Earthquakes.

2. Types of Continental Margins

I. ACTIVE C.M) → PACIFIC TYPE

Those margins which in the present geological time period exhibit plate boundary interactions.

At present Pacific margins are very active, hence the alternate name.

Pacific C.Ms are ~~fire~~

II. PASSIVE C.M) → ATLANTIC TYPE

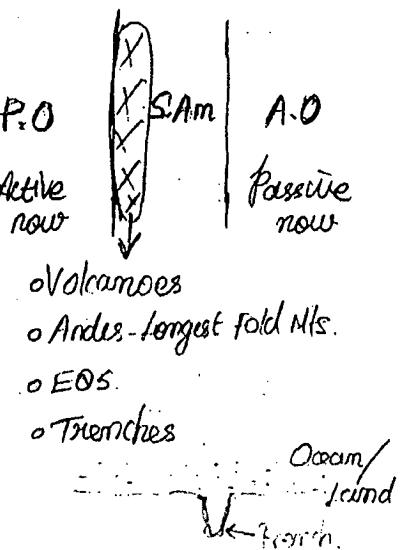
Those in present geo. time period do not exhibit plate boundary interactions.

At present the Atlantic margins are very passive, hence the alternate name.

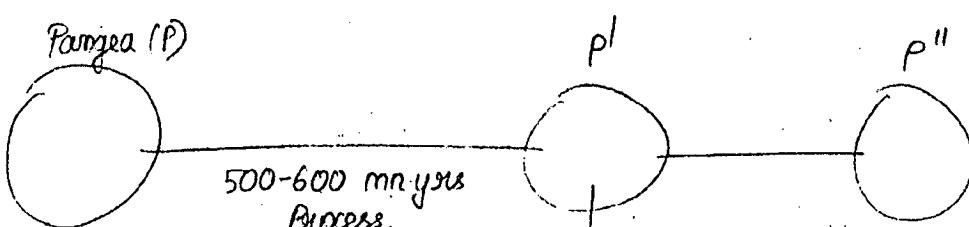
Note: GROWING PACIFIC BELT or "RING OF FIRE" - 80% of EQs:

(W. of NA & SA, Tap, Ind., Phill.)

See: ATLAS Plate Map.



Ex: Mariana Trench 11 km.
Chile-Andes Trench



While these small pieces come together, the main piece might start breaking away.

May not be complete but big pieces together.

* QUOTES TIME *

- * Love the life you live; Live the life you love
- * There are no great things, there are only small things with great love.
- * Words become Action; Actions become habits;
Habits become character; And character becomes your destiny.

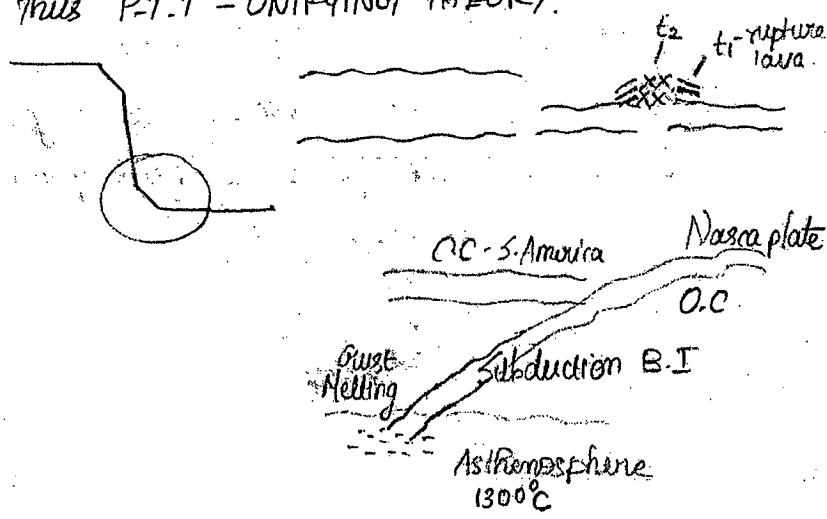
Example of Sea floor spreading

SCH
TUCO WILSON

RIFT VALLEY in E-Africa
 ↓
 All Lakes except L-Victoria are result of C.C breaking & dense lava subsiding & becoming sea.

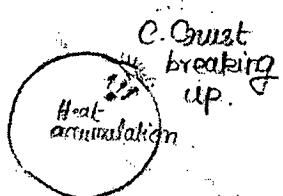
- [1] M.O.Rs [2] O.C [3] S.F.S
- [4] TRENCH [5] EQ [6] VOLCANOES
- [7] FOLD MOUNTAINS

A single theory explains almost all major endogenetic operations leading to formation of most physical features of earth.
 thus P.T.T - UNIFYING THEORY.



Endogenous actions cause heat generation at some places inside earth

Crust is bad conductor of heat & as heat accumulates, that area above heat-spot gets domed up - tensile stress - & finally will crack open



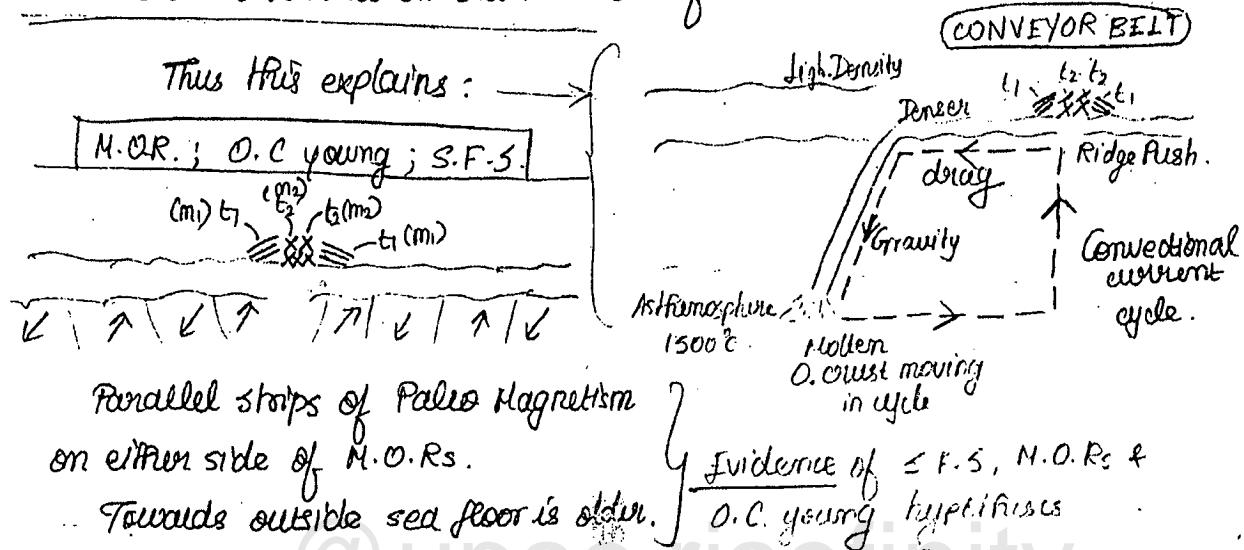
five ex: ETHIOPIA
(in last 10 yrs)

sialic/felsic (light density)
lava form asthenosphere - denser (NaFic)

so it subsides & forms a depression - which would later become sea - SEA FLOOR SPREADING

Geologically speaking, DIVERGENT BOUNDARY INTERACTION is CONSTRUCTIVE in nature as it leads to the formation of new crust.

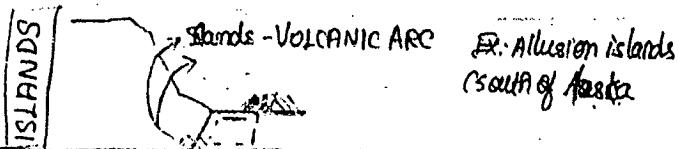
Geologically speaking, SUBDUCTION B.I. is DESTRUCTIVE in nature as it results in destruction of earth's crust.



Chile-Peru Trench → Result of C-O Subduction:
Nazca plate subduction under S. America.

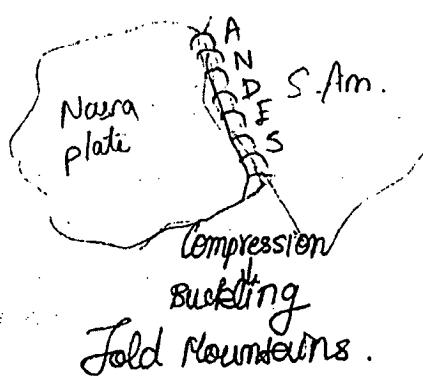
Mid Atlantic French → Result of O-O subduction.

Each Tensile of subduction can cause EQ.



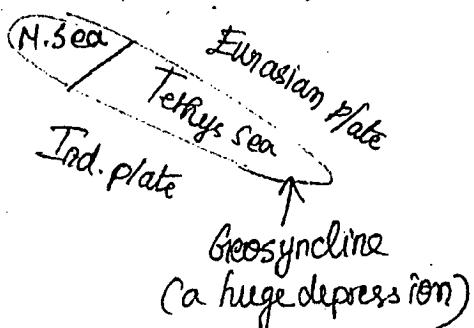
FOLD MOUNTAINS

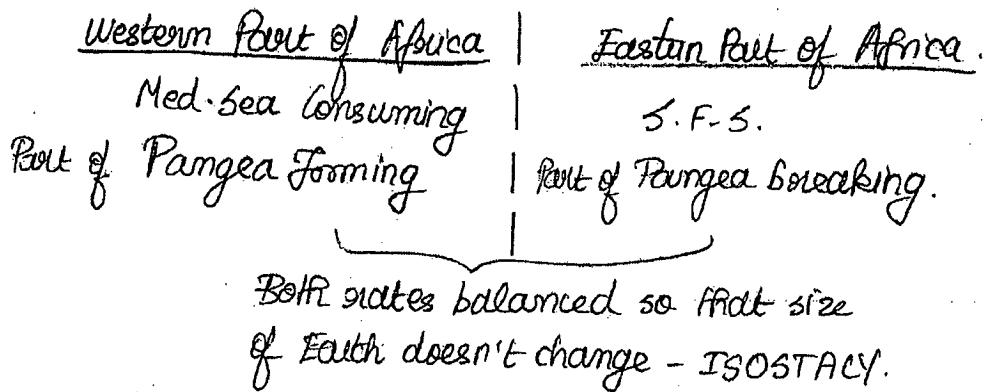
Andes - S. America



Marine deposits on Himalaya & Andes.

Bulldozer effect - the con. C. compressing the O.C. the marine deposits are lifted upon it.



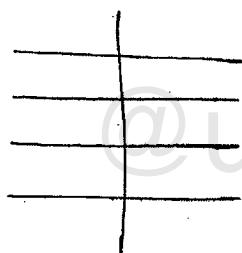


EARTHQUAKES

H.F. REID - 1906 - ELASTIC REBOUND HYPOTHESIS (Stick-Slip Phenomenon)

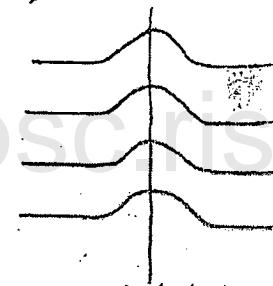
Turning point - Beginning of EQ studies - After 1906 California EQ.

a) Unstrained



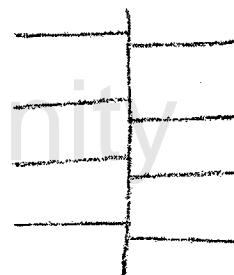
less/zero stress

b) Strained



Accumulated stress deforms rock

c) Unstrained



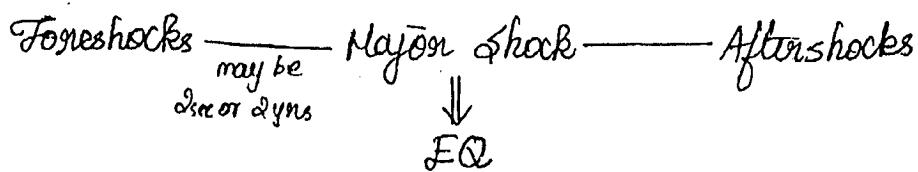
stress beyond Rupture limit
All stress released by EQ

Longer the time elapsed since the last major EQ - higher the chance for next EQ any time now.

All rocks have a certain rupture strength, which means that they will continue to bend rather than break, so long as the stress imposed on them does not exceed this rupture strength. When the stress becomes too great, the rocks suddenly move along a plane (the fault). That sudden movement snaps the rock on each side of fault back into original shape & produces EQ.

An EQ is a release of energy that has been built up during stress of increasing deformation of rocks. This energy release takes the form of seismic waves that radiate in all direction from place of movement.

H-F REID - PATTERN OF ENERGY RELEASE

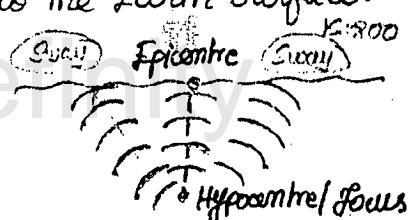


BASIC TERMS

Focus / Hypocentre: The point of origin / the pt where motion initiated.

Epicentre: The vertical trace of focus on to the Earth surface.

In general, the maximum damage because of EQ is not AT the epicentre but it is AROUND the epicentre.



On the basis of FOCAL DEPTH, the EQs are categorised into 3 types:

- ① Shallow EQ: F-D < 70 km → More destructive
- ② Intermediate EQ: F-D: 70-300 km
- ③ Deep EQ: F-D: 300-700 km

About 90% of EQs are with F.D < 100 km.

About 3% of EQs are Deep.

MEASUREMENT OF EQ

See reactions & learnings

Katrina Hurricane - US

Tragedy of Japan

Sandy Hurricane - US

I. MERCALI SCALE:

The 1st ever scale for EQ measurement was developed by an Italian geologist Giuseppe Mercalli in 1903. He measured in terms of Intensity, which reflects the impact of an EQ on cultural landscape.

This scale was modernized in 1951. Since then it has been called as MODIFIED MERCALI SCALE. It is close ended & uses Roman I-XII.

This scale is not useful for comparisons as besides intensity, damage during an EQ also depends upon many other factors like \Rightarrow Pop. density; Property distribution; Building designs & materials, etc.

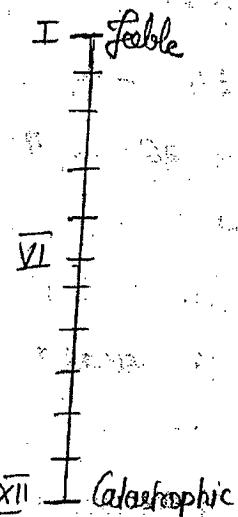
II. RICHTER SCALE:

The 2nd scale of EQ measurement was developed by C.F. Richter, a geologist from California in 1935. Magnitude is assessed on Richter scale, which reflects the amount of shaking of ground as measured by seismograph. It is an open ended scale. It is logarithmic with following 2 interpolations:

- A given value EQ is 10 times severe than previous lower value EQ & 100 times severe than ^{next} previous lower value EQ.
- In terms of Energy release, 31.5 is the factor:

$$\text{EQ}(7) \approx 31.5 \text{ E-EQ}(6)$$

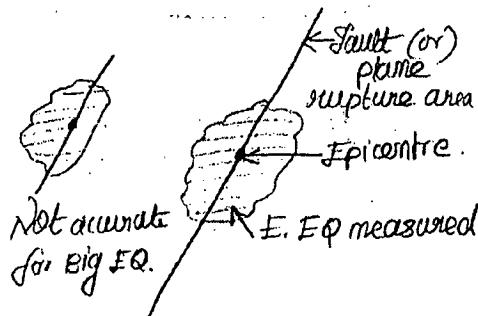
$$\approx 31.5 \times 31.5 \times \text{E-EQ}(5)$$



III. MOMENT MAGNITUDE SCALE

Limitation of Richter Scale

Seismologists at present prefer moment magnitudes for describing EQs - especially large ones. The reason is that Richter magnitudes don't accurately represent the energy released by large EQs on faults with great RUPTURE LENGTHS. The seismic waves used to estimate the Richter magnitude come from only a small part of fault rupture & hence can't provide an accurate measure on total seismic E-EQ of very large scale.



For moment Magnitude, we incorporate the following in calc:

> RUPTURE AREA > DISPLACEMENT OF ROCKS > GEOLOGICAL PROPERTIES OF ROCKS OF THE AREA

SEISMIC WAVES

An EQ releases pulses of energy called seismic waves.

A] Body Waves

- Travel primarily into the body of earth. Hence useful for making inference of e's interior.
- somewhat like SOUND WAVES (compressional waves)
- Move faster than surface waves.

B] SURFACE Waves

- Travel along ground surface or just below it. Primarily responsible for the destruction of earth surface
- Somewhat like waves on WATER surface

Rayleigh Waves Love Waves
little faster than R-waves

Primary (P-waves)	S-wave
1st to be recorded	2nd to be recorded
Fastest	

Sequence of arrival of seismic waves on Seismograph:

$$P \rightarrow S \rightarrow L \rightarrow R$$

Primary Waves / P-Waves (Longitudinal)

P-waves can travel through solid, liquid & gas. These are compressional or Push-Pull waves & move material forward & backward in the same direction ~~in~~ that waves are moving.

Infact, some p-waves emerging from earth are transmitted into atmosphere as sound waves that at certain frequencies can be heard by humans & animals.

Secondary / S-Waves

S-waves can travel only through solid. These are shear waves bcos they move the material ^{vertical frame} PERPENDICULAR to the direction of travel thereby producing shear stress in material. Since liquid & gas are not rigid, S-waves can't be transmitted through them.

Love / L-Waves \approx SNAKE's Movement.

The motion of L-wave is similar to S-wave but individual particles in the material only move back & forth on a horizontal plane perpendicular to the direction of wave travel.

(Most DAMAGING) to building foundations \Rightarrow L-WAY.

Rayleigh / R-Waves

They behave like water waves in that they move forward while the individual particles of material move in elliptical path within a vertical plane oriented in direction of wave movement.

Waves on WATER SURFACE

Surface waves are also called Orbital waves as these waves make the particles of the medium travel in orbital paths.

SINKING

-Glacial collapse

-Limestone landscape
(Chloro below)

-Soil layer change.

-Faults.



In a wave motion on water surface in the open ocean, it is the ENERGY which travels & not the water. The given particle of water moves in elliptical orbit.

Most waves on water surface are generated by wind's interaction with water.

Water surface in the ocean is such a medium that waves can travel on it for long distances w/o getting wasted much.

"Sea" → The surface of the ocean where WAVES ORIGINATE as a result of wind's interaction with water.

$$\text{Wave steepness} = \frac{H}{L}$$

← wave height
← wave length

As a wave enters the shallower waters of the shelf, it tends to sustain itself by steepening & moves forward but finally there comes a depth where the wave breaks & it is the 1st moment of time when the water actually moves during the wave motion on water surface.

Out of the three motions (Currents, Tides, Waves) in world ocean, the WAVES play the most dominant role in shaping the coastal landscapes.

Tsunamis

* "You were always a better person inside. All you had to do was to peel away the layers."

* "Giving birth to a baby is easier than worrying about it"

Tsunami > Wave transfers energy only in coastal region.
Harbour waves > Wave can travel long w/o losing much energy.
(Japanese)

→ No connection with Tides whatsoever - Tsunamis are NOT TIDAL WAVES.

→ Most of the Tsunamis are caused by major EQs.

↳ So, EQ is not the only reason

↳ Also, not all EQs cause tsunami

→ Wave is a transformation of the surface of ocean.

Tsunami is a DRAMATIC change of the surface of ocean

CAUSATION

> So, Only those Major ^{big} EQs which can cause change of surface can only cause tsunami. Generally these EQs involve vertical disp^t of ocean floor.

> A major volcano on floor of ocean can also be a reason.

> A major landslide of coastal mountains or of mid oceanic ridges

> A mass of Ice sheet breaking into ocean surface - splash

On an alarm of tsunami, a ship in harbour must venture into ocean to reach open ocean to be safe.

⇒ Japanese call unusual & destructive waves in world ocean as Tsunami.

Tsu-'Harbour'; Naumi-'waves'. The reason for nomenclature is these waves cause destruction at coast in general & harbour in particular.

⇒ In past, tsunamis were misunderstood to be TIDAL WAVES - they have No connection with Tides.

⇒ Tsunamis are primarily seismic waves. Most Tsunamis are caused by major EQs in world ocean. Every major EQ may not cause Tsunami; those EQs which cause drastic change in surface of ocean can cause Tsunami. General such EQs involve vertical displacement on floor of ocean.

⇒ Besides EQs, other upheavals: Landslide, Volcanoes, etc - in world ocean can also cause tsunami.

* CHARACTERISTICS OF A TYPICAL TSUNAMI IN OPEN OCEAN

① Wavelength $\rightarrow \geq 200$ km

② Speed $\rightarrow \geq 800$ km/hr

③ Immense Energy.

④ Great Distances ~~to~~ getting wasted

⑤ wave height \rightarrow usually ≈ 0.6 m (In general < 1 m)

Therefore, generally remain unnoticed in open ocean.

⇒ In shallow waters, they slow down & water begins to pile up.

Tsunami may form Crests > 30 m ht rushing into unsuspecting harbours with destructive effects.

⇒ A tsunami may consist of a single wave but Multiple Waves are much likely depending on how EQ releases energy.

For S & T

E.W.S for Indian Ocean
for Tsunami in
INDIA YEAR Book.

M-E-B

T-P-Gi

W-I-SS

T-H-P

F-H-F

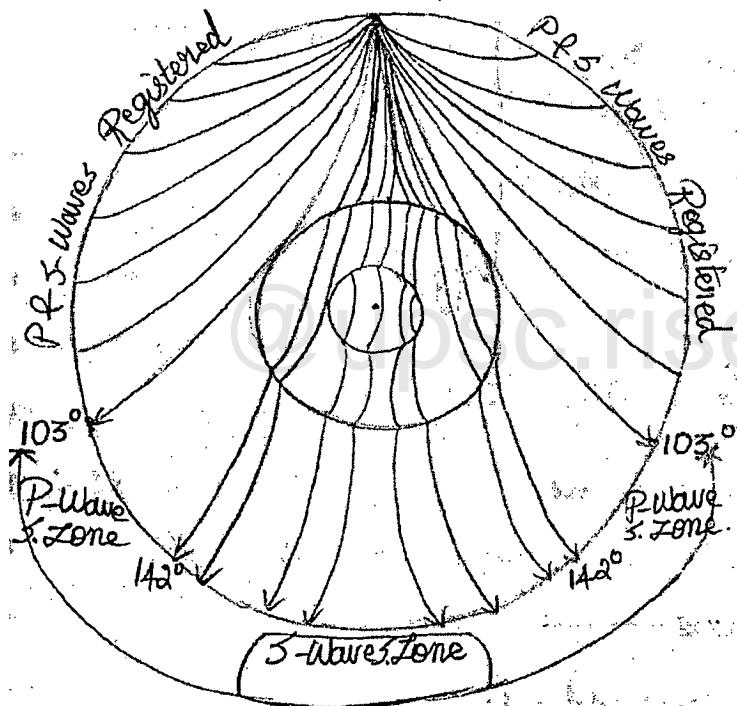
S-P-Gi

AT-2

⇒ The Pacific Ocean is the most affected one as it has more no. of SUBDUCTION ZONES along which large magnitude EQs occur.

⇒ Before Tsunami warning signals existed, the 1st notice of a tsunami to most observers would be the most rapid recession of shore line - this is bcs of the 1st arrival of the trough of a tsunami to the coast. The recession would be followed in minutes by one or more destructive waves.

SHADOW-ZONES



ANTIPODE $\leftarrow P^1 \rightarrow P\right)$

Antipode refers to the point which is diametrically opposite to the given point on E-surface.

ANTICENTRE

It refers to the antipode of the epicentre of the EQ.

P - $35^{\circ}N, 89^{\circ}45'15''E$

P¹ - $35^{\circ}S, 90^{\circ}14'45''W$

Aesthenosphere is solid enough to allow the passage of S-waves.

DISTRIBUTION OF EQS

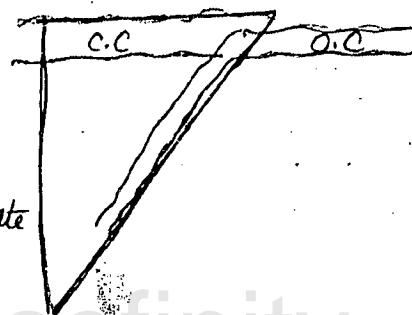
I. CIRCU- PACIFIC BELT:

- Indonesia ; Philippines ; Japan ; W. sides of N.E.S. America.
 - 80% of all EQs occur here.
 - This belt registers all the 3 - shallow, Intermediate, Deep-EQs.
- DEEP EQs are restricted to this belt alone.

Reason → The region is full of Subduction Zones (C-O + O-O)

Benioff-Zones:

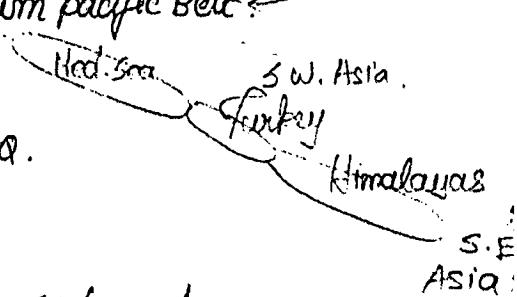
Inclined EQ zones which exists along pacific coast where foci of EQs deepen from shallow through intermediate to deep in landward direction from the Trenches.



II. TRANS- EURASIAN MOUNTAIN BELT:

- It extends from Mediterranean Sea through S.W. Asia into S.E. Asia and Himalayas where it meets Circum pacific Belt.
- 15% of all EQs occur here
- This registers shallow & Intermediate EQ.

Reason → Convergent B.I.



III. 3rd zone is associated with Global system of MID- OCEANIC RIDGES with extension to EAST- AFRICAN RIFT VALLEY SYSTEM

- 3-4% of all EQs occur here
- Shallow EQs only occur generally

Reason → N.O.R - bcos of Transform B.I along the sections where the subiges have got sliced off.

IV. INTRA PLATE EQs

Those EQs that occur away from plate margins, in the interiors of plate - Ex: EQ in GUJARAT in India

Reason → They are believed to be bcos of reactivation of ancient faults in the body of the plate. This reactivation is because of stresses induced in plate due to plate B.I.

The known contact zones b/w tectonic plates form the Earth's most active EQ belts. But EQs, some of them severe, can & do occur in other areas of the world. Even apparently stable shields such as PPR can experience severe EQ.

- * What if you failed yesterday? Today is not yesterday.
- * Believe you can & you are half way there
- * Nothing comes from Nothing

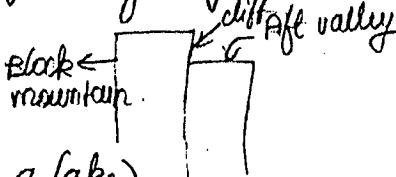
SHIELDS : The term 'shield' refers to an ancient land mass. The continental shields are very large, relatively stable & relatively flat expanses of very old rocks. The shields perhaps constitute the earliest "slabs" of solidification of molten crust. These shields form the nuclei/interior of the land masses.

Ex: The Indian shield - PPR

The Australian shield (western half)

The African shield - the largest in present world map.

EFFECTS OF EQs

- i) Land slides; Mud-slides & other forms of Mass Movements often result from a combination of circumstances among which an EQ can be crucial.
- ii) When movement along a fault generates an EQ, the scarp may be visible at the surface in the form of a fault scarp (cliff). 
- iii) Sometimes, EQs may lead to appearance or disappearance of surface features (like a lake)
- iv) Tsunami - (already covered before)

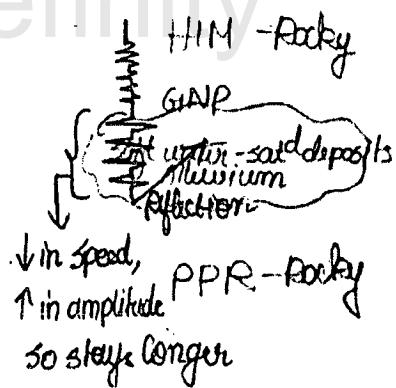
Sometimes secondary effects (like Fire etc.) can cause more damage than EQ itself.

LIQUEFACTION

It is the sudden loss of strength of water saturated soils resulting from shaking during EQ. It can cause large ground cracks to open.

Shaking can cause saturated soils to consolidate & thus occupy a smaller volume. During shaking of an EQ, water-saturated material may behave like a fluid resulting in fracturing, subsidence, horizontal sliding of ground surface.

EQ waves travel at a high speed through stiff crystalline rocks of the crust but slow down dramatically when they enter the region with soft deposits [a lake basin -



Ex: Kathmandu) on areas like GNP]. This increases their amplitude & causes stronger tremors.

In addition, the sharp contrast in the densities of the soft sediments & the rocks that surround it can cause the waves to reflect, trapping energy in the region - this extends the duration of EQ.

MISCELLANEOUS POINTS ON EQ

SEISMIC GAP: A seismic gap is an EQ prone area where statistically speaking, a major EQ is "due". This implies that there occurs a gap at present in the historical occurrence record of major EQs in that area.

In seismic gaps we should not go for big dev'l projects like dams, Railways, etc as they may act as triggers for EQs.

A no. of seismic gaps have been identified on Himalayas.

SAN ANDREAS FAULT: It forms a junction b/w the N. American & Pacific Plate.

A transform B-I along this fault makes California EQ prone.

BOOK
"Small & Beautiful"

- Schumacher - 1970s

NORTH ANATOLIAN FAULT: It cuts Turkey E-W across. Transform B-I along this fault makes Turkey EQ prone.

HOMOSEISMAL & ISOSEISMAL LINES: (Not much relevant today)

Homoseismal - line joining places which receives EQ waves at same time.

Isoseismal - line joining places with same intensity of EQ waves. Both are generally elliptical & run around epicentre.

SEISMOGRAPH & SEISMOGRAM: 1st by Filippo Ricchi - 1845
(Italy)

Seismograph detects, records & measures the vibrations produced by an EQ. Seismogram is a record of seismic waves detected by a seismograph.

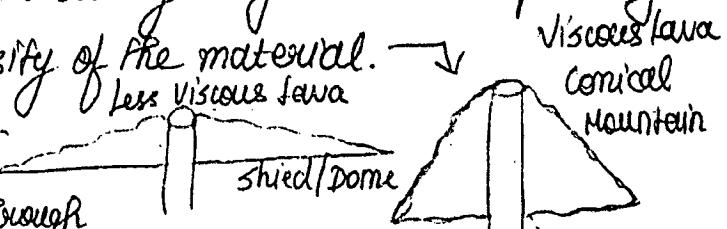
* JOHN MITCHELL was the 1st to recognise that EQ's spread in waves & destructiveness reduces outwards in general.

VULCANISM

It is a process of eruption of molten material.
Molten material is called "Magma" beneath E-surface & called "Lava" when comes out on E. surface.

- Broadly speaking, 2 Types of Eruption processes:
- i) Central Type → Molten material comes through a pipe (conduit) formed from inside the earth. The material spreads on all sides of the pipe resulting in features - depending primarily on the viscosity of the material.
 - Viscous lava
 - Conical Mountain
 - ii) Fissure Type → Molten material gets ejected out through a linear fracture (Fissure) & the material spreads on both sides resulting in more / less horizontal sheets.

The term "Volcano" refers to the conduit / fissure through which the eruption takes place.



3 Types of Volcanoes:

PORTAL Notes

1] Active

2] Dormant

3] Extinct

LAVA

ACIDIC

BASIC

- a) Poorer in NaFIC & Richer in SiFCA
- b) comparatively cooler
- c) Highly viscous due to ↑ silica
(as silica can make bonds easily)
- d) Acidic eruptions have potential to produce violent eruptions
(as gases/volatiles can't esc. easily)
- a) Richer in NaFIC but poorer in SiFCA.
- b) Extremely hot ($> 1000^{\circ}\text{C}$)
- c) less viscous/more fluid due to ↓ silica & ↑ temp.
- d) Such lavas tend to vent gases easily so less explosive eruptions.
- e) Basic eruptions generally eject out enormous amount of lava.

DIFFERENTIATION:

PORTAL Notes

Geologists believe that early in E's history there took place this process resulting in 3 layers of Earth.

→ In beginning, all rocks of Earth were Igneous in nature.

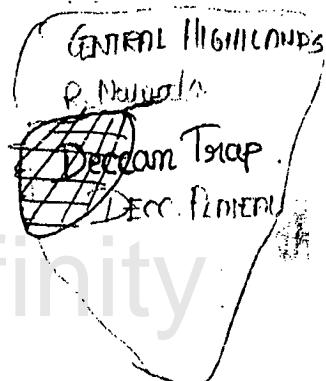
→ None of the 3 presently occurring types of rocks (S, S, N) is considered to be primary because in nature there is a cyclic process of rock formation.

* Vulcanism played an \otimes role in making \oplus a living planet. It is believed that over a geological time, the volcanic gases created the Oceans & Atmosphere & these gases even affect today's climate.

- * It is gen. understood that our present atmospheric composition got finalised only around 600 mn yrs ago - CAMBRIAN Period.
- * Emissions of volatiles from Earth's crust is called OUTGASSING
- * Water Vapour is the main constituent of volcanic gas (70% - 90%) followed by: CO_2 ; SO_2 ; traces of $\text{N}_2, \text{H}_2, \text{CO}, \text{S}, \text{Cl}$

LIPs [LARGE IgNEOUS PROVINCES] / Flood Basalts

LIPs are also called Flood Basalts & are formed on continents, also on ocean floors. These are defined as "voluminous emplacements of predominantly mafic igneous materials".



Ex: DECCAN TRAP:

- N.W. portion of Deccan plateau.
- This region experienced numerous Fissure type eruptions in past.
- It is an example of flood basalt.
- The term "Trap" is from Swedish meaning 'Steplike' topography
- Abutting of Basaltic lava has resulted into B.C.S -
- BLACK COTTON SOIL: One of the finest ex. of Parent material controlled soil.

Ex: SIBERIAN

The volcanism which covered Siberia with lava is of special interest bcos it occurred at same time as the greatest extinction of species in geological record - 250 mn yrs ago. Some geologists believe that eruption caused the extinction perhaps by polluting the atmos. with volcanic gases that triggered a major C.C.

DISTRIBUTION OF VOLCANISM

I. Circum Pacific Belt:

Along Subduction boundaries (i.e) Ring of Fire around P.Ocean.
Includes - W-side of N. & S. America & Indonesia, Philipp, Japan.

Ex: Mt. Saint Helens is an active volcano in state of Washington.

It is an example of STRATO-VOLCANO.

II. M.O.R + E.A.R.V.S:

Along sea floor spreading centres on ocean floor. (i.e)
MOR (Mid Oceanic Ridges) - Ex: Iceland

Areas of Rifting on continental plates (esp. East African Rift Valley System - EARVS).

III. Hotspot Vulcanism:

At Hotspots, where individual plumes of magma rise through the crust. A hotspot volcano is a volcano situated away from tectonic plate margins. Hotspots are very hot areas in the mantle & these are supposed to be fixed in location.

Ex: Hawaiian Islands hotspot

Eastern Island hotspot

Yellow Stone NP hotspot

Reunion Island hotspot - supposed to be cause of Deccan Trap

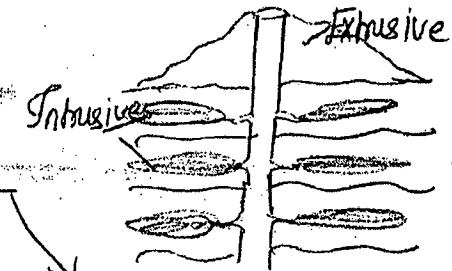
* We shape our tools and our tools shape us

* The diff b/w Tech & Slavery is that slaves are fully aware that they are not free

IGNEOUS FORMATIONS

INTRUSIVE

- > Formed beneath Earth's surface
- > slow rate of cooling - result in coarse grained structures
- > Granite is the most common one.



EXTRUSIVE

- > Formed above Earth's surface
- > Faster rate of cooling - result in fine grained rocks.
- > Very rapid cooling results in Glassy texture. Ex: Obsidian (volcanic glass)
- > Basalt is the most common one & is particularly wide spread on ocean floor.

INTRUSIVE IGNEOUS FORMATIONS

Country Rocks - The original rock of an area on which intrusion takes place.

'Pluton' - Used to describe all forms of igneous intrusions of all shapes & sizes.

2 Types of Intrusions

- i) Concordant → The one which follows the existing bedding planes.
- ii) Disconcordant → It breaks right through existing bedding planes.

Some Standard Intrusions

1] SILL - A flat, sheet-like igneous intrusion - Concordant

2] DIKE/DYKE - A thin, vein like igneous intrusion - Disconcordant

3] BATHOLITH - A huge igneous intrusion of great depth covering a large area $\rightarrow 100 \text{ km}^2$ - Disconcordant
Irregular in shape & intrudes across

layers of country rock. They often lie in the cores of major mountain ranges like Himalayas & Andes (Geologists

SILL

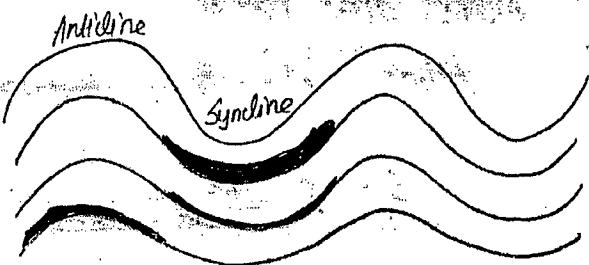
DIKE

concordant

disconcordant

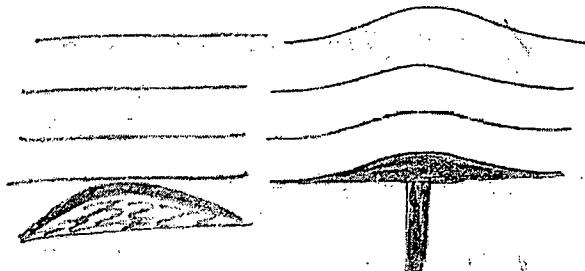
express their surprise over the absence of active volcanism in Himalayas at present) Batholiths cool very slowly & result in very coarse structures.

4] LOPOLITH - Saucer shaped igneous intrusion - Concordant (in Syncline)



5] PHACOLITH - lens shaped igneous intrusion on syncline or over anticline.
- Concordant.

6] LACCOITH - lens shaped igneous intrusion with flat base (or)
Mushroom shaped - float forces
the overlying strata into a dome.
- concordant.



Note: The term 'Stock' is used to refer to smaller sized igneous intrusions collectively & 'Batholiths' for big ones.

EXTRUSIVE IGNEOUS FORMATIONS

ERUPTION MATERIAL

- 1) LAVA → The molten material which gets properly solidified.
- 2) ASH → Sand sized volcanic material.
- 3) DUST → Volcanic material finer than sand.
- 4) CINDER → Half burnt volcanic material.

Note

Ash cones

TEPHRA / PYRO-CRATIC Materials → Tephra is the term generally used for Ash, Dust & other material sent by volcano eruption - the term does not include LAVA.

Larger chunks of tephra are called V. Bombs (\approx tennis ball)

Smaller chunks of tephra are called Lappili (\approx Peas)

LAHAR

Volcanic Ash & DUST + WATER

makes Mud Flow.

'Lahar' refers to a torrential mud flow - very destructive.

AA & PAHOEHOE (Hawaiian)

Both are hawaiian words & refer to 2 types of lava formations.

AA → Jagged + chunky lava (i.e) Angular blocky formations.

Viscous lavas result in formations with appearance of piled up, sharp-edged blocks.

Paehoe → less viscous lavas resulting inropy lava formations.

Lava may cool quickly to develop a thin skin. If lava continues to flow underneath, the surface wrinkles into rope-like coils.

HOT SPRING / THERMAL SPRING & GEYSER

Hot Spring

- > Continuous flow of hot water from the ground.
- > Not explosive. Have dissolved minerals.
- > Usually, but not always, associated with former/present volcanic activity
- > More common than Geysers.

Geysers

- > It is a hot spring that intermittently, sometimes at regular intervals, throws up a jet of hot water, steam, etc.
- > It may occur on areas that are or were volcanic.

CRATER

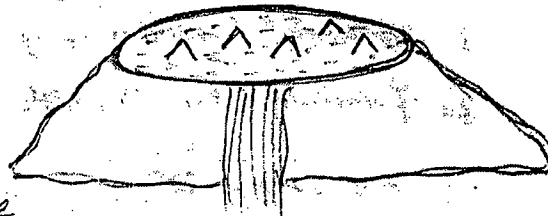
Ex: Taupo Lake, NZ



Bowl/funnel shaped depression, usually round & with steep sides. A crater may result in CRATER LAKE.

CALDERA

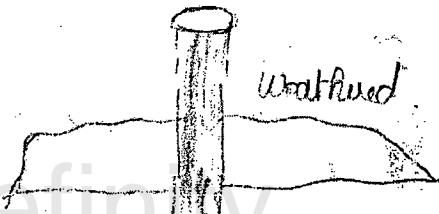
A large, basin shaped crater. They are found at the top of volcano where the original crater has collapsed.



The basin which is many times larger than the original volcanic vent may be flooded to produce a lake or the floor may contain a no. of small conical hills produced by volcanic activity after the collapse.

SPINE/PLUG

A tower of hard rock left by a volcano.



SCORIA

Scoria refers to bubble filled stones ejected from a volcano. Dissolved gas can sometimes make magma froth. This froth cools into stones of low density filled with bubbles/vacoles.

Ex: Pumice stone - floats on water.

REASONS FOR SEASONS

Seasonality refers to:

- Seasonal variations of Sun's position above the horizon
- Changing day lengths during the year.

SUB-SOLAR POINT & SUN'S DECLINATION

- Refers to the place where the Sun is directly overhead
- It refers to the latitude of sub-solar point
 - Declination annually migrates through 47° latitude b/w 2 tropics.

SOLSTICE

Latin - refers to Sun standing still / reaching highest position in given hemisphere.

EQUINOX

Two days of the year when all places on earth have equal length of day & night.

5 REASONS FOR SEASONS

- ① Earth's Revolution
- ② Earth's Rotation
- ③ Tilt of E's axis
- ④ Axial Parallelism
- ⑤ E's Spherical Shape

Why Elliptical Orbit is not a reason for Season?

On about Jan. 3rd, E is 147 mn km from sun, closer than at any other time. This position is called Perihelion.

On about July 4th, E is 152 mn km from sun, farther away than at any other time. This position is called Aphelion.

Although E is closest to sun & receives more energy (7%+) on Jan than on July, this difference does not manifest as reason for seasonality. As a proof, consider that E is closest to sun during the cold N. hemisphere winter.

CLIMATE CHANGE

Change in the average temperature of E's surface

In a long term perspective, energy coming from sun to the Earth & the energy sent back by Earth to space are almost balanced. This balancing act of nature leads to a constancy of the avg. temperature of E's surface.

The basic reason for CC is - Earth's HEAT BUDGET getting disturbed.

E's history is a History of CC.

In geological past, Natural Reasons led to CC.

At present both Natural & Anthropogenic reasons lead to CC.

Postal Ans. Prepare

SEASONALITY

1) Earth's Revolution

At an avg. distance from sun at 150 mn km, Earth completes its annual orbit in 365.2422 days at a speed averaging 107280 km/hr in a counter clockwise direction when viewed from above the E's North pole.

2) Earth's Rotation

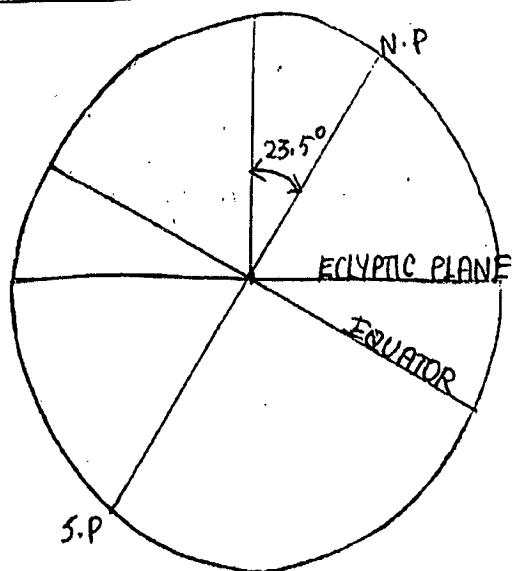
Earth's rotation produces a diurnal pattern of Day & Night. The dividing line b/w day & night is circle of illumination.

Circle of illumination always bisects Equator, hence daylength on Equator is always evenly divided (12 hrs D, 12 hrs N).

All other parallels experience uneven day length through seasons, except for 2 days a year - EQUINOXES.

The seasonal variation in length of the day increases as we go from Equator to poles.

3) Tilt of E's Axis



To understand the Earth's tilt, imagine the elliptical orbit of Earth about sun as plane with half of sun & Earth above the plane & half below. This flat surface is called Plane of Ecliptic.

Now imagine a fr line passing through the plane. From this fr, E's axis is tilted 23.5° , it forms a 66.5° from the plane itself.

The axis through the E's 2 poles points just slightly off POLARIS/POLE STAR which is appropriately called NORTH STAR.

4) Axial Parallelism

Throughout our annual journey around the sun, E's axis maintains the same alignment to the plane of Ecliptic & to polaris. In each position, E is revolving with axis oriented identically or parallel to itself. This condition is known as axial parallelism.

5) E's Spherical Shape

E's curved surface presents a continually varied angle to incoming parallel rays of sun.

The latitudinal variation in angle of solar rays results in an uneven global distribution of insulation.

Appx. Date	Name (from N.H perspective)	Sun's Declination
Dec. 21-22	Winter Solstice	$23\frac{1}{2}^{\circ}$ S
March 20-21	Spring Equinox (Vernal Equinox)	0°
June 20-21	Summer Solstice	$23\frac{1}{2}^{\circ}$ N
Sept. 22-23	Autumnal Equinox	0°

DAWN & TWILIGHT - Notes



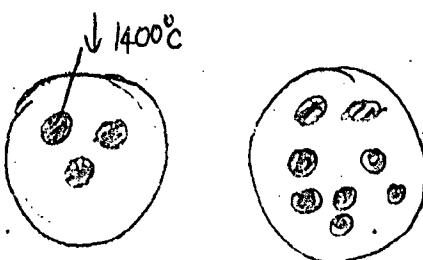
NATURAL REASONS FOR CC

Read
 Calendar corrections,
 SOLSTICES
 GREGORY.

1) Sun Spot Activity Cycle

Noise spots \rightarrow ↑ heat on Earth.
due to change in Sun's mag-field.

Cycle in multiples of 11.



2) Orbit

Tilt - Mean $23.1^{\circ} \pm 1.5^{\circ}$ change

Orientations

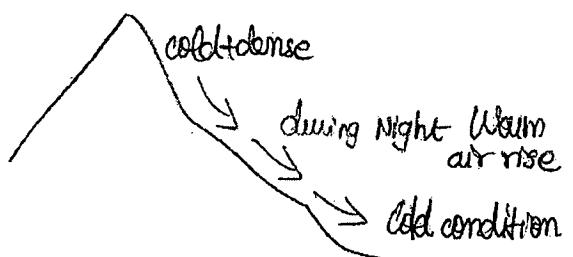
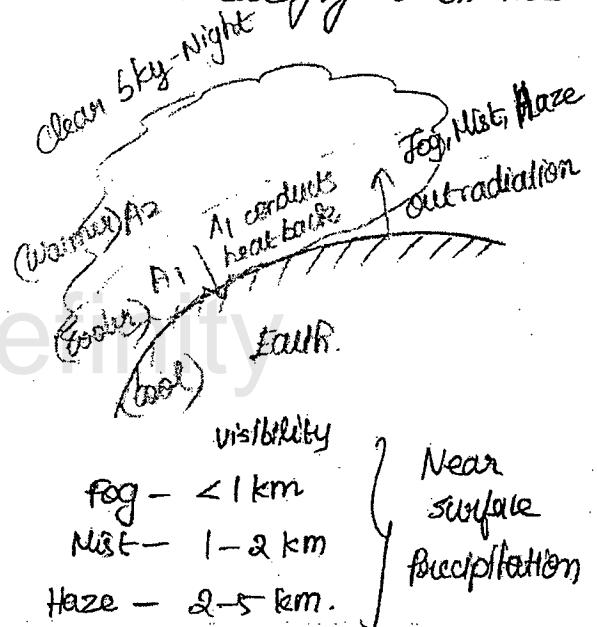
Precession of Equinoxes

The slow change of relative positions of equator & the ecliptic on which the celestial North pole appears to describe a circle in space every 26,000 yrs.

At the same time, equinoxes complete one movement around ecliptic. This form of motion results from the gravitational attraction of sun & moon on E's equatorial bulge which causes the E's axis to trace out conical figure in the heavens/space.

Temperature Inversion

- i) Fronts
- ii) Isoropopalse
- iii) E's outradiation during night
- iv). Topography



POLAR VORTEX

Intense cyclonic system in polar areas - in upper atmosphere (esp. stratosphere) - Intense low pressure over the polar ground High pressure.

When vortex weakens, it sends cold air along surface to higher & middle latitudes also instead of just poles.
When it is intense it is constrained in poles.

@upsc.risefinity

@upsc.risefinity

HUMAN GEOGRAPHY - SHIV ARPIT

NCERT :

X - ICSE - Geography

XII - NCERT - Human Geography of India ?
" " " World. } - ignore data - old.

⇒ Concepts — Important for Prelims

⇒ Data — Important for Mains.

Sources - Newspaper

ESI, Year Book (Govt. schemes)

Afti class : Go revise, look at previous year qn. papers on
that topic.

SOURCE: EST

Dalai Report on
doubling Farmer's
income

AGRICULTURE

Importance of Agriculture:

* Agriculture is the largest Employer
where almost 50% of workforce directly
depends on agriculture.
was 45% in 1910-11
28% in China
Leave land, not village

* It also contributes very significantly
17% (40% in 1910-61)
to the GDP & most of our Economic indices
reflect the importance of Agriculture.

* Many of our social problems like
Poverty, Malnutrition, Rural out
migration, Farmer suicides etc., can be
attributed to the unviability of agriculture.

→ Changes in temperature & Rainfall patterns
affect Agriculture more than any other sector
of economy [Effects are highly divergent for
Irrigated & non-irrigated areas].

→ Agric. also contributes significantly to
Green House Gases [GHG] emissions where
rice cultivation & livestock release CH₄ into
atmosphere.

→ Most of our Ecological problems like
Land degradation, Eutrophication, Ground

Farm holdings	No. of hold	Year
8.28 ha/person	70 mn	1910
1.16 ha/person	138 mn	2016

India	Trade
Wt.land: 160 M ha	0.3 M ha
Exp: \$ 33 B	\$ 10 B
Ltrs: 36 kg/day	3-7 kg/day
milk	
per capita: 0.199 ha	0.038 ha
Ag. land:	

Absence of co-op or collective farming
- small machines - not in India

→ 2.2 L Ovre - 1.8 L Ovre
EXP Rev

Statal deficit - 5.74 L Cr.

- 1.67 L Cr - Food subsidy bill

- 66-70 thousand crre on

Fertilizer subsidy - 2017

→ Tube well - fixed. Irrigation

- 5000-6000 crre Elec. subsidy

→ Balance of Trade - Due to

-ve (Imports > Exports)

2014 - \$ 26 B Exports

2017 - \$ 33 B ..

- \$ 10 B - Import of oil seeds

60E-70E Ovre

→ Cultivable area ≈ U.S.

→ Pulses - Tanzania, Aus,

↓ Myanmar, NZ, ..

largest producer, consumer & Importer

- 2017 - Banned exports of pulses

water depletion & contamination etc., can be traced to faulty agricultural practices.

• Agric. is a means of empowerment and India's strength. We can't afford to neglect it & development of country would remain a distant dream until Agric. is given the importance it deserves.

Features of Indian Agriculture:

• Irrigated

• Non-urbanized

• Fertilizers

• NPS scheme

• Irrigation

• DEBT scheme

• Crop Xylem

SOIL HEALTH CARE CHALLENGE

Structural & Chemical changes

Gold from off. board - 1.1 P.C. - 1990
WORLD AGRIC. CENTER - ① - 41.1.P

	2013	2015	2016	2017
2013 - rainfall - 11.11% based				
soil land	135 M ton	13.05		
2015 - drought - 21.2 "		16-17		
2016 - monsoon - 27 " "		22.95		
2017 - .. - 875 ..				

2013-2016	Agric. land	VS Agri. land
100% irrigated	Pun	↓ Water use efficiency
90%	Haryana	compared to China &
76%	UP	Brazil
62%	WB	
50%	TN	

Naphtha - Byproduct of Petrol

↳ used in fertilizer.

↳ >50% of natural gas - imported

Exports in Agriculture ↓ in 3 years

Production: Ground water depletion - 300 m/yr.

- 2nd largest producer of horticulture ↓

> 3000 tonnes

High production - but high prices yet

But we are wasting a lot

- 2017 - 31k 500 tonnes - Fruit waste.

CIPHET

Urbanisation - Rural out migration

Town - 75% male not in agriculture

- > 400 ppl / sq. km

- > 4000 population

Migration - Push - Our home town push out
Pull - Delta pulling in

- Agriculture is not profitable

- World Bank - Non-agri - 5-2 times in
urban areas in India

Indust. Survey - 2015

61% farmers ready to leave farming if
given alternative

- Unskilled labour - Migrant - exploited
in urban

conflicts - Comp for resources

- Unless we have self-suff smart villages we
can't have smart cities.

Summary:

Rainfed ; Irrigation
 ↓ ↓
 Datas - problems Datas - problems

Problems on Mechanisation

- Indian context.
- Limited success in collective farming

Fertilizers

- Limited access
- Uneven distribution
- Disproportionate use.
- Nutrient Based subsidy
- Neem coated urea
- Soil Health Card scheme
- DBT scheme (not same as UPA)

(given to company not individual)

Sex Ratio

For every 1000 male how much F

- Migration alters this ratio

PURAL	URBAN
1000 F	1000 F
1000 M	1000 M
800 M	1200 N

- Feminization of Agriculture

↓ 47% women labour

↓ reduced productivity

Very less wages

- No machines to reduce drudgery of women

- Diff for women to get loan - bcos of collateral not in her name
- ↑ interest rate - financing ↕ total family
leads farmer suicides

NCRB - 11,000 suicides - 2017

2016 - Worst drought in century
in TN (which gets rainfall in
Oct, Nov, Dec unlike other
states which get rain in summer)
↳ protests in Delhi

High per capita income state in Agri
too have farmer suicides.
- Vidarbha suicides

Structural problems - Non performance
of agriculture

Global Hunger Index - 2017

100th rank / 119 countries

Includ North Korea, Iraq

OBC revolution in Indian politics

directly related to success of Green Revolution - late 60s (Land + Prof. in Agriculture)

Brit. introduced Zamindari system

Absentee landlords - intermediate class

LAND REFORMS:

↳ serfdom rights

↳ to abolish zamindari

↳ land ceiling - diff. in diff. states

Bullock capitalists - a term given for those who profited from G. Rev.

FAINFALL:

Green house gases - global warming -

Agric. mainly aff. by ↑ temp. & rainfall + variations in pattern

M.S. Swaminathan - 2010 - for 1°C ↑ -

5% reduction in production - loss of pests.

Agric. also contributes to GHG gases, GW & climate change

FAO - 18% total GHG from Agric. sector

WRI - 13.5% from transport (circular)

Rice cultivation, cattle → release methane
requires more water, salts
dead woods release CH₄
- urea - Nitrogen dioxide

Environmental disaster - faulty Agric. practices

- Delhi smog → stubble burning in P, H

Oct, Nov - change from rice → wheat
→ Migrant labour - costly - so burn fields.

NGT banned these practices

Punjab - less rainfall - not suited for Rice
use Ground water - depletion

1 unit of CH₄ more heat > 1 unit of CO₂

climate change - Anthropogenic

Modifying agric. practices

today more area in rice which req. more water - shouldn't be cultivated in less rainfall areas but it is done.

- 1kg rice - 5000 litres of water

Aerobic practice of rice cultivation

If 2% seaweed in cattle feed

we can J CH₄ from cattle upto 90%

Eutrophication - Algal bloom

↓ due to

untreated sewage

industrial effluent

excess fertilizer water bodies

surface runoff

Shifting Agri: Burn forests - Agri after few months

by tribal groups - Have some func.

India - SOFT - Good in making laws

STATE - Not good in implement.

Integrated Nutrient ManagementOrganic Fertilizers & Organic Farming:

Chemical Fert + BIO + organic Fert. Fert

(Rhizobium
bacteria)

SIKKIM - Fully organic state

NEGHALAYA - " " by 2020.

Possible micro-nutrients

But not as much productivity as chemical fertilizers - so organic is not efficient - so only supplementary to chemical

W.B. → 2nd largest producer of vegetables - uses chemical - Sikkim - can't do this much.

O.F. will be useful for farmers only if proper access to markets is available.

Siliguri vegetables flooding Sikkim - as they are cheaper due to chemical ferti

In long run bio fert can take over CF; But chem' Fert should be used in correct proportion.

In India, farmers use urea in terms of bags (50 kg.) → Govt had made it 45 kg → To reduce usage.

Natural gas price in India:
3 times × Gulf price.

Fert. Industry in those countries:

↳ we can import from there.

This will be cheaper.

↳ but it is debatable as it is related to food security - we can't fully rely on other country.

Backward linkages:

Pesticides:

Some crops are more affected than others:

BIO \Rightarrow Neem, garlic.

CHENICAL \Rightarrow Insect dies

INDIA

Avg usage: 600 gm/are hectare
(chem)

U.S.A - largest consumer - } because
7 kg/ha 18% of total of good land.
pesticide.

Japan - 12 kg/ha

China - 13 kg/ha

Lesser land than India.

We comparatively use less

pesticides - But Europe, Jordan

has suffered due products due to
pesticide residue

Problems:

Application technique of pesticide -

more important than quantity.

Vidhava: >50 died - pesticides on cotton plants - No training to apply - unsafe - inhalation. } \Rightarrow Monocrotofase

Kerala (kasargod) — cashew

↳ > 2.5 lakh pesticide products

Endosulfan — Highly toxic pesticide — difficult to regulate this much.

↳ sprayed by helicopter — → 25% of 2.5 L are spurious / aerial — inhaled — still problem, contaminated products.
effets exist — Now banned. TESTS Based on effects:

Insecticides Act 1968 — regulates On Animal health

usage of pesticide — but On Environment

outdated — now 2017 law but ↳ But no tests on effect of human

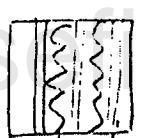
still not updated. [But in U.S. → > 70 tests for human].

↳ We registered only products not molecules — for pesticide.

(similar to nutrient-based subsidy)

↳ 280 pesticide molecules registered now — but perpetually almost $\frac{1}{3}$ rd of 280 banned in other countries.

IPM - Integrated Pest Management



okra cotton

Problems

↳ Pesticides kill all pests.

Even useful ones like:

Faithworm — aerating soil

Honey bees — pollination; ↑ yield

↳ Accumulated chemicals in plants

i) So we can use BIO PESTICIDES like Neem.

ii) Lady bird — will attack okra also attack cotton

attackers — ballworm & insects; Asphodels

so this can be used as TRAP

CROPS (here okra)

2015 - Anupam Verma Committee

↳ 13 molecules ban proposal but govt. made another committee — so still not banned.

Female tiger urinate - attracts
male tiger - smell - Feromones

↓
secreted by animals to attract

iii) Use of FEROMONES ↪ Fall on this, die'

iv) Kerala Farmu: New method:

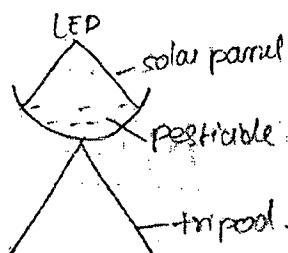
Trirod in field - with chemicals - Insecticides

Solar panel - LEDS attract insecticides

↓
sustain 3-4 hrs

[6PM-9PM]

max. of pest
attack.



⇒ Only 35 IPM centres in country

↳ Not enough manpower to
train farmers.

Most farmers get pesticide from
Private dealers (June 2017 -)
Diploma → Read

↳ profit oriented - sells irrational
↳ They have not much knowledge
of pesticides but they advise farmers
so wrong use - residue.

↳ this will also make
pests resistant against
pesticide.

Summary:

- Little amount
- toxic & chemicals
- Tests - improper
- Advisors - improper
- only 35 IPMs
- registered in perpetuity

running backward

linkages in Indian Agriculture.

Reasons for ↑ productivity

↳ Green revolution

→ HYV seeds

i) Seeds - also a misfit

B.W link -

↳ Most farmers don't

procure seeds - but retain
from past produce -

FARM SAVED SEEDS

so seed replacement

ratio ↓

v. less

100 Ares

Wheat

10 acres - certified seeds
90 acres - Farm-saved seeds

Seed replacement ratio of wheat in India $\Rightarrow 10\%$

especially low for:

by poor farmers

- Millets
- Oil seeds (gram-most important)
- Pulses

	2016	2001	seed replacement rate
Gram-Only	19%	4%	
Gr. mixt.	22%	5%	

\hookrightarrow Varietal replacement rate -

need to increase bcos:

- repeated same crop cultivation
- less nutrients - less productivity.

Are enough seeds available in India? If we have do we have enough HYV, QYV (quick yielding variety), drought-resistant, thermal

PUNJAB

180 days
PUSA-44 was the most used

Now, PR-121 used - bcos of QYV
PR-126 \leftarrow 120-145 days.

Benefits \Rightarrow of HYV + QYV

\hookrightarrow More crops in same field at diff. times

Interdepartmental panel in climate change (IPCC)

- Report on climate change
- Assessment report in 2015.
- rainfed areas - became dry due to global warming.

\downarrow
Need to develop climate resistant seeds (drought, heat resistant).

PULSES:

- By poor farmers
- Diff. to produce HYV

\downarrow
HYV available to all? to all seeds?

HYV can't be reused - so

again buy next year -

should GM crops allowed?

For:

\rightarrow \uparrow population - no stability - limited land - \uparrow demand of food - Need to go for GM crops.

2002 - COTTON BT - GM
 \leftarrow toxic for soil bacteria gene into cotton / ball worm

So ↑ production of cotton.

Not only ↑ yield/area, but also more area under cotton cultivation now.

300 hybrids of BT cotton now used.

⇒ ↓ cost compared to pesticides.

Nutrients in field - also goes to unwanted plants - Develop

Weeds → Use Herbicide against

⇒ Pesticides may affect good plants too.

HT (Herbicide tolerant) plants of GM will help tackle weeds without affecting plants.

→ Short shelf life items : like tomato (stored @ $\downarrow 0^\circ$ - gets rotten). GM tomato (Anti-freezing gene)

From fishes living in frozen areas.

Against :

i) Not safe for consumption - Cancer.

But WHO - says it is safe

US - cultivates, but

EU - Doesn't allow production & imports.

India = BT cotton ✓

BT brinjal X

GM mustard X

Cotton seed oil - used in vanaspati - health issue.

- Debatable - no conclusive evidence -

ii) Biodiversity loss -

(news - illegal sale of HT cotton in Maharashtra - Read)

BT variety cross pollinates with actual indigenous variety - in long run - loss of indigenous variety

iii) Monopoly of companies -

Can't patent crops - royalty decided by Govt - SC judgment

↳ Monsanto so excited.

{ Availability ✓
Affordability ✓

Reasons why farmers can't access good seeds?

↳ Missing B.W. link.

CREDIT - Next B.W.
Linkage.

If farmers:

hold stock - can't invest in next crop

distress sale - loss; so go for credit.

problem:

↳ Non-availability through institutions, regional rural banks, co-operative banks.

Institutional agencies

rather than money lenders.

formal credit

1950-51

2016-17

7% → 58%.

Improvement

informal

93% → 42%.

Almost 85% - small, marginal

farmers. (SMF)

2008-2016 \Rightarrow Only $\frac{40\%}{\text{to } 85\%}$ of formal credit (58%) goes to SMF (85%); $\frac{60\%}{\text{to } 15\%}$ goes to big farmers.

↳ Disparity in reach of formal credit among SMFs & big farmers. - Disparity on social front.

N.E. India:

2.83% → GSA (Gross Sown Area)

3.49% → Agric. GDP

0.82% → Formal credit

Central Region:

27% → GSA

25% → Agric. GDP

15% → Formal credit

→ Disparity on Regional front.

Farm loan waiver Scheme

i) Political stunt

ii) Not beneficial - will ↑ defaults.

Instead use this money to:

- R&D

- Agric. Infrastructure

iii) Benefits 15% big farmers

↳ 12.5% land in female name.

Also many farmers are landless -

Difficult to produce collateral in bank.

Govt \Rightarrow No collateral for < 1 lakh.

Self-help group - gather money own.

Interest subvention scheme -

Loan upto 3 lakhs - farmers get at rate of 7% per annum.

If promptly repaid:

Next time 1 lakh - additional 3% subvention, so 4% interest rate.

≤ 3 lakh → 7% p.a

≤ 3 lakh → 4% p.a

≤ 3 lakh → 4% p.a

_____ X _____ X _____

FEATURES OF INDIAN AGRICULTURE

1) Indian agriculture is RAIN FED. According to annual report on agriculture 2016-17:

52% of cultivable land in India does not enjoy Irrigation support.

Very few states - Haryana, U.P., Pun... have created Irrigation Infrastructure for the farmers. Some problems in these states include:

- (i) Low water use efficiency
- (ii) Ground water depletion due to overuse of tubewells.
- (iii) Flood irrigation techniques are wasteful.

(iv) Micro-irrigation systems are confined to some high value crops cultivated by large farmers

2) Indian agriculture has very LOW LEVELS OF MECHANISATION.

- ↳ Fragmented land holdings
- ↳ Machines unavailable for small farms
- ↳ Limited success of collective farming.

3) Indian agriculture is marked by ABSENCE OF FORWARD & BACKWARD LINKAGES of Fertilizers:

- i) Distribution is not uniform
- ii) Urea is not part of NBS scheme (Nutrient Based subsidy). Max. subsidy goes

to urea. As it is readily available, Farmers overuse urea.

iii) Soil health card scheme has been introduced to check the disproportionate use of Agro Fertilizers.

iv) Neem coating of urea has been made mandatory as it prevents diversion of urea to industries.

v) Govt. has introduced DBT (Direct Benefit Transfer) to plug leakages during distribution.

b) Pesticides:

i) Use of chemical pesticides in India is 600 gm/ha, not comparable to US, China, Japan, etc.

ii) Insecticides Act 1968 is outdated. The new law drafted has not seen any improvement over the previous one.

iii) Molecules are registered in perpetuity. Almost 1/3rd of total pesticide molecule registered are highly toxic & banned in most countries.

iv) As there are >2.5 lakh products, regulation by Govt. agencies is difficult resulting in spurious pesticides flooding the market.

v) Though the govt. promotes IPM (Integrated Pest Management), only 35 IPM centres exist in India.

vi) Farmers purchase pesticides from private dealers who are not competent enough to advise farmers.

c) Seeds:

i) Most farmers in India use farm saved seeds. The seed replacement rate and varietal replacement rate in India needs improvement.

i) There are issues related to

- Availability

- Affordability

ii) Intro of GM crops is matter of debate with concerns expressed over:

⇒ Bio-diversity loss

⇒ Adverse effect on human health

⇒ Creation of Monopolies

d) Credit:

i) Still 42% of total farm credit comes from Informal sources.

ii) The share of SMFs (small & marginal farmers) in farm credit from institutional agencies was only 40% in 2008-2016.

iii) Disparities are also visible on regional front.

iv) Under the Interest Subvention scheme loans upto 3 LAKHS are given @ 7% p.a. Additional

subvention of 3% also given for prompt repayment.

RBI \Rightarrow 18% loan to Agriculture
8% to SMFs.

X X X

Forward linkages:

increase, 100 kg due to improvement in B/w $\xrightarrow{10\text{rs/kg}}$ 1000 Rs but
linkage 200 kg $\xrightarrow{5\text{rs/kg}}$ 1000 Rs same
proper.
 \hookrightarrow so need FW linkage - market

Cob-Web phenomena?

\uparrow price \Rightarrow \uparrow more for a crop farmers goes for cultivation
 \downarrow prices \leftarrow More supply \leftarrow

History

Agriculture produce & Market Regulation Act

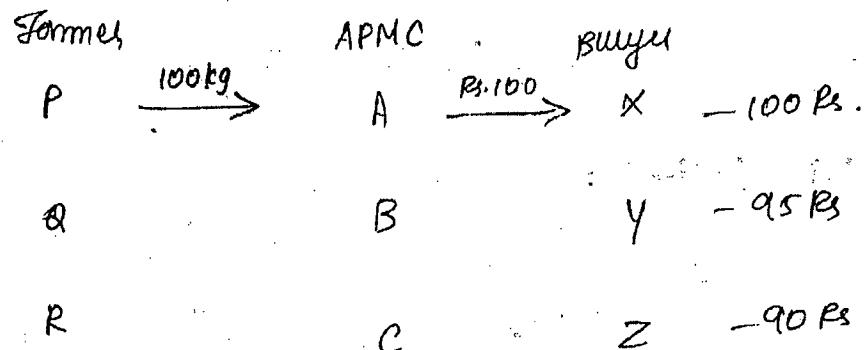
- i) Credit can't sell @ farm gate.
- ii) APMC mandis/markets - in each district
 - \hookrightarrow Register, get license (middlemen)
 - \hookrightarrow Auction sale through licensed middlemen.
 - \hookrightarrow All would come to APMC to buy

↳ Auctioning process diff in diff states

↳ Quality check done - through hand

- Sample box bid

↳ Commission to A, B, C & fix to APMC infrastructure.



~~Pro~~ Reality:

- Head of mandi decides prices - Predecided.
- A, B, C start deliberately for low bid - prevent greater amount.
- Namesake auction.
- A, B, C don't pay sufficient - delay - farmer diff to cultivate again.
 - ↳ or they pay very less to farmers.
- Conditions very poor for farmers of perishable goods.
 - [M.P - 50 paise/kg - Tomato ; T.N - 35 Rs/kg] ↑ less shelf life
- Farmer $\xrightarrow[\text{avg.}]{\text{432 km}}$ Mandi - Transport cost + Labour.
- Place of large exploitation instead of helping farmers.

Model APMC Act 2003:

i) Exception from compulsion to go to APMC - Farmers must be free to sell his produce anywhere

↳ But, Agri is state subject. But so states only can implement.
But head of mandis are powerful ppl so states don't implement.

Delhi & Maharashtra - amendment

Non-perishable item - compulsory APMC

Perishable item - Exception

Bihar - 2006 - repealed APMC

Other states diluted it even if they implemented

ii) Contract Farming:



- Only 25% of consumer price goes to Farmers
- Long supply chain.

↳ Retailers directly purchase from Farmers - Contract farming.

Earlier we didn't have food security so went to old APMC.

Now we have market surplus so we can go to amend APMC.

↳ Some states have done - some not.

↳ Benefit: Good price of Farmer; ↓ middlemen.

↳ Register at APMC by Retailer is must to get from farmer

↑ pay tax - but not using services.

Contract Farming Law 2018 May:

In earlier laws of contract farming:

- = Retailer must register with APMC even when not using its service.
- = Company overshadows farmers making them weaker party.
- = Company tricks farmers with contract made complex - eliminate produce of size, quality - giving low price -

New law, 2018:

- ⇒ Farmer to be constantly considered as weaker party.
- ⇒ No permanent structure in farm; No transfer of ownership to sponsor.
- ⇒ No need to register at APMC mandi - But online registration to Registering committee.
- ⇒ Agreement must be strictly followed - all produce as per contract must be bought @ pre-determined prices by retailer.
- ⇒ Insurance coverage for natural factors (storms, floods, ...)
- ⇒ Farmer producer organisation (pool of land of 20-30 farmers) - enter into deal with sponsors.
- ⇒ No explicit import restrictions for sponsors.

[HOARDINGS] Vs [CAPTIVE
STORAGE]

Another problem in market:

⇒ High price dispersion:

Reason: ② - Price dispersion

↳ Absence of unified market.

Quality of wheat	State	Price
A	Punjab	100 Rs/kg - lowest
A	F.N.	200 Rs/kg - highest

e-NAM Project:

Farmers APNC Buyers

↳ Upgraded infrastructure
in Mandi

A

P

X

B

Q

Y

C

R

Z

↳ New storage facilities
↳ Auctioning through electronic medium - buyer, trader, exporter
Any person from anywhere in India can bid - Better price & Transparency

VIRTUAL MARKET: Farmers will go to APNC Mandi's - There

electronic medium will be available.

↳ Trading portal.

⇒ This project doesn't BYPASS Mandi's but aims to give more choices for farmers; still Mandi will levy taxes.

⇒ Testing facility will be there in mandi - Quality assurance.

⇒ However transport is to be done, but in this case atleast intermediaries in supply chain process are cut down.

⇒ Unless states amend

APMC laws, they can't do

e-NAM.

As of Now ($<10\%$ of PM; $<7\%$ farmers)
585 Mandis - part of e-NAM
6000 Mandis - Total

2339 mandis - principal
(PM) markets

Remaining - sub-mandis

⇒ Primary rural agriculture

(PRAM)

markets → Direct sale to buyers

But today ⇒ we have market surplus.

so we need to bring PRAM to e-NAM

so that we can ensure good price for

good exportable products of Horticulture,

organic farming

⇒ AAI's will help farmers with digital platform.

DAIWAI COMMITTEE REPORT — Read

Model APMC Act

- i) One license to traders valid across any mandi. In ~~any~~ state.
- ii) Bringing down area covered by ~~any~~ mandi → From 432 km^2 to 80 km^2 .
- iii) Warehouses & silos — Here too markets can be set up.
- iv) Commission fixed → Non perishable — 2% from 2% of APMC
Perishable — 4% from 1% of mandi

✓

MARKET

* Most of the states enacted APMR act* during 60s & 70s where the farmers were to sell their produce only at APMC mandies through the mechanism of Auction.

* But the mandies are now the places where farmers are exploited.

Problems:

- i) Cartelisation (group formation)
- ii) Poor Infrastructure
- iii) No value addition facility
- iv) High Commission & Mandi Tax.
- v) Large area covered by Mandi etc.,

* As the country is moving towards a stage where it generates marketable surplus,

* APMR - Agriculture Produce

Market Regulation Act.

it needs to improve its share in international trade for Agri commodities. In order to achieve this & to cut the long supply chain of govt, the Govt. has formulated Contract Farming Act, 2018.

Important provisions:

- i) Farmer is considered as the weaker of two parties.
- ii) No permanent structure can be constructed on farmer's field
- iii) Land rights / land titles can't be transferred to the sponsor
- iv) Farmer Producer Organisations can undertake contract on behalf of farmers.
- v) A registering committee headed by an officer will be responsible for ONLINE

REGISTRATION of farmers. Mandis will be bypassed. To make e-NAM a reality, Govt. has formulated

- vi) The crops under contract farming will be covered under APLM Act, 2017 [Agriculture produce & Livestock Management Act]
- vii) The sponsors will have to procure all items from farmer (as mentioned in the contract) at a PRE-DETERMINED PRICE. Some provisions:
- i) Licence issued to a trader will be valid across the mandis of the state

To reduce the police dispersion and to make auctioning transparent the Govt. has come up with

e-NAM Project

It is a VIRTUAL MARKET on a trading portal where the auctioning would be done through electronic medium. Mandis will not be bypassed, but upgraded.

ii) Average area covered by the mandis will be brought down to 80 km^2 (from 432 km^2)

iii) Private markets will be setup at warehouses, SILOS (areas of bulk storage)

iv) Tax levied by mandi & commission charged by agents will be capped

MSP

[Minimum Support Price]

→ Announced before sowing season by Government to encourage farmers to cultivate.

→ Govt. will have estimate: but we may have:

due to { More production - \downarrow Price \rightarrow Procurement @ MSP
rainfall or other } Less production \rightarrow \uparrow Price \rightarrow Bonus over MSP for
conditions (to prevent farmer's loss)
procurement for PDS.

[Bonus is at discretion of
Govt - it may / may not]

Last year:

MSP - for 23 crops

⇒ But still why farmers go to APNC mandies?

↳ Not aware of MSP [Dalwai comm - <10% farmers
[2016-ESI - Farmer doesn't aware of MSP before sowing]

have awareness - esp oilseeds, pulses] Highest Procurement

↳ procurement is very late [wheat - April \Rightarrow June]

He needs good storage to hold. But he will not have
money for next sowing.

→ Govt's amount doesn't come up front to Farmers.

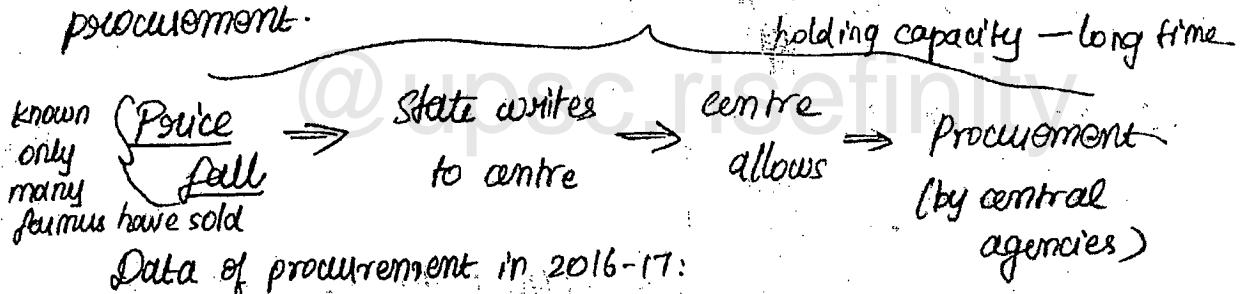
Other than Rice & Wheat (which are main in PDS),
procurement is very complex.

Price Support Scheme:

→ Procurement other than Rice & wheat.

→ Done only when price falls below MSP. Bcos in
other case when Market price is greater than MSP, farmer
already gets benefit, so govt. need not procure.

→ State must utilise the procurement after centre allows
procurement.



Data of procurement in 2016-17:

Dalwai committee recommendations: (On doubling farmer's income)

* Market Assurance Scheme:

- i) Procurement by state govt. directly, without waiting for approval of centre, by state agencies \Rightarrow when ~~MP~~ prices fall $<$ MSP.
ii) Centre will share $(30\% - \text{all India})$ $(40\% - \text{N.E. India})$ loss of state procurement.

* Private procurement & stocklist scheme:

- i) when price $<$ MSP, state invites tenders to private companies to procure from farmers @ MSP.

\hookrightarrow Incentives like: tax credits, waiver of export duty or reduction; custom duty waiver.

* Price Deficiency Payment:

operational
(Price loss, Overhead cost - 40% of total procurement cost - Govt. loss)

\hookrightarrow sell it to market price ($<$ MSP). The deficient amount ($MSP - \text{market price}$) will be transferred to farmer's bank account.

[Madhya pradesh - did similar one

\hookrightarrow But withdrew - Lack of land Records

M.P. \Rightarrow Soyabean production - harvest October (moisture)
 (less price)

But, when MP brought scheme,
 the trend reversed, prices fell
 price increase \downarrow |
 usually November (dry) |
 hangable down to buy
 (High price)

- Bas Market PPL reduced market price - very low amount - Govt. great loss - No loss for farmer.
- Farmers couldn't properly register with Govt. area of land
- Nodal price \Rightarrow 2 months across neighbouring states of particular crop - this price must be strictly enforced so that market PPL can't reduce abrupt costs - like in N.P - to make PDP a success.

* Market Intervention Scheme (2015) - N.O. Consumer affairs (Nao)

No NSP announcement for perishable goods.

\Rightarrow - 50% state accept \rightarrow - 50% centre govt. \rightarrow in NSP procurement

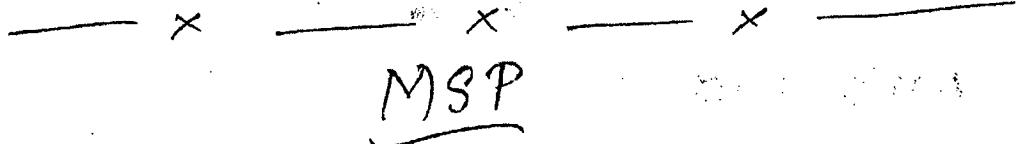
	Prod.	Price
2016	100kg	100 Rs/kg
2017	>110 kg ≥10%	<90 Rs/kg <10%

\hookrightarrow Using procurement is state's responsibility

M.P. \Rightarrow last year - Onion surplus production - 3 Rs/kg

\Rightarrow State procured & sold at 1 Rs/kg in PDS shops

Kayastha \Rightarrow this year, Garlic - produced in same way



- i) It is the price guarantee * Dalit Committee on doubling given by Govt. to farmers. Farmers Income recommends:
- ii) It is announced before the sowing season to encourage farmers.
- iii) Although the govt. announces an MSP on 23 crops, MSP linked direct procurement takes place only for RICE, WHEAT & SUGARCANE
- [Fair & remunerative Prices (FRP) are given to sugarcane cultivators].
- iv) For other crop procurement is done under:
 • Price support scheme only when price of commodity falls below MSP.
- * Dalit Committee on doubling
Farmers Income recommends:
i) Market Assurance Scheme:
 a) The state govt without taking any approval from centre can procure farmer's produce through its agencies if market price $<$ MSP.
 b) The centre reimburses the losses if any upto a limit.
ii) Private procurement & sickness scheme:
 a) If the MP $<$ MSP, the state can invite private companies to procure farmers produce @ MSP.
 b) Companies are given incentives in some other forms:
 Ex: Tax holidays

iii) Price Deficiency Payment:

a) The operational costs of procurement are as high as 30-40% of total cost of procurement.

b) Under this scheme, the procurement will not be done, farmers will sell produce @ M.P. the difference [~~MSP~~ - MSP - M.P.] amount is credited to farmer's account.

CACP - calculates MSP.

On basis of:
cost of production

- price of inputs

- avg. price of product in domestic & Intern'l market

- future price

Cabinet Committee on Economic Affairs - stamps it.

FCI - stored products in here.

But cost of production is different in each state.
cultivation

So some states would face loss.

↳ So Govt. gives bonus to compensate high cost of
MSP cultivation.

↳ If every state announces bonus \Rightarrow Price dispersion high
 \downarrow

So centre govt. opposes it to. \leftarrow No uniform policy
state govt. — centre will give only MSP — bonus must
be bore by state only. Decentralised procurement. (?) didn't
understand.

M.S. Swaminathan Commission:

i) MSP — atleast 50% $>$ cost of cultivation } Govt. promised &
(150 Rs) (50 Rs) (100 Rs) now implemented.

(High MSP \Rightarrow \uparrow MP \Rightarrow \uparrow Inflation.

But Farmer — tells not enough — even to cover cost } Conflicting
Industrialist — cloth — \uparrow MSP — high cost. perspectives)

Then why farmers protest?

Calculation of M.S.S comm diff from centre Govt. now.

$$\text{Govt.} \quad \frac{50\text{Rs.}}{A_2} + \frac{10\text{Rs.}}{FL} - \text{MSP-150 Rs.} = \text{Actual paid + Imputed Value of FL cost}$$

$$\begin{aligned} \text{Actual paid} & \quad \text{Disguised} \\ \text{cost by farmers} & \quad \text{family labour} \\ \text{Avg. value.} & \quad \text{Avg. value.} \\ \text{Aug. value.} & \quad \text{comprehensive cost} \end{aligned} \quad \begin{aligned} \text{M.S.S.} & \quad C_2 = A_2 + FL + \text{Land Rent} \end{aligned}$$

On 23 crops:

C_2 = 38% higher than ($A_2 + F_L$)

Great difference.

PRACTICE OF MONOCULTURE:

Land diverted to rice & wheat

↳ Due to MSP favouring P'a & wheat - Farmers cultivate it more & more.

Rice	Pulses
<ul style="list-style-type: none"> - High water demand - Irrigation - ↑ Fertilizers - Pesticides - ✓ Machines 	<ul style="list-style-type: none"> - Dry crops - Rain-fed - ↓ Fertilizers - Pesticide - X Machines

$$x + y = z \quad p + q = r$$

cost profit MSP cost profit MSP

only based on economic factors \Rightarrow But we must take social returns
what about intangible factors?

Food Security:

It is not only about food in quantity but also balanced diet (Nutrition too).

Pulse have many social benefits:

- Nutrition, water saving, less fertilizers, export scope.

- Ground water depletion, contamination }
- Air pollution.
- Soil salination; fertility loss of soil. }

But taken long term
identification

M.S. Swaminathan Commission

i) MSP to be fixed at 1.5 times cost of cultivation.

Though the govt. has agreed, it calculates MSP on a slightly modified form:

↳ 50% profit is calculated over $A_2 + FL$ &
Not over C_2 (comprehensive cost)*

* $C_2 \Rightarrow 38\%$ more than ($A_2 + FL$)

ii) The policy makers have also blamed the MSP policy for the problems related to monoculture as the policy is cues in favour of RICE & WHEAT.

It is often argued that MSP calculation should include social returns on production.

Problems in MSP:

- Pilferages
- Low quality produce
- Leakage etc.

Though we have many problems in MSP, we don't have any better alternative - until land records are properly set;

Agro-climatic planning:

Cultivate climate favourable crops

Forward linkages:

Warehouses

Value addition

Transportation.

Warehouses:

✓ very important to prevent farmers from

DISTRESS SALE.

✓ Plus credit facilities + (Warehouses) Storage facilities.

Storage capacity

sugar - 160mn. tonnes

✓ In India - undu storage capacity

FCI - poor maintenance of storage facilities

↳ Even moisture-less rice will rot in godowns; sprout

✓ why rot on godowns? Why not sell free to poors?

↳ Traders got for free & sold back to Govt. @ MSP.

✓ Cold storages - 34 mn. tonnes - for short shelf life.

- Traders take for hoardings

- High cost

- Erratic power supply - spoiling prevention

210% items only get this facility

✓ Credit @ cheaper interest

✓ Negotiable
receipts.

2 tns
wharf

WDRA

3 lakh value - receipts.

↳ (Value in receipts) can be used as collateral in
bank + Interest subvention scheme.

Transportation:

↑ Cost.

- Roadways - Highest - max. done here only, however.

- Water ways - Lowest - not enough inland waterways

- TN - cotton - 50% of total gain

- but demand > production

- Gets from west african state
water way transport

Gujarat cotton
to T.N.
Roadway transport

- 2015-2016 → 62,000 Refrigerated vans required

↳ But we have only 9,000.

Value addition: - increase shelf life.

- Many foods wasted due to lack of this.

- Farmer not getting > 20-30% of consumer paid.

But milk farmers get > 70% of consumer paid.

Boots of co-operative societies;

value addition - skimmed milk powder - 6 months shelf life.

- Butter

- Ghee

- Panies

✓ Apples \Rightarrow sent to southern parts from north

Damaged apples (fell down one side dark)

can be used for jams, juices

✓ Tomatoes \Rightarrow pastes, ketchups

Backward linkages will hold value only when backed by Forward linkages.

Forward linkages

WAREHOUSING :

It plays important role as it prevent farmers from making DISTRESS SALE.

Problems include:

i) Under utilisation

ii) Poor maintenance

As India is the 2nd largest producer of horticulture, largest producer of milk, largest exporter of meat - specialised storage systems like cold storage are needed.

TRANSPORTATION:

- As against requirement of 62,000 REFER VANS, only 9,000 are flying on the roads.
- Also we need to reduce the cost of transportation by ensuring that Roadways, waterways and Railways are complementary to one another.
- Govt. has started a scheme SAMPADA that seeks to develop an efficient COLD CHAIN INFRASTRUCTURE & cut the supply chain of govt.

VALUE ADDITION:

- It can be any process or activity that increases the:

- i) Monetary value
- ii) shelf life of product

/ It can be grading, sorting, Processing, Packaging, etc.,

1].

4th feature of Indian Agriculture:

2].

* Most farmers in the country practice:

3].

Mixed Agriculture

A non-crop option along with crop cultivation.

⇒ the non-crop option is a source of additional income, provides nutritional support to farmer and family & also acts as a hedge during lean season.

Mixed Agriculture

→ Crop + Non
crop options

→ Crop + cattle
 \downarrow
Fodder \downarrow
Manure

Complementary

- wheat + cattle

- sugar cane + cattle

- Mustard + Agriculture

Bee boxes -

Help in
pollination.

5th feature:

Indian agriculture is SUBSISTENCE TYPE.

Farmers cultivate a small piece of land with help of family & little output is sold in the market.

[This is changing fast as farmers in country are taking to commercial crops or food crops are grown to sell in domestic / int'l market]. India is looking to occupy an

Multiple cropping

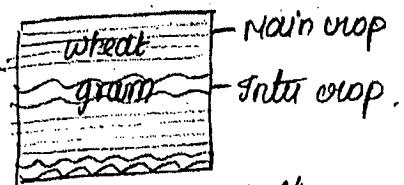
→ Two / more crop
in same field @

diff. season

→ Nutrient management
(otherwise lost
fertility)

- Rice - Khanif

- wheat - Rabi



→ Same time, same
field,

season, > 1 plants.

→ Complementary to
each other ; cultivated
after time gap.

wheat - takes nitrogen

gram - legume - fixes
nitrogen.

Mixed cropping (Intercropping)

Increased share in int'l market in agri commodities. It is evident in new Draft export policy for Agriculture,

- Contract Farming,
- Private procurement

PRODUCTIVITY

Method:

1) Yield / unit area (or) kg/hectare.

↓ in India compared with other countries.

India

Wheat = 32 = 8000 kg/ha - UK

Rice = 2500 = 6000 kg/ha - China

Cotton = 519 > 2000 kg/ha - Australia

(only cotton, not seed)

INDIA

WB says: Avg. yield of cereals: 2900 kg/ha (Paddy as measure)

ESI says: " " " : 2153 kg/ha (Rice as measure)

NORTH AMERICA

WB says: " " " : 7318 kg/ha

We are largest producers of:

Breed	INDIA	Tea	only because of High scale - large area
Native	3.8 kg/day	Milk	due to more no. of cattle & not productivity
Mixed	7-8 kg/day	Rice	under production
ISRAEL	56 kg/day		

Areas of high productivity: where,

use of good seeds, fertilizers, methods etc.

CHINA	INDIA	
~ 65 cm/year	~ 118 cm/year	- suitable for rice cultivation
~ 12% of TGA 105 M ha	~ 50% of total geo. area = > 160 M ha	
	per capita availability of Agricultural Land ↓	
0.0775 ha	0.129 ha	
Rice: 30 M ha - 65% irrigated	44 M ha - 52% irrigated	
- Better agric. infra	Though we have more per capita	
- Better forward & backward linkages	cultivable land, China still produces more than us.	due to

PUNJAB	Bihar
Aug. Ann. rainfall	65-80 cm
	110-150 cm - more suitable for Agri.
	Very fertile soil - low-lying areas - new sediments from middle ganga plain - flood enriches soil -
Rice	4400 kg/ha
	1530 kg/ha
	98% irrigated
	49% irrigated
	Contradiction Due to dev. of F & B. linkages

Grain	kg/ha
Rice	2500
Wheat	3200
Sorghum	889
Bajra	1311
Pulses	769

Low productivity of crops
from dry backward poor areas.

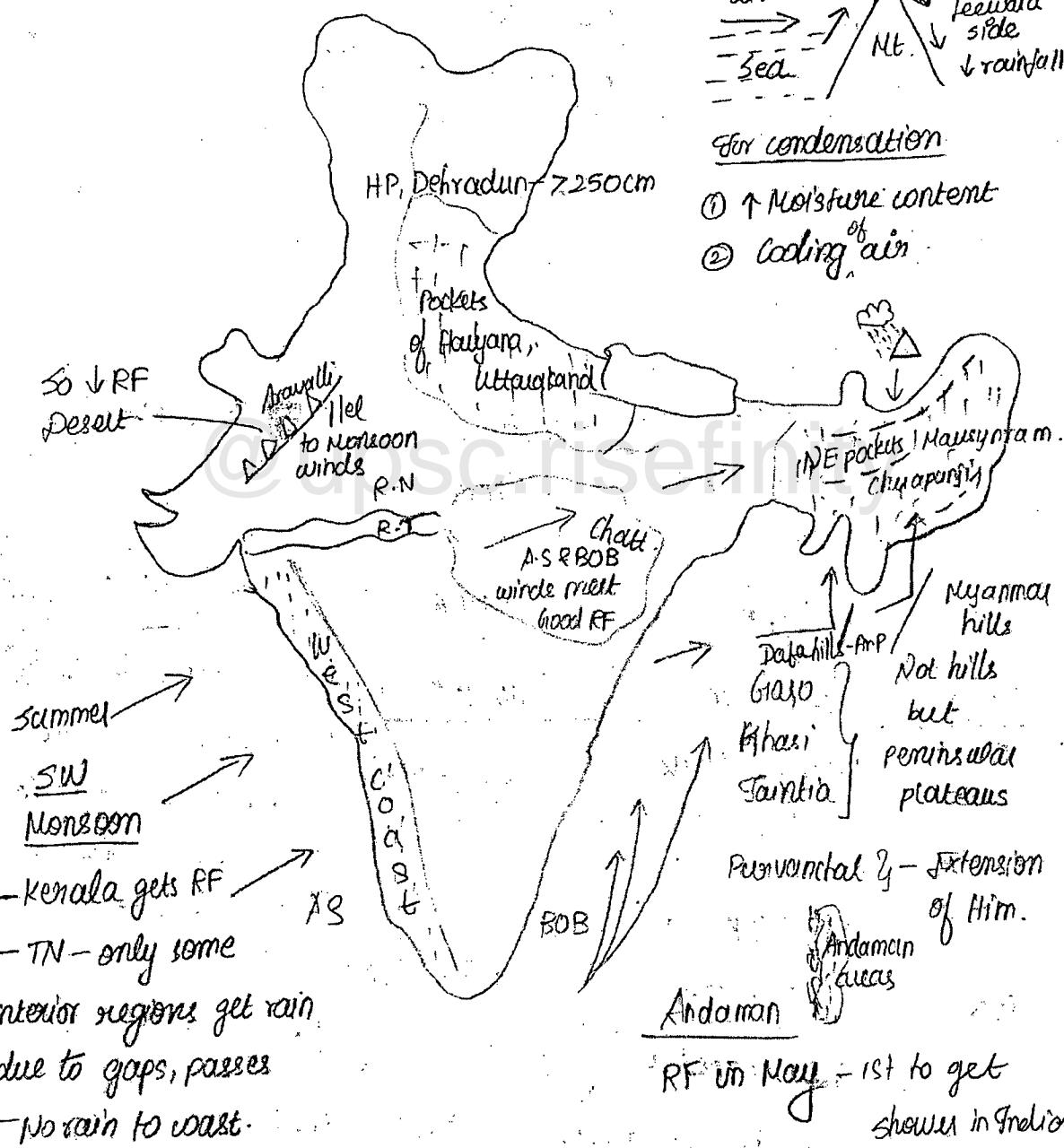
- warm air
- no cloud form

- OROGRAPHIC RF.
(more in India)



For condensation

- ① ↑ Moisture content
- ② Cooling of air



MORE RF

LESS RF

Inner parts of plateaus

- leeward side - Orographic RF

Eastern ghats - Dissected hills

- Reduced relief

Rajasthan, kutch

Jadakh, Leh

Cold desert

- far away from sea (moisture less area)

- ✓ Punjab
- ✓ Q/Haryana
- ✓ S.Belt
- ✓ West UP
- ✓ N. Rajasthan

Good productivity

① wheat cultivation + rice cultivation

↓
staple food.

Basmati endemic, but
other rice after G.R.

② cotton + ③ Sugarcane production

(currently)

(after G.R.)

TN

Canvey basin

- RF in winter - NE Monsoon

① RICE

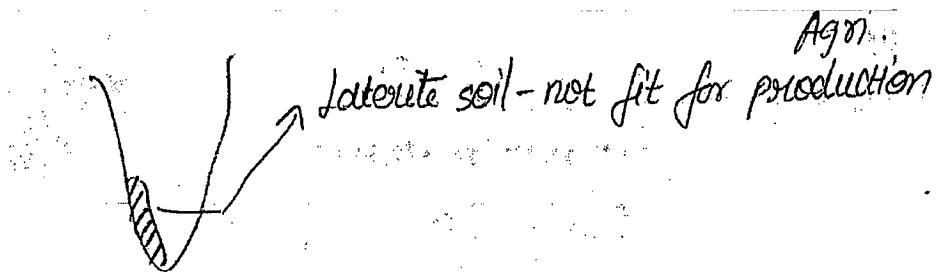
② COTTON

③ S. Cane

- High productivity

NE (Oct, Nov, Dec)
(winter)

RF →
due to
orientation
of coast



Coastal AP

Rice

Brackish water aquaculture - Mar. export of marine products
(Farm ponds into B.W. ponds) - Demand in abroad

Mangoes

Oil Palm - Leading producer of oil palm
(Fruits $\xrightarrow{\text{into}}$ palm oil) (Orang.)

- Endemic to equatorial Africa.

\downarrow
- daily rainfall & Good temp

200-300 lit/day - drip irrigation

MP

Fastest growing state Now

- phenomena in last 15 yrs.

wheat - Durum (hard variety - betta price)

Biscuits, pasta, bread)

Soyabean

Pulses (\uparrow production but not good productivity)

US $\xrightarrow{\text{Tax on China}}$ for soybean
 \downarrow import
Adv. for India.

BIHAR
Red gram

Marathwada
Sugarcane

GUJARAT
Green gram

TS & K
Horticulture

NASIK
Onions

Low Productivity

1 Marathwada

7 kutch — Salter part of sea, R. Indus

2 Telengana

8 Rayastan-sw — Rohi plain, Most fertile India

3 Royal Ganga

9 Ladakh — Snow, ↑ N, K, Phos

4 Bundelkhand

10 Himachal Mountain

↓
(MP+UP)
areas

acute water scarcity
(N. Raj- Sardar Ghandi

- Granite hills, Marble

→ Aggr by snow melt

canal

- Ken Betwa canal now

Zings of channels

↑ productivity)

Kulhs

5 NE Region except (Tripura, Lower Brahmaputra Valley, Assam Tea)

- Hills - no flat terrain

cherapunji

- Absence of F & B linkages

Drought area -

- Acute water scarcity

↓ drinking water

6 Plateau interiors (except

↑ RF but hill slopes

Telangana - best quality cotton areas

run away

Poor connectivity to dry land.

Land use pattern in India

- ① Net sown area ~ 47%.
- ② Current fallow ~ 4.5%.
- ③ Other fallow ~ 4%.
- ④ Cultivable wasteland ~ 4%.
- ⑤ Pastures ~ 3%.
- ⑥ Forest ~ 23%.
- ⑦ Non-Agri Land use ~ 13%.

Net sown area - 47% of TGA

- fit for cultivation + Also cultivated

Current fallow

- fit for cultivation + No cult. for 1 year

Other fallow

- f. f. cult + No cult. for > 1 yr but < 5 yrs

Cultivable wasteland

- f. f. cult + No cult. for > 5 yrs

Pastures

- Grasslands, grazings, meadows

Net sown

area
Not orchids,

Forest - 23%

free cultivation

coconuts

- Forest area + free cover outside forest area

any area under forest dep. (state) - even Grasslands if Govt says so

PRODUCTIVITY

- i) It is one of the methods to measure the performance of agriculture with kg/ha as the most common unit.
- ii) Productivity of crops & non crop option in India is low as compared to other countries like US, China, Australia etc..
- iii) The productivity patterns of countries in the world don't always reflect the controls of physiography & climate & are more closely related to development of forward & backward linkages.
- iv) As the population of the country is less likely to stabilize before 2050, there would be greater demand for food grains in near future. There is also a need to reduce the net sown area as land would be diverted for forest, pastures etc..

So, we need to OPTIMIZE PRODUCTIVITY and CROPPING INTENSITY (increasing them to those levels which can be supported for indefinite time)

- v) This is not difficult as the yield gap in most parts of country is very high (YIELD GAP is the % difference in the actual yield and potential yield)

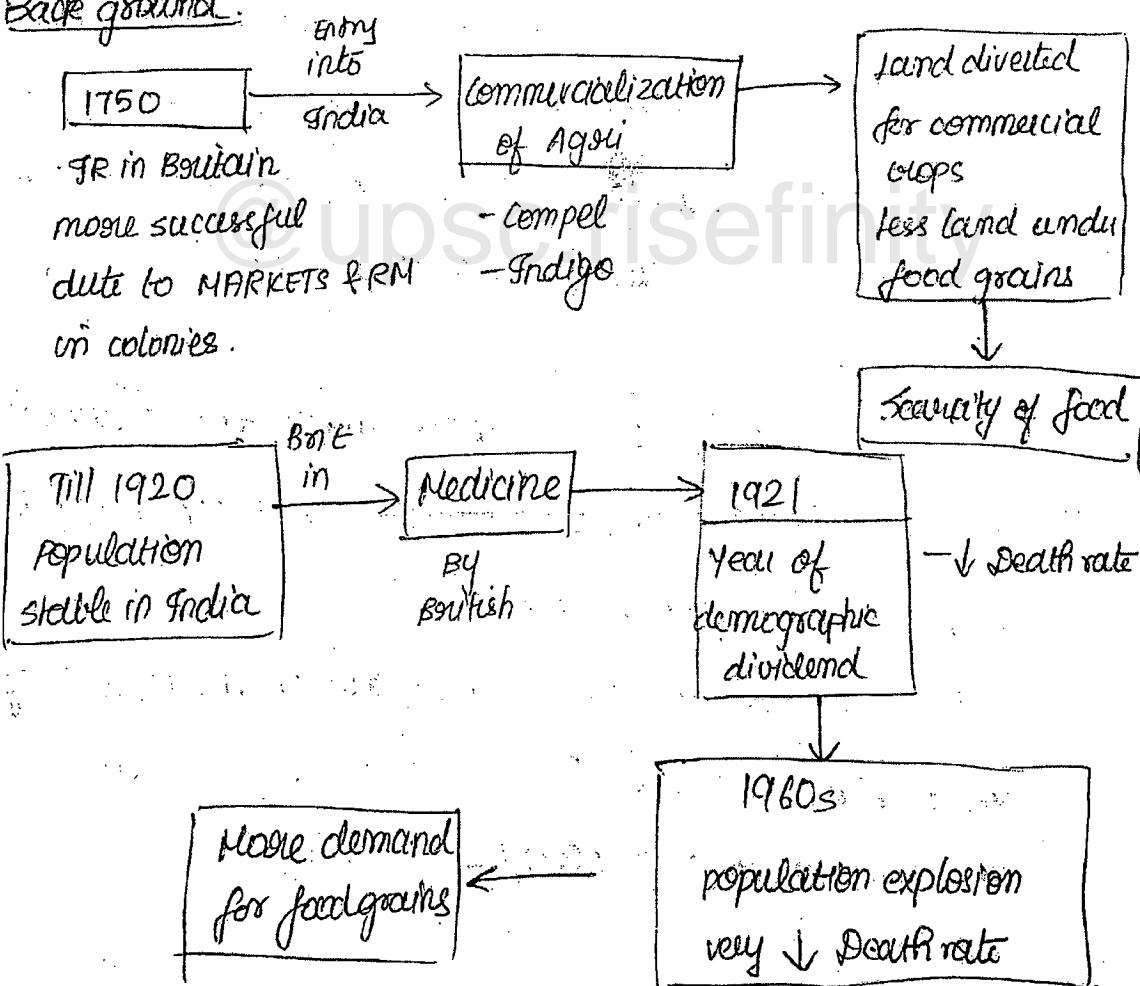
Conclusion:

The policy makers have also argued to take into account the WATER PRODUCTIVITY as India faces problems of water scarcity. Ex: Bihar might have less land productivity for rice but has a high water productivity

GREEN REVOLUTION

- ✓ Productivity } Revolution.
- ✓ Technological }

Background:



1st FYP	Focus on Agri production	Focus on Agri.	Net target
2nd FYP	Import substitution	Focus on Industries Neglected Agri	production didn't improve But met target

3rd FYP Very less Agri production (didn't meet target)

late 60s - Famine - No food grain availability

Required Grants from abroad
USSR couldn't help

Pakistan was close with US then
Nitritically base

PIA80 USA
Grains to feed pigs - they also sent weeds deliberately

We were in a situation to move towards self-sufficiency

But, there were SOCIAL MOVEMENTS all over

- Demanding wages, rights, } old social mov.
- better state of living standard - IR
- Better quality of life } New social mov.

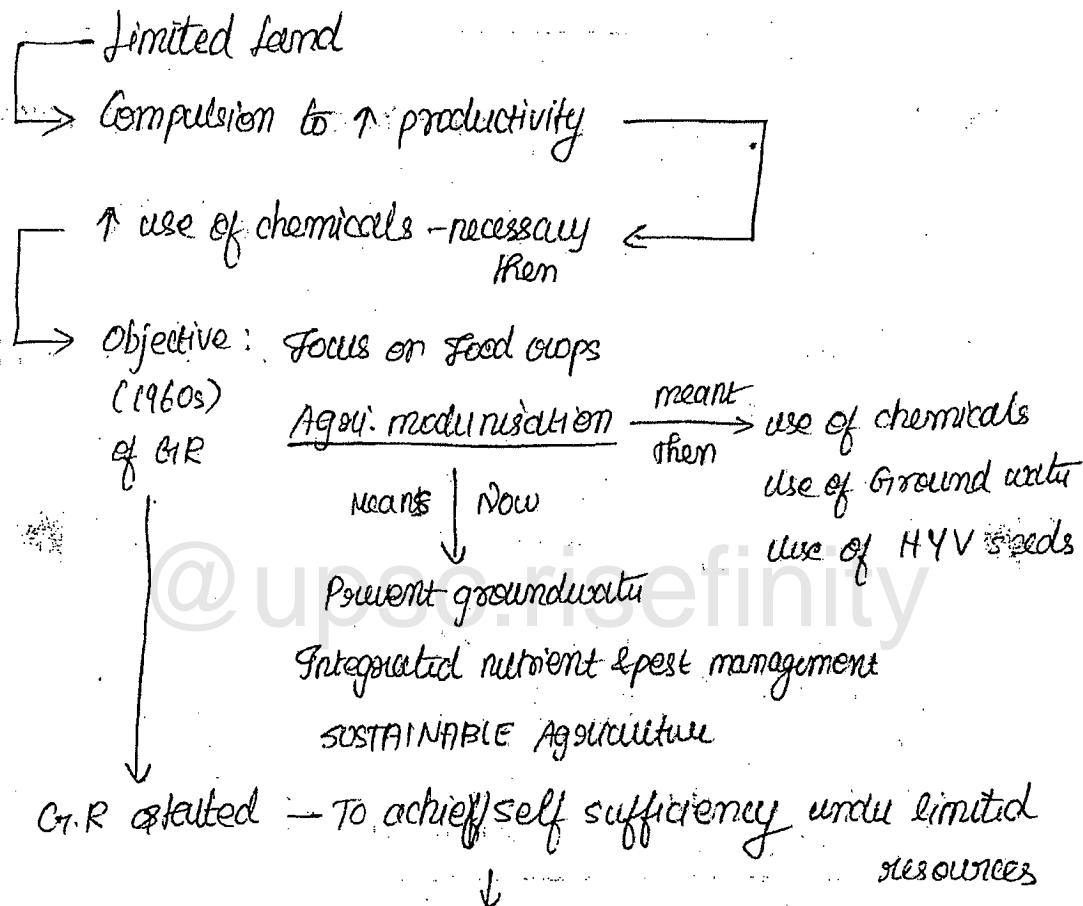
'Silent Spring' book - Toxic effects of DDT.

Norman Borlaugh:

"Food first, Environment Next"

West - Talked about env. & qual. of life bcos they were well-fed

India - But we were dying



1813 Chautu - IL for
education

"Trickle down
approach"

All money into more capable party
to give result in (first time) min.
possible time ⇒ "Trickle down approach"
Punjab, Haryana, Western UP

Non-agricultural land use

Desert; Barren land

Urban infra-land

Highways

Canals

Govt. says Forest must be increased from 23% $\xrightarrow{\text{To}}$ 33%.
From where land will come? ③ & ④

① Pastures \Rightarrow 3% $\xrightarrow{\text{To}}$ 4%.

- Bcos of \uparrow protein demand from animals
- Animals feed on pastures, so need to increase

② (Urban) Non-agricultural land use:

- Is increasing due to \uparrow urbanisation
- Land will increase under urban

But from where land? ① - No other option

But we also need to increase productivity - \uparrow population

Idea: Not to maximize productivity but OPTIMIZE
productivity

China & India - can't be compared

\uparrow
overuse of inputs } Env.hazards; Ecology problems
Depletion; unsustainable } ↓ Fertility

Optimize productivity $\xrightarrow{\text{means}}$ ↑ productivity without causing ecological problems - sustainable
(Land will lose fertility)

Yield gap:

claim under ideal conditions	-	Actual output
------------------------------------	---	------------------

[Ex. of automobile mileage]

YG

MH - 50 Y. - Towar

GJ - 47 Y. - cotton

UP - 25 Y. - sugarcane

From bridging yield gap

will give good results

	Land productivity	water productivity	
Punjab	4400 kg/ha	5300 L/kg 150 kg/ft ²	19 kg/lakh litre
Bihar	1530 kg/ha	7700 L/kg	56 kg/lakh litre

RICE

$$\text{Grossing intensity} = \frac{\text{Gross sown area}}{\text{Net sown area}} \times 100\%$$

$$\text{Need to optimize}$$

$$300\% = \frac{300}{100} \times 100 \quad \text{cultivated thrice in year (if)}$$

Now, In India - 141%. Not even 1.5 times

Why?

Rajasthan - 197%.

water scarcity - poor irrigation

sol:

- ✓ Irrigation
- ✓ Quick yield varieties - to cultivate every season

to ↑ Gross intensity

Why GR bypassed E-India inspite of fertile soil & fav. climate?

Deliberate imbalance based approach

Modernisation — ✓ Machines

- ✓ Chemical Fertilizers
- ✓ Chemical Pesticides
- ✓ Irrigation
- ✓ HYV

Avg. size of farm holding State

0.4 ha	Bihar	-
3.8 ha	Punjab	
1.15 ha	India	

Bihar — ↑ fragmentation due to ↑ population — not suitable for machines

Re — 97% under small & marginal farms (SMF)

Punjab — 34% under SMF

- ↓ fragmentation — suitable for machines
- Irrigation system in Punjab, PAK — TUBE WELL (MW)
- Hydro-elect from HP.

Bihar — chotanagpur plateau

Hooghly - Industries

More electricity to Industries

} No focus on Agrn.

Punjab — GR started with HYV wheat

- Naturally Punjab, Haryana, W.U.P.

AP } Coastal areas
 TN } Cauvery Basins - Next focus of G.R

- Better developed states.
- Again E-India bypassed.

G.R was successful:

PROs

- ✓ Now India is not only self sufficient but exports too.

1970 - 71

2017-18

Total food grain prod ⁿ	82 M tons	280 M tons
Rice prod	35 M tons	110 M tons

→ Less Agri land but productivity increased inspite of it.

wheat 11 M tons 100 M tons

Fert. usage 13.5 kg/ha 130 kg/ha

↑ Forward link } in Pun,
 ↑ Back link } in Hary,
 W.U.P.

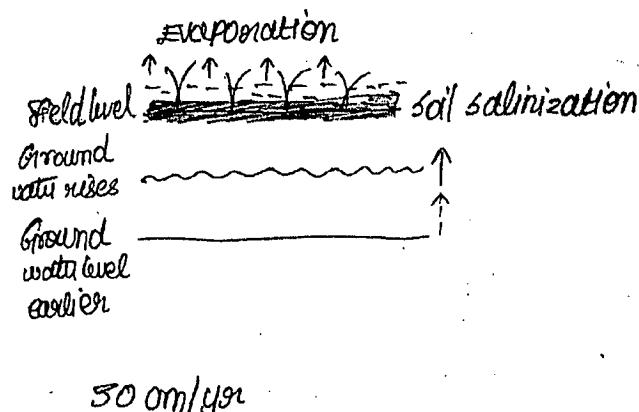
CONS ① Overuse of chemicals w/o considering Environment

→ Loss of soil fertility - Soil Salinization - Over Irrigation

Ex: Punjab - 60-75 cm rainfall - But once requires more water - Ground water extracted leaving back salt in soil, which was earlier diluted in water, due to Evaporation. ⇒ SAMBHAR LAKE

↓ Precipitation ↑ Evaporation
 ⇒ Salinization

RICE CULTIVATION



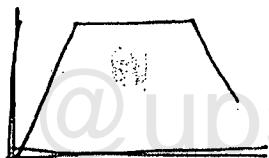
80-110 cm/yr \rightarrow Drip in ground water in Punjab

GROWTH RATE OF AGRI

1972-87 ~	5.8%
1987-2005 ~	3%
2005-2008 ~	1.3%

SOIL CONTAMINATION WATER CONTAMINATION

PUNJAB



Podium in ground water of Punjab \Rightarrow High cases of cancer

Subsidies are given by ⇝
Panjab Govt. for patients
"CANCER TRAIN" - free ticket.

② Nutritional Security

though we produce more crops (rice & wheat) which are major, we still suffer from Malnutrition bcs Rice & wheat production have increased @ the cost of Pulses & other crops (Millet... etc.) .

100/119 - om Hunger Index.

537 # 537.- women on premenopausal age are andemic

15% - Under nourished

INI # PM - 'Hidden Hunger'

Iron; Zinc; Deficiencies. are ↑ due to lack of pulses, millets, oilseeds etc.

	July 90'	2007
Pulses	12 mn tons	14 mn tons

Fov. of Edible oil are imported. ; MONOCULTURE

GIR was not a revolution of all crops but only rice, wheat, sugarcane.

③ Polarization & Backwash instead of Tickle down & Spread Effect.

GIR's strategy was 'Tickle Down' but it has not turned out successful.

DISPARITIES IN SOCIAL FRONT

Only Punjab; Haryana; Western UP; Kavery Basin; Coastal Andhra P.
(Eastern UP) (Rayalseema) (other parts of AP)

Regional disparities ↑ due to this → Social effects too arose.

'Rich' vs 'Poor'

GIR was a revolution only for Large & Medium Farmers but not small & micro farmers.

④ Main problem was not GIR per se but an improper understanding of GIR by policy makers & people too.

Farmers with a false sense of surplus pumped too much water

Today

'Evergreen Revolution' must be a 'Rainbow Revolution'

Blue R. - Fishes

Yellow R -

Pink R -

white R -

Focus must be also on Tribal regions.

Land reforms are crucial for Evergreen Rev.

both → Quantitative aspects - acquisition, fragmentation...
needed → qualitative aspects - soil salinization, fertility...

No proper land records with govt, hence DBT not properly implemented.

Modernisation of Agriculture must be understood as SUSTAINABLE AGRICULTURE

Ideas / Programmes under EVERGREEN REVOLUTION - Read.

Problems in GR

— GREEN REVOLUTION

* GR was started with following OBJECTIVES

- i) Solve the problems of Hunger.
- ii) Make India Self Reliant in Food Grain production.
- iii) Develop Forward & Backward Linkages.
- iv) Shift the focus back to Food Crops.
- v) Agriculture Modernisation

* STRATEGY:

With limited resources & urgency to deliver, GR was started in Punjab; Haryana; Western UP; Coastal AP; Cauvery Basin.

Rest of the areas were bypassed. It was a part of DELIBERATE INBALANCE STRATEGY, where it was assumed that once the areas of GR develop, the development will TRICKLE DOWN to other areas.

* EVALUATION:

- i) the Agri. production on the country increased with food grain production increasing from 82 Mn Tons (1970-71) to 280 Mn Tons (2017-18).
- ii) The production of RICE & WHEAT increased from 35 Mn t & 11 Mn t to 110 Mn t & 100 Mn t respectively in the same period (1971-2018).
- iii) Forward & Backward linkages were developed with Improvement in use of FERTILIZERS, CERTIFIED SEEDS, IRRIGATION, etc., A no. of RRB (Regional Rural Banks) also came up that provided cheap & easy CREDIT to farmers.

* Problems: But there are certain problems in Indian Agri. system today which can be traced to FAULTY Agri. PRACTICES taken up during the GR.

i) Overuse of CHEMICAL FERTILIZERS has CONTAMINATED GROUND WATER and SOIL HEALTH - problems of soil salinization, soil erosion can be traced to excessive use of chemicals.

Cultivation of WATER INTENSIVE CROP like Rice in Punjab, Haryana & Western UP has created load to the GROUND WATER DEPLETION.

- ii) The TRICKLE DOWN approach failed to deliver & the areas that were bypassed during GR are still the most underdeveloped Agri. regions.
- iii) Although production of RICE & WHEAT increased but it was at the cost of Pulses, Millets & Oil seeds.

IV) GIR did not bring equal benefits for RICH & POOR farmers.
The gap b/w them increased after GIR.

With shrinking Agri-land & increasing population
there is a need for 2nd GIR. It has to be a RAINBOW REV.
that focusses on all the Crops & Non-crop options. The 2nd AR
needs to be an EVER GREEN Revolution with focus on
SUSTAINABLE AGRICULTURE. X

SUGAR CANE (SC)

⇒ and most important cash crop after Cotton.

Tropical crop ⇒ Temp: 21-27°C required as optimum, but it
can withstand wide temperature but not for long.

⇒ World distribution - cultivated only within sub-tropical regions

Ex: Mexico; Cuba; Brazil (SA) - largest producer - 34%;

Africa - SA; Uganda; Tanzania; Mauritius;

Australia - one of highest yield;

SE Asia - Indonesia - largest in SE Asia but not major exported.

Thailand

Vietnam; Cambodia; Laos - recent boom

SOUTH ASIA - INDIA & PAKISTAN

↳ More sugar than required.

⇒ RF req. - for SC production 100-150 cm.

But SC is sensitive to amount of water supplied

↳ Too much - leads to ↓ sugar concentration but juice is more.

↳ Too less - leads to ↑ fibre but juice is less.

⇒ SC is an exhaustive crop - suck all nutrients from soil.

→ It is a mono crop - dense stands - not capable of multicropping after 3-4 months.

→ Maturing period 10-12 months

'Adzali' variety → In KR, MH → 16-18 months - August to Nov.

⇒ RATOON CROPPING Method

→ More buds in 'sets' are preferred.

→ No seed; crop itself is seed.

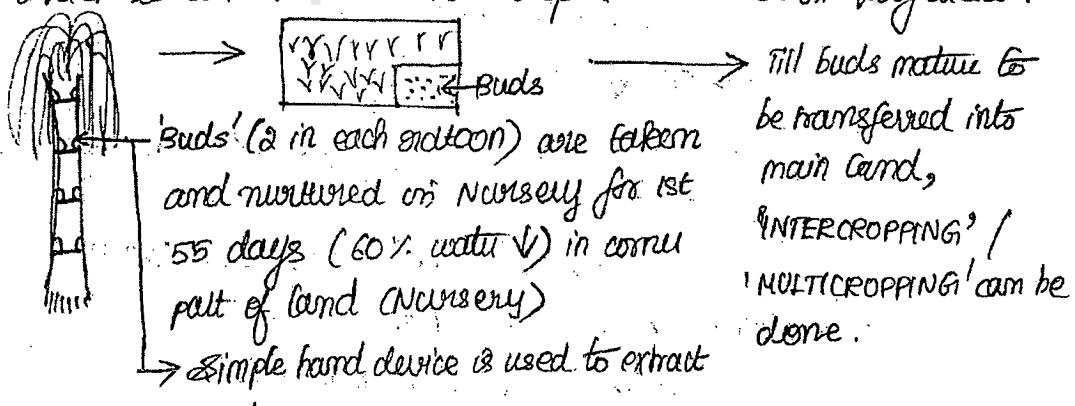
Benefits:

→ Saves seed crops' cost - seed cost, labour cost, time;

But the productivity / yield of each successive ratoon is less

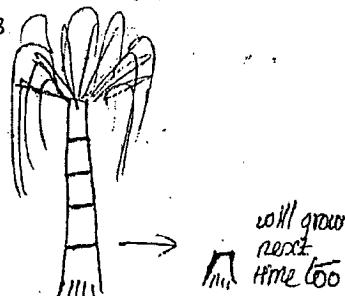
Sustainable sugar nutritive (SSI) / Bud Chip Technology of SC

Fruitfulness by farmers to reduce the water consumption of SC which is an intensive water crop & cultivated on dry areas.



→ Simple hand device is used to extract buds.

→ KR & MH uses Micro-irrigation for SSI.



Eastern UP - started SC very early in INDIA



Punjab → Haryana → Western UP



Peninsular India.

why?

✓ Fertilization & RF; [21-27°C] Temperature.

✓ Earlier these areas were under
INDIGO CULTIVATION.

INDIA HPP

[Germany's synthetic dye affected
Indian Indigo - Champaran
↳ hence farmers started SC]

✓ South India took to SC very
late as it was accustomed to
cotton cultivation (But pests,
losses were ↑ in cotton - hence,
given Fertilization south started SC)

① → 47% of total area of SC is
in UP (esp. more in W. UP)
"sugar belt of India"

→ yields in Punjab not so high ④ → Bihar

② → 20% in NH after W. UP ⑤ → Uttarakhand } sugar surplus state
(esp. southern NH) + Maharashtra → WB - no SC production but ↑ consumption

③ → KARNATAKA
↳ Belagavi - distinct character
of more sugar content
→ TN - Now facing drought.
2016 - Drought; 2017 - ↓ RF

⇒ Total area under SC - 5.04 Mn ha

MH; UP - area under cultivation different.

	% of area	% area
MH	20%	34%
UP	47%	34%

2015 - TN - 100 t/ha; → Better yield due to Tropical variety of SC.
- Punj - 60 t/ha.

→ Temperature → $21-27^{\circ}\text{C}$

→ Rainfall → 100-150 cm

→ It is sensitive to the volume of water & variation in RF amount impacts quality.

→ It is cultivated with RATOON CROPPING

→ SSI (Sustainable Sugarcane Initiative) is a method of cult. which saves water; seed crop & also enables intercropping on initial days.

→ SC matures in 10-12 months

→ ADSALI variety matures in 16-18 months

→ Areas of SC cultivation are:

▷ Western UP ▷ Maharashtra ▷ Karnataka

▷ Terai regions ▷ Bihar etc.
of UK.

→ the total area under SC is ~5 Mn ha

SUGAR INDUSTRY

→ Now facing crisis

↳ Can't pay to farmers & can't close without govt permission.

→ LOCATION

↳ Always near SC fields. why?

▷ Weight loss on raw material - so to achieve good RECOVERY RATE

↳ Only final sugar transported & not all the raw materials.

▷ SC has to be crushed within short time (24-48 hrs) or else

microbial action will lead to 'DEXTRAN' produced more which

will reduce the amount of juice in SC. EX: BRAZIL - very near to fields itself.

→ Animals can't spread SC > 20-30 km - via carts.

↳ 524 mills in India;

119 - UP (more area under SC but ↓ industries)

187 - MH (vice versa ")

→ Why SC in Peninsular India rising? (why move from North?)

① Tropical variety of SC

TN 100 t/ha Production Recovery Rate

↳ Higher yield, better 'Recovery Rate'. PT 60 t/ha 9.36%
(TN has 2 times yield than PT).

② 2014-2015 → NH (Highest SC)

since 2016 → [CO 0238] [Coimbatore 0238] in UP - Now the highest

↳ 80 ft height

↳ Rec. rate 10.8%

③ Crushing season in pen. India is longer — good for south India

▷ SC can't tolerate cold season - frost act - bad for North India.

Now; Dec - Mar. work for mills to get ready for wheat they hastily crush SC first.

③ \hookrightarrow No fixed market price. - In North

Market can't be searched after harvest since it needs to be crushed within 24-48 hrs.

In South, Better co-operative system.

Farmers are also owners of mills

\hookrightarrow profit share, market, price.

Mill owners req. regular supply of SC as industries can't negotiate in installments

\hookrightarrow As in South farmers are owners hence supply is ensured; but not so in North.

④ \hookrightarrow Late arrival of SC in South - New & better machinery

⑤ \hookrightarrow More area under SC in South.

Functioning of Sugarcane Mills

* NSP not possible in SC. why?

\hookrightarrow Delay involved - all nutrition will go within that.

* Solution? FRP (Fair & Remunerative Price)

\hookrightarrow 2017 - ₹ 255/quintal

for recovery rate of 10%

2018 - ₹ 275/quintal (FRP may \downarrow or \uparrow based on rec. rate)

* \hookrightarrow SC is politicised for vote bank.

Ex: BJP \uparrow FRP in KR as they lost last election

MH - FRP ~~not~~

UP - (FRP ~~not~~ SAP/State advised prices) - \uparrow cost for Mills in

(₹ 25) (₹ 15 Rs)

powering Raw Material



\uparrow Market price.

FRP - 275 Rs/Q
SAP (in UP) - 315 Rs/Q \rightarrow by 155. Rs/Q.; so UP farmers get more.

Mills don't pay full immediately.

Govt \rightarrow within 2 weeks in case of balance.

1996 rule \rightarrow If delayed from 2 weeks, 15% interest.

\rightarrow But mills don't get enough price/profit, so they don't pay the balance to farmers (only 200 out of 315 paid - 115 remain) leading to accumulating doubt.

Farmers require \circ FIXED PRICE & \downarrow Some Reservation Area
 \downarrow \circ FIXED MARKET.

UP \rightarrow officials will inspect CRAs & from farmers should sell SC only to that particular mill as told by officials.

Avg. yield is announced by Govt.

'SUPPLY TICKET' issued by Govt with Avg. yield & date to give.

Benefits:

\rightarrow Fixed market for farmers ✓

\rightarrow Regular supply for mills ✓

Disadvantages:

\rightarrow Excess quantity of SC > avg. yield - farmers find it diff to sell this.

\rightarrow But, more mills within closer areas is a problem as

none will get adequate supply. Solution? Min. Distance criteria

\rightarrow Farmers don't directly harvest SC, but mills do.

Location of Sugar Industry (SI):

- i) SI is always located near SC fields.
why?
 - a) SC is a weight lossing Raw material & locating Industry near SC fields saves Transport cost.
 - b) SC has to be crushed within 24 hrs of harvest.
Else Recovery Rate comes down.
- ii) Since last few years SI is getting concentrated towards PENINSULAR INDIA (SOUTH). The:
Reasons:
 - a) Pen. India cultivates TROPICAL VARIETY of SC fruit
has higher yield & better recovery rate.
 - b) Due to Moderate Winter Season, CRUSHING period in Pen. India is longer.
 - c) Sugar Mills (SM) work best under COOPERATIVE SECTOR.
Pen. India has better Co-op. culture
 - d) As mills have come to this region recently,
most of them have latest Tech that gives
better productivity.
 - e) SC has emerged as Alternative to COTTON which
is very much prone to Crop losses. so dry
areas with Irrigation provision have started
cultivating SC as it gives good returns.

—*—

Problems in Sugar Industry

→ SIs have to pay a lot to farmers.

Ex: 10,000 cr - MH SIs.

India - largest producer + largest consumer. But we needed more last year. Demand: 25 Mnt; Production: 20 Mnt - 2017.

So the SIs got good price. But in 2018, production is in surplus. Demand: 25 Mnt; Production: 32 Mnt - 7 Mnt surplus.

∴ prices ↓. SIs can't pay to farmers.

2017-18 : 5.04 Mn ha } Area of SC ↑
Now : 5.44 Mn ha

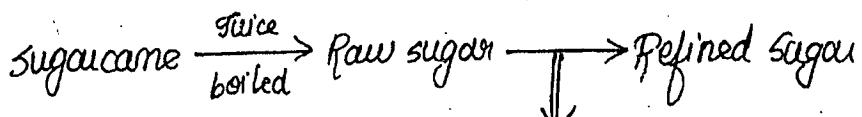
Season: OCT-MAY, so

2018-19 : production would ↑ to 35 Mnt - 10 Mnt surplus.

Indian cost: Rs. 35 } ours is not competitive

Brazilian cost: Rs. 25 }

Cost also links to crude oil cost. If crude oil cost ↑, SC ↑.



Can be converted into: ← MOLASSES

Indust. alcohol (Ethanol) \Rightarrow can be blended with Petrol & Diesel

Human alcohol

Raw sugar (100 kg)

90 kg sugar

10 kg Molasses

'C' Grade

80 kg sugar

30 kg Molasses

'B' Grade

Sugarcane

↓ directly

Ethanol

- 40 Rs/lit

If crude oil price ↑ → mixing of Ethanol → Demand for
with petrol ↑ Molasses ↑

Industries would
prefer Ethanol ←
production rather
from sugar production.

2015 - Crude oil price very high

But from, SHALE GAS rev. on US decreased crude oil price

→ May, 2015 - Crude oil price very low.

Brazil & Thailand were earlier focussing on Ethanol
But now, they are producing more sugar, hence the
sugar price in Int'l market is less = Rs. 25/kg.

MINIMUM INDICATIVE EXPORT QUOTA

20 Lakhs of sugar to be exported by Sept-end.

But industries were not keen, so recently Govt. has
extended date till Dec-end - 2018.

INCENTIVES

For every ton of export - Rs. 55 subsidy
of sugar

But this 55 Rs. has to be given to farmer & not own
operations.

CHINA doesn't allow Indian sugar import.

INDONESIA - demands reduction in duty of PALM OIL
for Indian import of sugar.

70% of oil import is palm oil & comes to India from
Indonesia & Malaysia.

So, Govt. can't find any external markets.

So, now Govt. is seeing to allow Grade molasses for
Ethanol production for Energy security.

Before 2018: No food grains for Energy production
But, BIO FUEL POLICY: Rotten food grains (rice, wh, pot, corn)
can be diverted for Energy.

Also, with falling rupee & ↑ crude oil prices, we
will have more drain of forex if we get more oil from oil.

So, Rotten food grains to Ethanol becomes advantageous.

'B' & 'C' grade Molasses ✓ → for Ethanol production.

So sugar production will ↓ → Better prices.

Govt now mandates atleast 10% blending of Ethanol with
fuels. But now only 4% blending. Why? Ethanol prod. not enough
So govt. now permits grains → Ethanol production.

But, Industries don't have tech to direct manuf. of Ethanol
from Sugarcane - requires Distilleries.

So, Loans - No interest 1st year; 2nd year onwards - 6%.

Qn is when not producing sugar, how STs would pay for farmers?

600 lt of ethanol = 1 ton of sugar.

Based on this, Recovery rate of sugar can be calculated & price can be given to farmers.

$$10t SC \xrightarrow{\downarrow} 1t sugar = \frac{R.R}{10\%}$$

600 lt of
ETHANOL

same

$RR = 10\%$

Now, India is set to become largest producer of sugar in 2019 surpassing BRAZIL (as Brazil is deviating to ethanol production due to ↑ crude oil price).

So now, Govt. realized incentivising for export is not working well this year - ↑ price for world; excess sug. production.

So, better price for 'B' grade molasses & direct ethanol from alcohol.

Before 2013, certain systems impacting STs.

⇒ LEVI SUGAR SYSTEM:

cost of production 35Rs/kg

retail cost 45Rs/kg

cost in PDS 15Rs/kg

If a sugar mill produces - 100 kg - atleast 10% @ a price lesser than cost of production to PDS - Govt. mandate this was recommended to be done away with. 2013 - gone ✓

→ REGULATED RELEASE MECHANISM:

SG

4 months → 12 months
(operation)
prod: 120 kg Dem: 120 kg.

But if 120 kg produce is released wholly, it will be surplus in market & prices would be down.

On every mill, a quota fixed - to release only certain kg in a particular month.

Mill A → Oct → 10 kg
Mill A → Nov → 20 kg
Mill A → Dec → 8 kg. } Prices would be controlled artificially ✓

But mills refused to this as they wanted to export as prices were ↑ in int'l market then.

Another problem is storage & maintenance.

In 2013: It was abolished.

But after 5 years gap:

→ 2018: It was brought back - for better market price.

Why? No scope for export - less prices in int'l market; Excess sugar prod.

→ Govt. has also taken susp. for maintenance of storage

Revenue for SI:

Not only sugar;

BUT Bagasse, Molasses, press mud also.

→ Outer bark / Fibre; Raw material for paper industry;

→ Source of Energy generation - SIs burn Bagasse & produce Electricity & sells surplus power to Govt.

MOLASSES

Ethanol.

PRESS MUD

Apart from clear juice & fibre.

Used as fertilizers.

U.P

N.P

Molasses → Rum man. unit

Earlier, strict restrictions for diverting Molasses to other states.

Complex process - Hence SIs didn't sell outside.

But after 2013: It was done away with

But, now with excess production, storage of Molasses is done by digging in ground - water contamination by Molasses.

20% of total sugar - To be packed in Jute Bags.

Disadv:

i) Cost of Jute bags ↑ than plastic & synthetic - COST OF PACKING

ii) Sugar is hygroscopic but Jute is not water proof, so

sugar becomes wet & moist. — QUALITY OF SUGAR

GOUT PACKAGE

Export subsidy

3mn buffer stock to be created + storage resp. by Gout.

Interest free loans

Flood policies + quota

BUT, STs opposed:

No capacity to crush SC this season.

UP:

Price to be given to farmers within

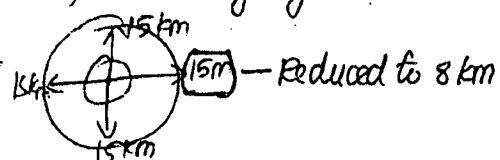
5000 ← 1000 - co-op
400 - pvt

white sugar 'kandsari' - 80% consumed in Rayastan.

> 1000 kandsari units; BUT { Last year - 2017
only 168 operated

Why? Last year, less production, majority SC given to sugar mills.

BUT this year; with excess production, UP is trying to
recover kandsari units. —



TN problem:

Drought like conditions → Since 2015, Reduce in SC production.

↓ Yield → also ↓ R.R. (due to ↓ water avail; ↓ Twice)

TN STs → Only 20% operation

↳ Burnish of SC.

@ duty free status

Demand: Allow Raw sugar import (less price than domestic)

But this would aff. domestic market, 100% duty on R. sugar import

If govt. allows, TN can produce sugar at low price, this would affect domestic market.

RANGARASAN PANEL

→ Abolish all govt. control.

→ Pricing formula: FRP - 275 Rs/Q; No SAP - 315 Rs/Q.

(As Naf. issue of SI is pricing)

But profit to be shared 70:30 with farmers within 14 days.

MAHA; KARN - following this now.

Gujarat - FRP in installments.

U.P - has not implemented it.

PROBLEMS

i) The pricing mechanism is far from straightforward.

Many state govt. announced SAP to please the farmers which increases the cost of sugar production.

[SAP in U.P in 2017 = 315 - 325 Rs/Q]

FRP " " = 255 Rs/Q]

→ Under SUGARCANE Control order, 1966:

Mills have to pay the amount within 14 days, else 15% interest/annum is levied.

→ High SAP increases C.O.P where mills are not able to pay to farmers. As a result the mills had to pay

around 23K Cr in May, 2018

- ii) Compulsory State packaging not only increases the cost of packaging but also impacts the quality of sugar.
- iii) The state govt. impose a no. of restrictions on movement of byproducts which are also a revenue source to sugar mills.
- iv) Against a demand of 25 Mnt, production in country stands at 32 Mnt. It is likely to increase to 35 Mnt in the next sugar year.
 - This has led to price crash.
 - Although, the govt has imposed MINIMUM INDICATIVE EXPORT QUOTA system, but mills are not very keen on exports as price of sugar in int'l market is very low.
 - The govt also gives a subsidy of Rs. 55/ton on export of sugar.
- v) → For the 1st time govt. has permitted to produce ETHANOL from 'B' grade molasses & has allowed DIVERSION of Sugarcane for Ethanol production.
 - This will improve the sugar prices & we would be able to meet the targets of ETHANOL BLENDING.
 - To incentivise the industries, govt. has also increased prices of Ethanol which is sold to Oil marketing companies.
 - Interest free loans have been announced for setting up Ethanol manufacturing units.

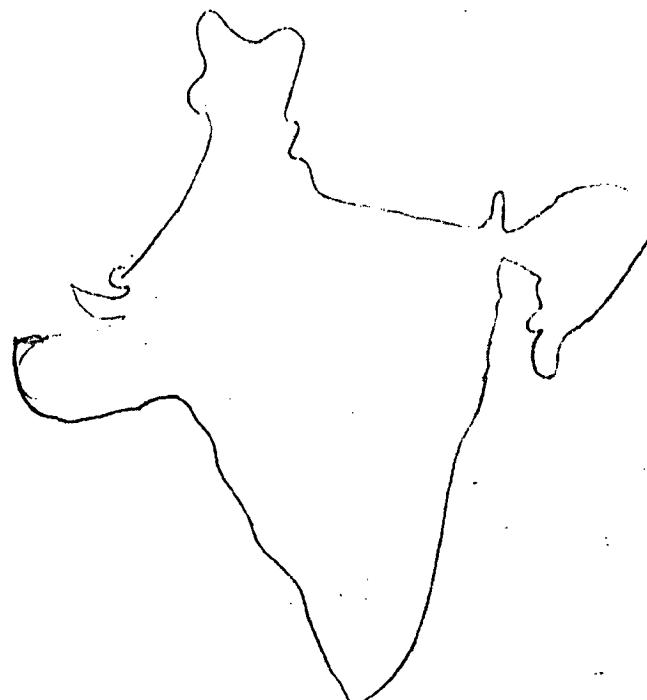
- v) After a gap of 5 years, govt. has reimposed REGULATED RELEASE MECHANISM with cost of storage borne by the Govt.
- vi) the mills in TN are working at 20% of their capacity due to reduced yield & less Recovery Rate.
- the RANGARAJAN PANEL ON sugar Sector Reforms had recommended to completely Deregulate the sugar Industry for sugar pricing. It gave a REVENUE SHARING FORMULA which has been implemented in peninsular states. —

— X —

@upsc.risefinity

TEA

- Tropical crop
 - Ideal temp: $20-30^{\circ}\text{C}$
 - Can't tolerate: $<10^{\circ}\text{C}$; $>35^{\circ}\text{C}$
 - ↳ Leaves $\downarrow \rightarrow \downarrow$ productivity $\rightarrow \downarrow$ quality.
 - ▷ Req. Heavy Rainfall: 150-300 cm
 - ▷ Req. more water but water must not stagnate.
 - ↳ Hence in slopy terrain - more cultivation
 - ↳ Soil required: with more permeability;
slightly acidic soil
 - shade-loving plant
 - ↳ Hence other shade trees planted amidst
 - Early plucking of leaves required
 - ↳ Hence req. ↑ labour force esp. women (tender work)



✓ ASSAM productivity: 2000 - 2500 kg/ha. - 150 Rs/kg

50% of total Tea esp. upper Assam + Dooar areas

✓ WB productivity: 1000 - 1400 kg/ha. - 540 Rs/kg

25% of total Tea

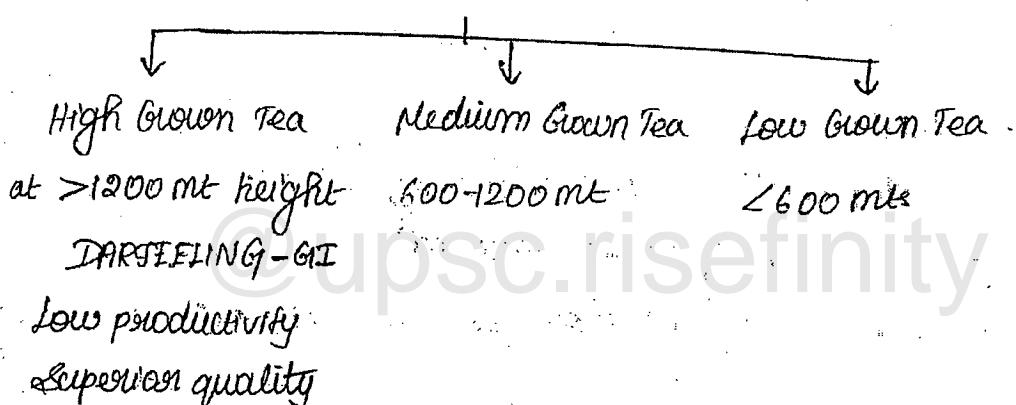
2 areas Hills - Dayi, Tal

Foothills (Dooar)

Door to Himalayas

Imp. for TIMBER & TEA

INDIAN TEA



DARJEELING

plantation dont operate throughout year.

But in March . . . ; not in corintu season.

✓ PENINSULAR INDIA

20 - 22% Tea

- In ③ KARNATAKA - Doorg
India ① TN - Nilgiris (Ooty)
② KERALA - Wayanad

Quality ↓; But ↑ productivity

✓ NW INDIA.

UTTARAKHAND : Dehradun, Almora - ↗ 5000 ha (but Assam - I)

HIM. PRADESH : Kangra (GI) tea garden)

↓ productivity; ↑ Quality

Britishers tried to cultivate tea all along India

But couldn't do much in upper shivaliks of UK, JK,
but were successful in WB region.

why? Temp & Rainfall unfavourable



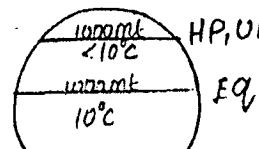
⇒ Effect of sea ✓ Near to sea - Moderate Temp

NE India (except higher reaches)

✗ continental - Extreme winter ($< 10^{\circ}\text{C}$)

HP; UK - only possible Tea in monsoon

⇒ LATITUDE



HP, UK: $< 10^{\circ}\text{C}$; WB: 10°C

⇒ WINDS, RF

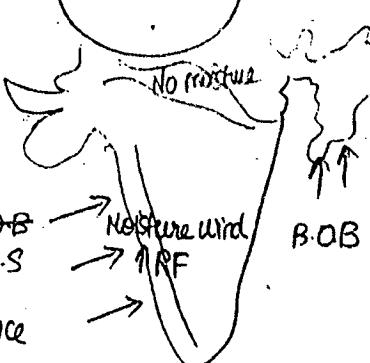
Not much

moisture

wind to

NW India. Hence

↓ RF. Hence ↓ Tea



KENYA, SRI LANKA

20Y.

Major exports

CHINA

ARG., JAPAN

INDIA

Largest area but not largest prod.

INDIA

CHINA

Higher latitude

5-6 months - only plucking season.

↑ productivity

why? → OLD CROPS

[50-80 yrs possible]

But good produ. only for 40 yrs]

Our tea crops - BOH-era.

→ Alkaline soil in Assam

Flyash from Bhutan cement plants settling in Ass. plains
Hence ↓ productivity recently.

2017 - 1250 mn kg

ESTATES

~ 66% [> 800 mn kg]

Large area

Own processing systems

Owned by corporates

Dif. brands of Tea from
one area for Marketing

SMALL TEA GROWERS

~ 33% [> 400 mn kg]

Small area

Dep. on nearby fact. bcs no
own processing systems

TN - 54%

WB - 40%

ASS - 27%

Coop. cutting exposure to tea
Faulkner, 85%. Tea, bolt now 86%.

why? Labour cost = 45-60%

due to PLANTATION LABOUR ACT

→ Social security benefits

(Housing; subsidized ration;
Blankets; Hospitals/Bills,
Groceries; school)

45-60%, yet Labouraunch

To avail these benefits, have to work for min. no. of days (280)

of 300 Rs/day & wage

→ 150 Rs - cash

→ 150 Ps - kind

Remaining days (-280 days),

they will work in nearby

waban centres - 400 Rs/day

esp. south - labour launch

↓ Export share for India despite largest area.
(7-8%)

why? Demand is for orthodox tea in world.

We produce CTC variety

what diff? Only in processing. Not in crop

Land holding: 2-20 ha

Dep. on BOUGHT LEAF FACTORIES (BLF)

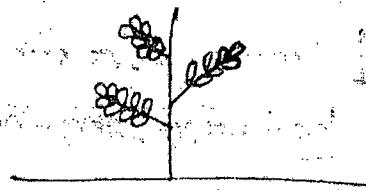
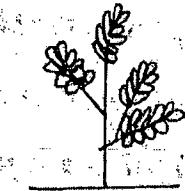
Arrangement b/w Fau & BLF,
mediated by Govt. via agreement.

Since past 6 years,

Auction price - $\downarrow = 150 \text{ Rs/kg}$

So, COP-↑ \downarrow fairness willing +
ACC-Pr-↓ demand M.S.P.

→ BLF + pesticides + other expenses .



Any Leaf - can use scissor

After dried - 24 to 30 hrs

then crushed in grinder

Stems sent to other fact.
(Incense...)

Crushed tea is sieved

then roasted

- very small; round

How to ↑ Orthodox tea prod?

↑ Per capita consumption - 660 gm

India

12.2 kg/yr

Paraguay

Uruguay

9 kg/yr

Turkey

7.6 kg/yr

→ Popularise Tea drink to Increase DOMESTIC DEMAND.

INDIA exports to RUSSIA → GERM → POL → UAE → IRAN

B'DESH ← PAK ←

IRAN:

29-30 mn kg Tea every year

But, now US sanctions.

Then we need to have agree. with Iran or

Route it via UAE (UAE & Iran have lot of agree)

this will ↑ cost to Iran

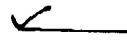
Kerala Floods

Wayanad prod. affected

NE India problems

Daijeeling - Gorkhaland issue - Tea fact. shut down during peak seasons

Recent bands & strikes.



TEA

Problems:

- ⇒ India has the LARGEST AREA under Tea cultivation but is not the largest producer of Tea.
The productivity is low due to:
Old Tea plantations
Productivity of tea gardens in ASSAM has declined due to fly ash deposition which has made soil ALKALINE.
- ⇒ Most of the corporate houses have cut down their exposure to Tea due to
High cost of production - max spent on labour
Labour shortage is also problem for most of these plantations
- ⇒ The small Tea growers are not able to make profits as:
Auction price of tea has been STAGNATED since long.
these cultivators who sell tea to BOUGHT LEAF FACTORIES are demanding:
MSP for tea.

- ⇒ India's share in Global Export of Tea is not commensurate to production as:
- Much of demand in world is for ORTHODOX TEA, while India produces largely the CTC VARIETY.
- ⇒ With Sanctions imposed on IRAN, which is a major market for Indian tea, we would have to route Tea through UAE which would increase the cost of Tea in Iran.
- ⇒ The Tea Industry faces problems related to BANDHS & STRIKES, LABOUR SHORTAGE, CLIMATE CHANGE, FLOODS - impacted Tea production in WAYANAD & IDUKKI etc...

Govt. Initiative:

The Government has recently approved a 400G PACKAGE for promotion & development of Tea.

It will focus on both UPSTREAM & DOWNSTREAM linkages of Tea.

(i.e) Forward & Backward linkages.

COTTON

Most imp. cash crop ~ Mass. area

Traditional centre for cotton.

Imp. area for cotton textiles.

Comfortable fabric for Indians

Dry & warm areas - optimum

Temp: 20-30°C

Winter season not suitable.

UKRAINE - Northern most Cotton producer in Europe

USA - one of major producers

Only in Southern states

AMERICAN CIVIL WAR → North vs South states.

Cotton req. more labour hence south required slavery.

AFRICA → Western African countries are important

Egypt - finest quality, great demand globally

'GIZA' cotton - long length of fibre (35 mm)

Note: QUALITY OF COTTON: Higher length of fibre - less joints, ↑ strength.

Thinner the thickness of fibre

S. Africa -

TURKEY - Turkey yields high

AUSTRALIA - Highest yield in the world.

ASIA → CHINA

PAK - Punjab province & Sindh province
(Punjab) (Gujarat)

→ very fine quality

NDIA - Largest / 2nd largest producer
Sub-tropical areas.

Rainfall \Rightarrow 75-100 cm

Less RF enough - Dry areas suitable.

Very sensitive to time of RF.

Requires moisture for sowing season.

No RF must be there during Bolls out.

DEST ATTACK \Rightarrow prone to it ; vulnerable

40-45% of total pesticides goes to cotton.

2015 - 90% white flies - Punjab

2017 - Ball worm -

TYPES OF SOIL \Rightarrow Rich in lime content very suitable.

Punjab, Haryana, MP, UP

Guj, Mah, Telangana

\rightarrow BLACK COTTON SOIL - ideally suitable

\rightarrow They have \checkmark RF hence this soil containing clay can hold huge moisture.

\rightarrow Access to irrigation facility, even though Alluvial soil

LABOUR FORCE \Rightarrow Huge required:

No mechanised plucking here as on AUS



cotton bolls don't mature at same time.

In west countries, if 60% bolls mature, farmer would spot-spray DEFOLIANT - to shed leaves & turns stem to brown. from a machine

goes & sucks only the white part.

But in INDIA - manual plucking

- 3 times in 1 season to pickup balls maturing at diff times.
- If left long balls would turn yellow.
- So cheap labour required
- Also labour req. for spraying pesticides

AREA under cotton \Rightarrow 2018 - increased; production ↑

Last year it was not good.

2015: 90% damaged due to WHITE FLY in Pun, Haryana

550 kg/ha - India

700 kg/ha - Punjab \Rightarrow 1200 kg/ha due to white fly

so in 2016, many in Pun. didn't cultivate

April - sow \rightarrow Oct - harvest

If not cotton, rice will be cultivated - needs more water

Research: Punjab under contract farming (Coca-cola)
produces KNO fruit - more prone to white fly cotton
near such fruit plants

wild bushes also reason

early sowing better to avoid flies

Farmers followed this & prod ↑

2018 - 798 kg/ha expected - Punjab

2018 - Good demand too.

CHINA - no. 1. in silk, cotton, synthetic fibres.

- But it demands more

- US usually supplies but now trade war - 25% duty

so India's cotton now competitive on China

Export depend on:

Value of domestic currency

→ now ₹ ↓, so good chance for exports

Guj : largest prod. in India

Mah : Second " "

2017 : Pink Boll worm in Guj, Mah

2018 : It was now contained, so good produce.

2017 : 108 lakh ha } Area of cotton in India

2018 : 122 lakh ha }

95% - BT cotton
area

Now, Illegal HT cotton (MONSANTO) also cultivated.

→ Mon. gave it for trials, then withdrew, but many companies illegally sell it now.

TN ; TEL - Cultivation season - Sow : Oct ; Harvest : April, March

RF : Oct, Nov, Dec.

(RF)

(Psy)

North India - Cultivation season - Sow : Apr ; Harvest : Oct.

TYPES OF COTTON

Long staple cotton : Fibre length (24-27 mm) - 55% area

Best quality cotton

Medium staple cotton : (20-24 mm) - 39% area

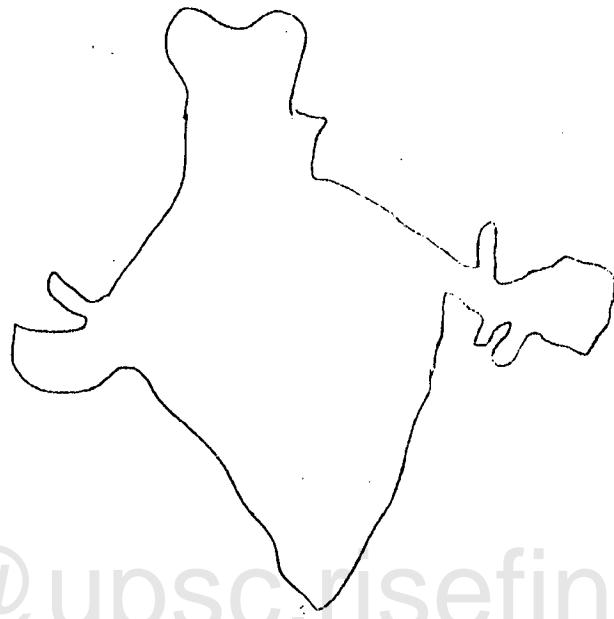
Short staple cotton : (< 20 mm) - 6% area.

QUALITY:

Best \Rightarrow Telangana

'SUVIN' variety - ^{Hybrid} cross of ST. VINCENT & SUSTATA.

\hookrightarrow Fleng ≈ 38 mm



@upscrisefinity

Traditional centres: GJ, MH, KA, TEL, TN

GJ: plains & sourashtra region.

MH: Vidarbha; Marathwada

TEL:

TN: Imp. producer but Demand $>$ production
of Raw cotton

North India (Recent):

HAR

PUN

N.RAS

W.U.P

INDIA.

Avg. yield - 550 kg/ha (Avg. wt. of fibre/ha)

AUS

2000 kg/ha

INDIA - 300 hybrids of BT cotton - 95% - ↓ yield

AUS - Open pollinating variety - few saved seeds - ↑ yield.
why?

Before 2002 arrival of BT cotton, 3 yrs trial period.

But now, 1 year trial period - not enough for quality check
low quality hybrid seeds

↳ Low harvest index - max. nutrient to stem & leaves
instead of bolls.

After cotton ball plucked, seeds → COTTON SEED OIL

Remaining
after oil extraction

Vanaspathi
↓
OIL CAKE

Nutritious fodder for cattle.

Note: GEAC (Gen. Engg. Approval Committee) has to give approval
for use of new variety of cotton.

last year

Note: USA - largest area under GM crops.

GUS: Groundnut
carianda

HT wheat - Tolerant to herbicides MONSANTO

'Roundup Ready' - Herbicide only kills off all other crops

Now found that it causes cancer.

INDIA - GM crops only after app. of Govt.

Monsanto withdraw HT application.

Illegally sold as 'ATM' by traders in GUJ & MH

COTTON

Temperature : 20-30°C

Cotton can't tolerate cold; Frost is harmful.

Rainfall : 75-100 cm

Cotton is sensitive to TIMING OF RF. [✓ Sow x Bolls out]

Labour Force:

Cotton cultivation & harvesting is not MECHANISED.

Plucking - 3 to 4 times in a season.

so, cheap labour is required.

Pest Attacks:

Cotton is VULNERABLE to pest attack.

Although, with BOLL GUARD II variety, the chances of
BALL WORM attack has come down, but greater instances of
PINK BALLWORM attack in peninsular India &
WHITE FLIES attack in Northern India.

Cultivation Time:

Cotton takes around 6 MONTHS to mature.

If market price & farmers would go for DOUBLE crops in 6 months.

Ex: 2017 - GUJARAT \Rightarrow Groundnut & cotton (3 mon each)

Cotton in India:

✓ GUJARAT ✓ MAHARASHTRA ✓ TELANGANA ✓ TN

▷ HARYANA ▷ PUNJAB ▷ M.P.

Soil Type:

BLACK SOILS are ideally suited as they are RICH IN LINE &
good MOISTURE HOLDING CAPACITY.

ALLUVIAL SOIL - in N-India as systems of IRRIGATION are present

COTTON TEXTILE INDUSTRY (CTI)

One of the very old industries.

~ 4% to National GDP;

~ 14% to Total Industrial production;

~ 14% to Forex (Export)

2nd largest sector for Employment after Agriculture

Traditional industry in India

India has been producer, market centre.

MUSLIN had great demand in ancient period.

Much on Handloom & Cottage.

Brit. intentionally

unseen tariff rates

Commercialisation of Agriculture

Cotton in Britain was controlled by India (premium status)

Very high import duty

Out of reach for middle class

Ppl were fined if wore Indian scarves in Britain

Brit. soldiers destroyed Handlooms

cut the thumb of weavers

Brit. dumped their produce

SWADESHI MOVEMENT

Revived CTI.

Symbolic importance

'CHARKA' - same for cotton textile & freedom struggle.

1st textile mill in India

1818 - Calcutta.

But didn't become successful.

1854 - Mumbai

1st successful cotton mill.

✓ Port facilities.

✓ Raw materials nearby [GUJ, SINDH, MH]

✓ Humid conditions (strength to fibre)

→ Artificial humidifiers in PUN, MP, etc..

✓ Labour enough available.

✓ Enough Capital & willingness

→ Parsi business ppl.

MIGRATION OF CII from MUMBAI

SC: 100 kg → 10 kg

Cotton: 10 kg → 10 kg - No ↑ or ↓ during processing.

→ pure raw material.

In irrespective of location of industry, the wt/gield of cotton after processing is same. So it is not necessary to locate industry at a certain place.

LABOUR / TRADE UNIONISM

Started in Mumbai. ↑ cost. ↓ Productivity in Industry

RAILWAY → MUMBAI - THANE

Easy to transport raw material.

AHMEDABAD & SURAT -

Mumbai port; Konkan port; GUJ - raw material; No trade
Tropical seasons ; GUJ - Business ppl. unionism

NORTH INDIA

Only 30 or 40 yrs in cotton.

But Mills have been true.

BANPUR - Manchester of N. India.

VARANASI - Skilled labour

- Handlooms famous

MODINAGAR - CTI

SAHARANPUR (U.P.)

M.P (Indore, Gwalior)

RAJASTHAN

AMRITSAR (P.J) - Good amount, quality, market,
prosperous region-capital.

SOUTH INDIA

TN - most important - $\geq 45\%$ yarn.

COIMBATORE - Manchester of S. India

NADURAI

TIRUPUR - Knitwear capital of India

CHINA CHENNAI -

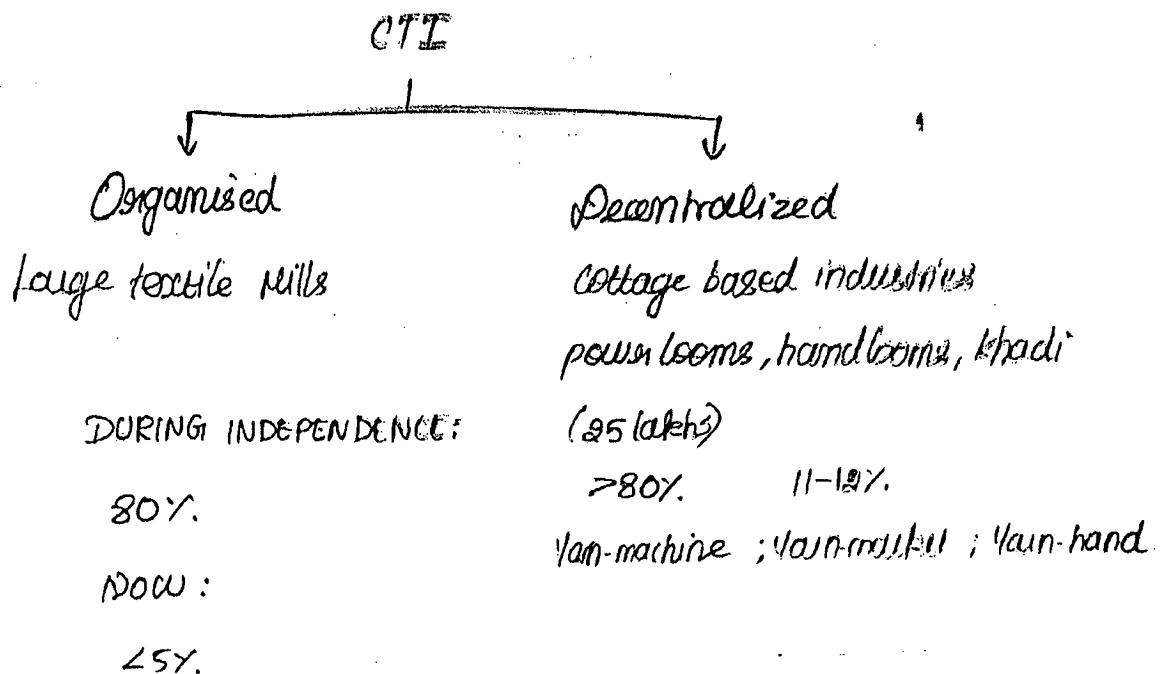
READYMADE GARMENTS

Largely market based

Based on assemblage of several materials

BANGALORE - most \otimes of readymade garments

GURGAON - \otimes of readymade garments



LOCATION OF CTI

- ⇒ Cotton is a PURE RENEW MATERIAL that doesn't gain/lose weight .
Hence Industry can be located anywhere b/w Market & R. H. C. centre
- ⇒ The 1st SUCCESSFUL COTTON MILL came up in MUMBAI in 1854 .
And over time, Mumbai became Most important centre for cotton Textile .
It had the following advantages :
 - ✓ Poor facilities
 - ✓ Humid conditions
 - ✓ Biggest market in W. India
 - ✓ Presence of GRS & MRSI business people
 - ✓ Proximity to cotton cultivating areas
- ⇒ Other important centres in MAHARASHTRA are :
 - PUNE DNGAPUR DOKRAJPUR DHANDE etc..

⇒ With penetration of RAILWAY NETWORK, migration of C.I. started.

AHMEDABAD & SURAT region became the 1ST DESTINATION.

It had all the advantages that Mumbai had with added benefit of CHEAPER LAND.

⇒ As cotton cultivation started late in N-India, most of

centres were market-based: Kanpur, Varanasi, Saharanpur;
Modinagar; Gwalior; Amritsar
Bhilwara; etc..

⇒ TAMIL NADU is the most important centre for YARN MANUFACTURING with areas like

COIMBATORE MADURAI TIRUPUR CHENNAI etc..

⇒ BANGLORE & GURGAON are important for H.A.F.T.
READYMADE GARMENTS as it is market based.

The industry in past few decades has moved towards the DECENTRALISED sectors with POWERLOOMS becoming most. The TEXTILE MILLS have problems related to:

Efficiency

Govt. control

Trade unionism etc..

Moreover, govt. also encourages Decentralisation of industries for BALANCED REGIONAL DEVELOPMENT.

Recently, MAH govt. has identified 115 TEHSILS which can be developed as centres for Textile Industries.

CTI & THEIR PROBLEMS

Less area under Long staple cotton, so ↓ quality.

Before partition, SINDH produced Long staple cotton

After partition, only Industries in INDIA, cul. area to PAK.

Indian raw cotton - not fetching enough price.

↳ Bcos we don't have BRAND VALUE

↳ Govt. fails now about Rating -

2nd position in Textile, but distant second - INDIA
Market share in Textile

CHINA ~36%

INDIA ~5%

BANG, VIET ~4.5%

We started very early in 1850s, but BANG - only after 1971
VIET - only at late 70s.

But their pace of growth is enormous - Exports

INDIA 5.47%

BAN, VIET 00%

Bang → 90% cotton - imported from India.

→ High density of pop → ↓ Labour price

→ Good USA & CHINA investment.

→ Avg. size of production unit ↑ here.

Avg - 80 machines - 150 ppl ⇒ INDIA

- 600 ppl ⇒ BANG

✓ Subsidies more in these countries. Ex: Electricity 35% cheaper.

PAK, VIETNAM, CAMBODIA, BANGLA. [LDC-least-Dev. Countries]

Duty free access to global markets

100 Rs $\xrightarrow{14.5\%}$ 115 Rs \Rightarrow INDIAN in USA

100 Rs $\xrightarrow{0\%}$ 100 Rs \Rightarrow BANGLA. in USA

India is largest producer of YARN.

Raw cotton (Fibre)
Yarn
Fabric
Garments

} We export all
FIBRE TO FABRIC/FASHION.

But, we have now excess yarn.

In last 5 years, 53% decline in Indian yarn in China

88% increase in Vietnam yarn in China.

↳ why? ✓ ↑ Chinese investment in Vietnam

✓ Duty - 3.5% for Indian yarn

- 0% for Vietnam yarn

✓ HANK YARN RESTRICTIONS

Handlooms - more employment. Hence req. subsidies

Rolled wool is Hank yarn - used in Handloom

Globt - 40% must come from Hank yarn

Only 10% industries - against this as it is benefit only to Handloom
they demand

(1988 \Rightarrow 36 lakh) No. of handlooms declined.

(2009 \Rightarrow 21 lakh)

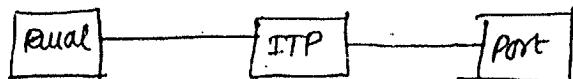
Taxes by Government

Cotton → Yarn → fabric
 Wash GST-5%
 Add starch variation is a problem on ITC (Input Tax Credit)
 chemicals - GST - 18% ITC is only given for 5%
 ↓
 → This is solved on August ⇒ Can claim all of tax - Govt.
 Govt. schemes

* Integrated Textile Parks (ITP)

Many companies → common infrastructure → ↓ cost of production
[Common skill-training centres,
utilities, etc..]

2018 | Out of 74 parks permitted, only 30 operating
data | Due to ↑ cost; Infrastructure not complementary



*A-TUFS - Amended TECHNOLOGY UPGRADATION FUND SCHEME

Scanned in 1999

Any machinery upgradation - Capital subsidy of 15%.

Amended on 2015

capital subsidy 15% \rightarrow 25%, only if it creates particular no.of-jobs [1 satk - 10 jobs etc..]

An other amendment in 2018

Can take loans from co-operative bank / society, earlier only CB.

Now, subsidy on spare parts, too @ 20%
accessories

Earlier, if TUFs allo availed, can't avail other SG schemes.

Now, can avail TUFs & other state schemes too.

* POWER TEX INDIA

25 latches ; 80% (60% exported)

Old machinery ; Decentralized (Ferratic power supply).

→ PN Credit scheme : Capital subsidy 10% (max. 1 Lakh)
for Tech & mach upgradation.

Interest subvention 6% / annum

→ Solar Power : solar panel at subsidised rate for
Installation.

* BUNKAR MITRA:

✓ Exclusively for Handlooms

✓ Helpline / call centres

* TECH MISSION ON TECHNICAL TEXTILES

Technical Textiles (Textile with specific purpose)

Geo-textiles - in soil erosion, roads, etc..

Centres for Excellence - 27 will be est for
R&D of Technical Textiles

* 6000 Cr PACKAGE

For developing CTI.

* RELAXATION OF LABOUR LAWS

8hrs per week overtime permitted

Multi Fibre Agreement:

As CHINA-US trade walls are going, India can use this opportunity. But before that we have to resolve our problems. USA imposed quota on every country on total cotton import.

In 2005 it was abolished, putting India back by BANG, PAK, VIETNAM.

But, China's cost of production ↑ now due to labour price ↑. So, next to China only India has full range FIBRE TO FASHION.

But now India is facing problem of REVERSE FDI.

PROBLEMS OF CTI

India has problems related to:

⇒ Scarcity of long staple cotton.

This has been a problem since partition when India lost Sindh which cultivated best quality cotton.

⇒ Indian cotton also doesn't:

→ Fetch high price in global market due to

✓ lack of grading, Branding & standardization.

⇒ Moreover, Raw cotton is not included under MERCHANDISED EXPORT FROM INDIA SCHEME (MEIS)

→ India faces a very tough competition from:

BANGLADESH

VIETNAM

CAMBODIA, etc.

These countries have low cost of production & they also enjoy DUTY FREE ACCESS to markets of EUROPE, USA & CHINA.

→ We have SURPLUS OF YARN in the country, bcos

↳ India's share in Chinese market - down to 50% in 5 yrs, while Vietnam's share in Chinese market - increased by 88% in 5 yrs.

↳ Indian yarn attracts a duty of 5%, Vietnam - 0% (duty free)

Trade deficit b/w INDIA & CHINA in textiles has increased.

We had :

2010-2014 - Trade surplus

Now - Trade deficit

China is DUMPING Textile products on India, for which India has recently imposed ↑ Import duty for 400 such products.

As China also sells its products through SL & BANGLA

with which India has FTA (Free Trade Agreement),

"RULES OF ORIGIN" have to be established.

⇒ Bcos of INVERTED DUTY STRUCTURE (specially in Man made Textiles), the companies could not claim ITC (Input Tax Credit) which resulted in loss for companies.

Recently Govt. has made amendment which would enable companies to claim ITC.

As cotton Textile Industry is one LARGEST EMPLOYER after Agriculture o 4% of GDP o 14% to total Export earnings, Govt. has announced certain schemes for Textile Industry.

GOV'T. SCHEMES

- # Amended TUFs
- # Technology Mission on Technical Textiles
- # Merchantile Export from India scheme (MEIS)
- # Power Tex India

IN NCERT

- | Look only for traditional problems
- | Don't see delta
- | - old delta .

COAL

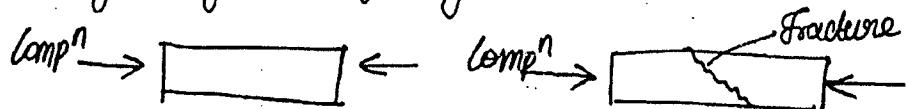
- ✓ Most important source of energy - electricity
- ✓ Total Installed capacity of power - 344 GW - 57% of it is coal.
- ✓ India - 4th largest reserves of coal - 315 Bn ton GSI, 2017
(upto depth of 1200 m)
- ✓ Imp. of raw material for steel industry (Smelting of Fe)

→ Result of anaerobic decomposition

→ Found in Hot & Humid conditions.

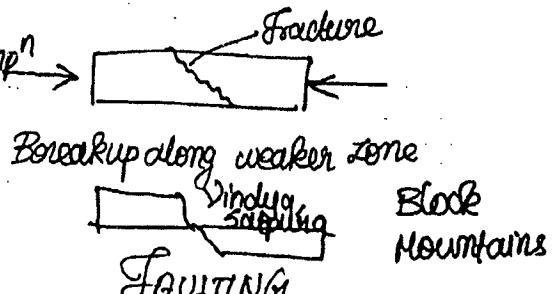
Associated with Vegetative matter.

~~Endogenous~~^{n/o} forces - foldings, mountains, etc..



Fold mountain
Himalayas

FOLDING

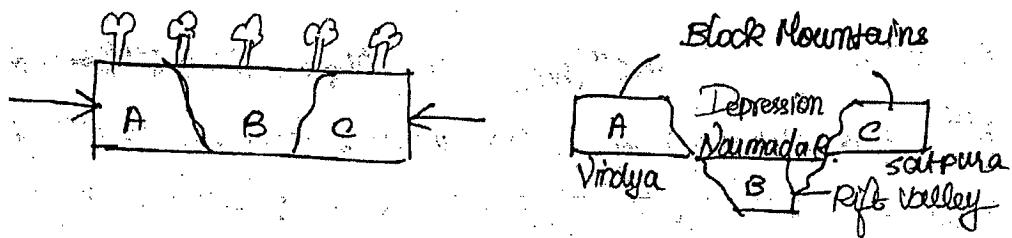


Breakup along weaker zone

Winding
Sapping

Block
Mountains

FAULTING



In presence of heat & water, good forces - Fissile.

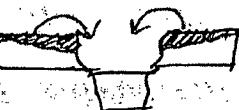
Rifting is a very slow process

→ Many excess die & mix with soil

→ Rain erodes A & C mountains

→ This eroded material settles on

rift valley upon vegetative matter.



This layer possesses it & absence of O₂ & heat from earth.

COAL → ANAEROBIC DECOMPOSITION in presence of Heat & water

Then why Import Coal?

AUS, INDONESIA, SA.
(49% of total)

Quality of coal in India not good.

↑ Must be more

① Depends on ~~carbon concentration~~ → Time, pressure, heat.

Indian coal is recent in time origin - Gondwana time period

It has less C conc. (200-250 mn years) ↑

But, Vegetative matter in AUS, USA

- 98% coal formed now -
699%

has been subjected to more heat & pressure over more time.

Avg. calorific value

Gondwana - 4500 kcal/kg

Other countries - 6500 kcal/kg.

Some in NE India, Rajasthan, Gujarat

⇒ TERTIARY COAL - 66 mn yrs - 26 mn yrs b/present
≤ 1% of total.

② MOISTURE CONCENTRATION - Must be less

Added during coal formation - part of molecular structure
& not that moisture added during washing.

Note: similar to Alumina vs Bauxite



Problem:

More energy used in evaporation

can't transport to long distance (> 1000 km)

→ Exposure to air - Breaking of coal - SLACK
problems to particulate matter

(small pieces of coal with air)

It also reduces calorific value

③ VOLATILE MATTER

Anything other than Carbon & moisture - impurities.

found during burning of coal - volatile matter.

Indian coal has HIGH ASH CONTENT - basic problem. 75%?

→ [35-45% in GIC] Si, Al, Fe, phosphorous.

∴ fly ash is mandated to be used in construction

SULPHUR CONTENT - Very low

→ [0.5% in GIC]

↑ Sulphur - unfit to use in steel & thermal power

[Damages Fe] [Pollution emitted]

SO_2

Tertiary coal

↑ Sulphur

↓ Ash

Gondwana Coal

↓ Sulphur

↑ Ash

Unfit to use in steel &

Thermal power plants

(Desulphurisation system for flue gas costly)

Fit?

PEAT

Youngest, softest, most inferior variety of coal

Carbon \Rightarrow 10-40%

FRIE AND: ↑ carbon in soil - fuel in industries after drying in sun.

Peat formed in conditions of WATER LOGGING

Swamps, Marshes, Bogs

Sundarbans Herbarious High elevation
Kerala plants Uttarakhand

BROWN COAL / LIGNITE

Harder, better than peat.

But, ↑ Moisture ($30\text{-}35\%$) \rightarrow ↓ Calorific value

\hookrightarrow can't transport to long distances.

BITUMINOUS COAL

Carbon \Rightarrow 40-80%

\rightarrow Sub-Bituminous - \downarrow Carbon - Much of Gondwana coal here

\rightarrow Coking Coal - \uparrow Carbon -

\hookrightarrow For making coke - raw material in S & Steel.

Coking coal - Steel Grade or Metallurgical grade.

↓ Ash (<18%)

↑ Carbon

vs

Thermal grade coal

↑ Ash (>18%)

Also referred to as MET COKE. It is diff. from PET COKE.

Pet coke - By product of crude oil.

Recently, banned if it has ↑ sulphur
import

'Bituminous' - Bitumen as end product

also byproduct of crude oil.

ANTHRACITE

Hardenest coal → Difficult to ignite, but once ignited - tremendous heat.
carbon ⇒ 95%. - Negligible moisture & volatile matter.

GRAPHITE

Carbon ⇒ 99%.

But costly, hence not used in power generation.

GSI - 315 Bntons ↘ 280 Bnt Non-coking

35 Bnt coking coal.

↳ so, much imposed.

Read

Yellow Book.
on coal deposits.

I. GONDWANA Coal COAL DEPOSITS IN INDIA

JHARKHAND

~ 26% of coal reserves

ODISHA — Thick jungles - animals ^(Elephant) migrated to Chattisgarh

790Y.

of
total

~ 25Y.

CHHATTISGARH — But when mining started here too - MAN-ANIMAL CONFLICT.

~ 18Y.

W.B. — 1st exploration 1774 in Ramigamji - Before that charcoal.

~ 10Y.

M.P. ~ 1951

9Y.

TELANGANA

~ 6-7Y.

① Jharkhand

R. Damodar divides Chotanagpur plateau into

Hazaribagh, Ranchi

Dhamtari - Thoarua coal field

Coking coal deposits

Gisudh — good coking coal.

Bokaro

Hazaribagh

Karampura — very \oplus .

stretches into

Palamu-Daltonganj coal fields

② M.P.

R. Son Valley coal.

Singrauli

Umari - Tributary of R.Son [Umri]

Along Chattisgadh border, Shahdol - Sohagpur coal fields
↳ Coking coal.

South M.P.:

Dindwara

↳ near to Kanchan & Ranch Valley coal

③ Chhattisgadh

Amarkantak plateau.

R. Narmada

R. Son

R. Hazarou → flows into Chhattisgadh.

Korba

Surguja - Shilmil } Coking coal deposits

Korba - Chisumiri }

④ Odisha

Talcher

Bundergarh

Associated with IB valley - Rich coal

Tributary of R. Mahanadi

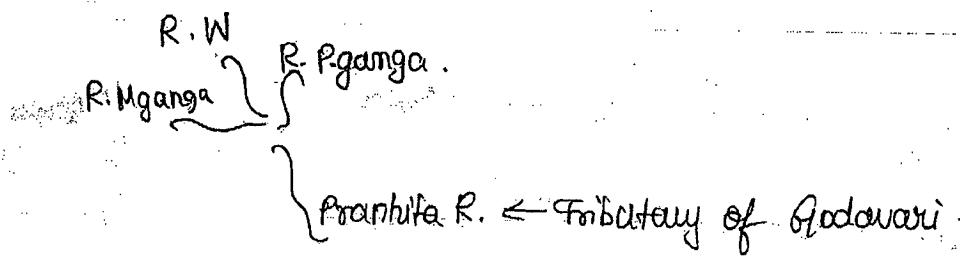
⑤ Maharashtra

Vidarbha - very rich resources

Fe ~~ore~~ ore

Limestone

R. Wardha Valley coal → It meets P. Ganga & N. Ganga river



④ Telangana

Singareni

II. TERtiARY COAL ($\uparrow S, V Ash$)

ASSAM \rightarrow Makum

AR-PRADESH \rightarrow Narmphuk - Narmchik

MEGHALAYA \rightarrow Mawlong - Cherrapunji

PARTASTAN \rightarrow Palana (near Bikaner)

GUJARAT \rightarrow Umarsar (in Kutch region)

III. LIGNITE Deposits

TN \rightarrow Neyveli

IV. PEAT Deposits

KERALA \rightarrow Karou soil regions (coastal, swampy)

W.B. \rightarrow Delta regions of Hoogli river

V. ANTHRACITE deposits

J&K \rightarrow Kalakode valley

But can't be mined - sensitive area

PROBLEMS OF COAL MINING

- ✓ Deforestation
- ✓ Air & water pollution

⇒ OPEN CAST MINING:

Coal @ shallow depth.

30 ft ↑ ~~mining area~~ mud & sand.
coal seam

Over Burden removal → Drilling & Blasting → Must coal washing

✗ Deforestation - major problem
+

✗ Habitat loss

✗ Air pollution - also due to long dist. transportation.

↳ Drilling - coal dust - particulate matter

Gout → Use sprinklers to absorb dust to ground.

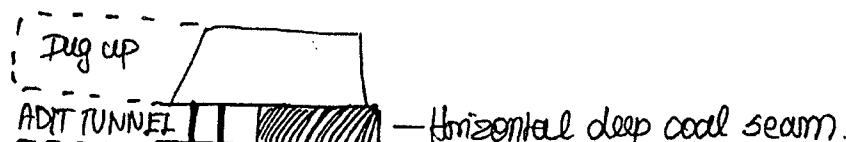
Recently Odisha - mining suspended due to no sprinklers + No sludge treatment plant

✗ ACID MINE DRAINAGE ←

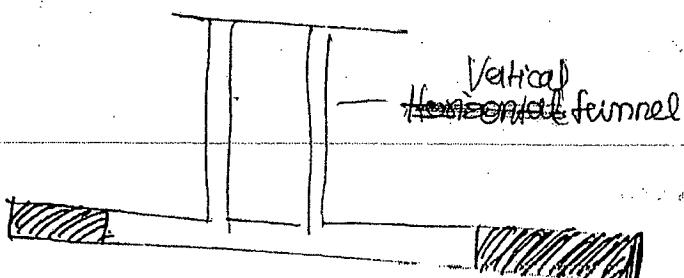
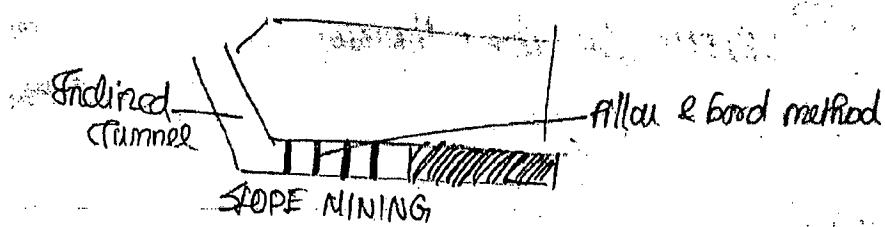
↓ caused by sludge ← sprinklers
washing

⇒ ✗ UNDERGROUND MINING:

Coal @ deep ht.



Adit mining



SHAFT MINING (or) Gallery mining

Problem:

Here, no deforestation problem. But,

at deep hts. Ground water present - need to remove it

But companies don't do it \leftarrow filter before releasing it

Ex.: R. Godavari - flooded with polluted water

80%	20%	reserved for captive mining
a Coal India Ltd (+ 8-9 subsidiaries) Singareni Collieries		

i) ~~fuel supply~~ fuel agreement \Rightarrow TATA-CIL

\rightarrow allocation of (a) block - price based on grading

\rightarrow If CIL is not able to provide agreed coal, it has to impose & give.

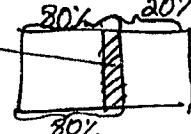
ii) If FSA is not good for private, it can go for Captive mining.

Under very strict govt. restrictions.

→ can mine - not sold in market - only to CIL-notified price
in case of excess of own operations.

1973 - Nationalisation of local mines

2017 - commercial mining



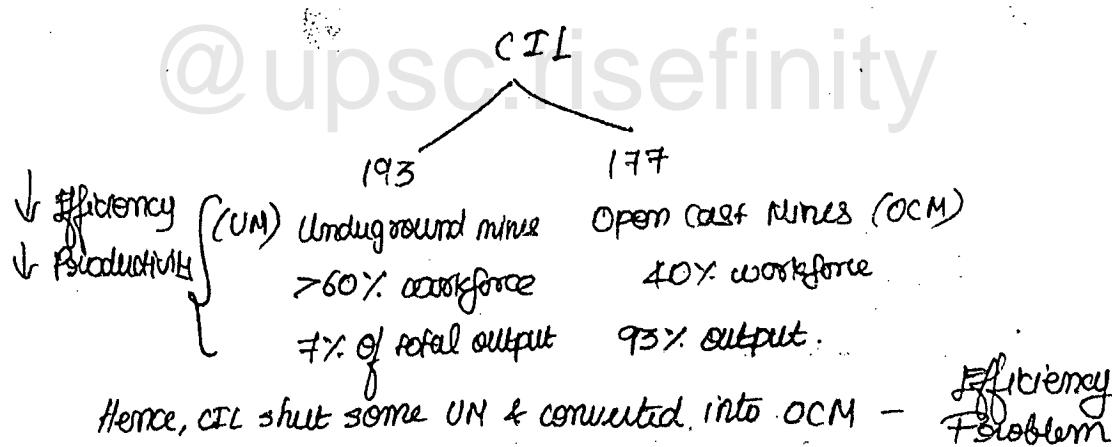
→ So in 2018, 87 companies auctioned w/o strict end use restrictions.

why? CIL not able to mine all coal.

To prevent captive mining - ?

Pandey-Sinha Committee.

95% of captive mining must be given to miners (not implemented)



Productive Measure:

ONS Output per Man shift - output in t/hrs by Indian worker.

OCM { INDIA - 16 t/ONS
USA - 69 t/ONS
AUS - 76 t/ONS.

UM { INDIA - 0.73 t/ONS
AUS - 40 t/ONS
World avg - 8 t/ONS.

Y less? Technique of Mining - Very Old.

UM { ✓ PILLAR & BORD Method - Pillars used to support roof
✓ PILLAR & ROOM Method. - wastage of coal in form of pillar.

⇒ LONG WALL MINING METHOD

No pillars.

Hydraulic support used instead.

Condition: Coal seam must be contiguous (w/o fracture).

In India, we have many contiguous coal seam but we are not updated.

ILLEGAL MINING Problem

- Natural resource
- Royalty to govt. → Revenue for welfare of ppl.

⇒ Report: Parliamentary Committee on Coal

2012 → 20% not reported mining

* Social problems

NE India: HAT HOLE MINING

NGT banned it in 2014; But ppl protested for livelihood;
so, need alternate source of livelihood for them.

* Coal Bed Methane problem

Rice → Methane (water in field, anaerobic decompr)

2. Methane on coal seam.

Calorific value - 8500 kcal/kg for CBM \approx Natural gas.

Sweet gas ($\text{No H}_2\text{S}$ - pungent smell)

No need filtration - directly into pipeline.

We have 62 Trillion cubic feet of CBM in India.

Only 1% of total natural gas production

Problem of exploration.

- Y need to explore CBM
- 1. CH_4 is GHG.
 - 2. Useful resource wastage.
 - 3. UM only in CBM. If not mined, more concentration.
 - 4. ↑ CBM is hazardous for workers.
 - 5. Fires in coal mine + easy spreading.
Ex: Shaubak coal fields.

* Quality problem:

Import need - Fluctuating prices — drain of forex.
Coking coal

Soln: (to reduce import):

◦ Coal Blending/Mixing:

High grade + semi-grade coal.

* Calorific value problem: can be increased by washing.

* Not enough wash houses - even stolen from storage.

* Coal dust from sprinklers \rightarrow can't be transported.

\rightarrow can do COAL BRICKETING

CIL Vs. NTPC issue.

Poor grading system.

Coal controller came in for grading 3rd party?

After 2017 - downgraded > 100 mines of CIL.

Labour health problem

2nd most hazardous after SHIP-BREAKING

Kinetics lung

Accidents - non compliance to safety procedures ex: Shuklaphanta

No proper regular health checkup. 20 dead.

CGI report - only 8% workers given this.

Procedures before shutting down

Landfilling in case of OCM - for rehabilitation.

Sanfilling in case of UM - to prevent land subsidence
& land degradation.

But most companies flout these rules.

PROBLEMS OF COAL MINING

Environmental problems:

Open cast mining (OCM) creates problems of COAL DUST, which POLLUTES AIR.

Coal dust is also a problem if thermal power plants are not located at pitheads. — (?)

OCM leads to DEFORESTATION that results in HABITAT LOSS.

ACID MINE DRAINAGE contaminates ground & surface water systems.

Illegal Mining

Parliamentary Standing Committee on Coal & Steel, 2012 reported that Actual production of coal is 80% more than what is reported to the government.

Coal Bed Methane (CBM)

CBM is a gas that is ^{adsorbed} adsorbed by coal seam during process of COALIFICATION.

It is known as SWEET GAS & has ↑ Calorific Value.

Although we have estimated reserves of around 62 TCF, but CBM makes up only 1% of total gas production in India.

If not exploited:

- a) useful source of energy gets wasted.
- b) CH_4 escapes into atmosphere — ↑ conc. of GHGs.
- c) Workers face health hazard if mines have ↑ CBM conc.

d) It is one of the reasons for fire on coal mines

Coal Quality

Gondwana Coal (G1C) has high Ash content. Hence, low calorific value.

We have to import METALLURGICAL GRADE COAL & the coal prices fluctuate a lot.

So, COAL BLENDING / MIXING can help us reduce the imports.

Coal quality can be improved by COAL WASHING & coal dust can be utilised by COAL BRICKETTING.

[Coal controller has downgraded a no. of mines operated by CIL & its subsidiaries after 3rd party verification was introduced]

Labour Safety & Health

A CAGI Report, 2010 highlighted:

Only 8% of workers given regular health checkup against the mandated 100%.

Also, cause of concern is Non-compliance to Safety procedures that results in accidents in coal mines.

Mine Closure

Some standard procedures are to be followed -

> Land filling - Open cast mines

> Land filling - underground mines

- before a mine is shut down

If these resources are exploited, we have problems like
LAND DEGRADATION & LAND SUBSIDENCE.

Recent development:

With an increase in demand of coal, Govt in [2017], opened up some blocks for Commercial Mining w/o any End-use restrictions. Mining rights would be given via FORWARD AUCTION.

Forward Auction

Mining rights can be given to [captive mining]

▷ Steel

▷ Cement

▷ Thermal power

CIL	①
SCCL	

2014: Coal Gate - Mining rights arbitrarily given.

→ SC cancelled those rights & gave this new procedure.

Forward Auctioning Bids in closed envelopes. } for Steel & Cement companies
Floor prices decided by CIL. } Highest bidder gets contract.

Reverse auctioning A $\xrightarrow{\text{PPA}}$ B \longrightarrow customer (PPL) } for Power companies
₹8.5/unit - Revisable } Lowest bidder gets contract

* PPA - Power purchase Agreements

When SC cancelled Rights - Bank loans stagnant
Power costs.

So, Govt. auctioning = SHAKTHI [scheme for Harnessing and Allocating Coal Transporting in India]

→ For companies with X Mining rights; ✓ PPA

Urdu shakti: contract would be given to company giving highest discount on agreed price in PPA (& not → Open auction - Reverse auction: *lowest price per se*)

Study Yellow
book for
Next class

IRON & STEEL INDUSTRY

and most important

2% to GDP

5 lakh - Direct

80 lakh - Indirect

One of 8 core industries

Output of this sector becomes input for many sectors.

Infrastructure - Reinforcements

Manufacturing - Machines

Automobiles - Flat steel

Agriculture - Equipments

Malleable, Ductile

(sheets) (wire)

↑ strength + ↑ elasticity.

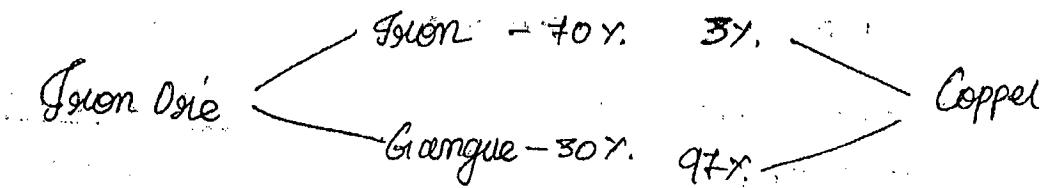
Much less price than other metals with similar properties

Cu - 5 to 6 times >

Tin - 10 times >

Fe - abundant in earth crust → O₂ - couples - Fe, Si, Al

Fe (5% of earth crust)



Copper — not even 6-7%, that too now exhausted.
Now as low as 2-7%, Cu & 97% impurities

Alloyability — of steel

○ Turbine — strong, anticorrosive

Steel + Nickel ↑

Springs — strength, elasticity

Steel + Vanadium ↑

In elec. industries — malleable magnetic

Steel + Cobalt ↑

Stainless steel

Steel + chromium

Strength of steel — change wif carbon.

0.4% — twice strength

1% — thrice strength

2% — many times strong, but brittle

Pig iron — hard, brittle — 4 to 5% carbon

No. of inputs — H_2O , Si, Iron ore, etc..

USA

Pennsylvania

West Virginia

Yellow Book

EUROPE

England

Important Ores

MAGNETITE (Fe_3O_4)

- Igneous deposit of iron
- Black in colour
- Excellent magnetic properties
- 40% Iron content - Richest Ore

HAEMETITE (Fe_2O_3)

- Sedimentary deposit of iron
- Reddish in colour (Oxide)
- Commercially most imp. ore of iron
(most areas this is source of iron)
- 55 to 65% approx.

LIMONITE ($Fe_2O_3 \cdot H_2O$)

- Sedimentary deposit of iron
- 40 to 50% iron con.
- Brownish

SIDERITE (Fe CO_3)

- carbonate form of Iron
- sedimentary deposit of Iron
- 30% conc. of Iron - less, But
 - self-fluxing / self-cleansing in nature.
↑
for cleansing, usually lime.
- so, widely mined iron ore.

Other Ores

PYRITE (Fe S_2)

- Not mined for Fe, but for sulphur only. why?]
- Fe + Sulphur — sulphur damages iron. ↙

GEOITHITE (FeO(OH))

- Iron ore in cold condition
- In areas of water logging
- though used commercially, not important.

AREAS OF ORES

Steel production started from IR:

1850s - USA - largest

1850s - 1980s → Remained largest > combined other nations.

USA:

Great Lake region [L. Superior]

(5 lakes around US-Canadian border)

- Mesabi
- Vermillion
- Minominee

Appalachian Mt. region

→ Rich coal + iron ore.

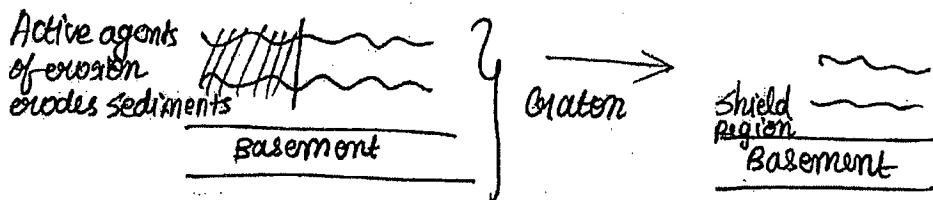
Black Band ores of iron: iron ore around the coal ore areas.

Ex: Jharkhand

CANADA:

Laborador Shield → St. John's

Foundation rock for every continent



Quebec Province

SOUTH AMERICA

BRAZIL

NINAS Gerais - South

Richest in SA.

At one point drove economy of Brazil.

USA takes lot of steel from here

VENEZUELLA

Cerro Bolívar / Bolívar Mts.

EUROPE

SWEDEN

> Kiruna

> Gränges

Defence equipments during WW-II made by Germany with these area's FeS.

As iron ore was not available in Germany, it attacked Norway for iron ore.

- ✓ Very high grade + Huge quantity
- ✓ Dug upto 1000

FRANCE

> Lorraine

Border of F & G - Fight for this area during WW-II

SPAIN

> Bilbao

UKRAINE

> Kourkoy Rog

- Black Sea

RUSSIA

> Kuzbas / Kuznetsk / Novokuznetsk

ASIA

CHINA

Largest firm top 9 in top 10

china - Russia border - Grasslands Temperate

> Manchurian Province

> Autonomous province of Inner Mongolia

Border of Mongolia

AFG

> Hajigak mines

- Richest in Asia

PAK

> Balochistan

Iran border ; tribal ; Hindu & Shia

Rich in minerals, oil & gas.

> Kimberlite province

Chitribot - recently discovered.

AUSTRALIA

Western Australian province

> Pilbara

AFRICA

> Mauritania

Not high grade but ↑ quantity

Taken mostly to European countries

> S. Africa

◦ Transvaal

Iron ore + Gold + Diamond → Very such
abundance of R. Vaal

INDIA

JHARKHAND

Major. in India

* Singbhum Shield Region - chotanagpur fl. region

◦ Singbhum districts (2)

◦ Lohardaga

◦ Palamau

◦ Hazaribagh

ODISHA

- > Mayurbhanj - Gorumahisani ↗ TATA - max. from here
Steel
 - > Jharsuguda - Ronai mines ↗ Good quality
 - > Keonjhar / Kendrapara
 - > Rambhaipur
-

CHHATTISGARH

- > Dantewada → Baivaldila (hump of an ox)
- One of highly mechanised mines
- Given through ≈ 260 km pipeline to Vishakhapatnam
- > Balot → Dalli - Rajgirha mines
Bhilai steel plant
- > Durg
- > Bastar

KARNATAKA

Dharwar Shield

- > Bellary
- > Chikmaglur ↗ Kudremukh (horse mouth)
- > Chitradurga ↗ Kemangundi (red - Hametite)
- > Shimoga
- Bhadravathi steel plant

MAHARASHTRA

EAST

o Vidarbha region

Chandrapur, Bhandara, Nagpur

SOUTH

o ~~including~~ Ratnagiri


Same Belt Goes to

NORTH GOR

Limonite & Siderite

@upsc.risefinity

Ore Beneficiation \rightarrow To get Concentrated Ore \leftarrow

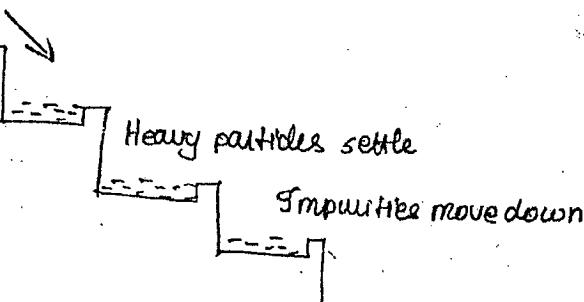
* Magnetite - Magnetic separation

* Washing

* Gravitational Separation

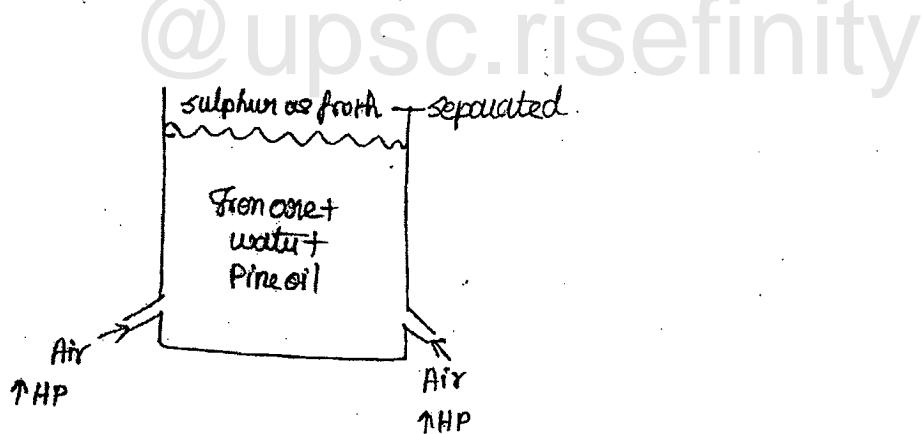
From ore

slurry



* Froth Flotation

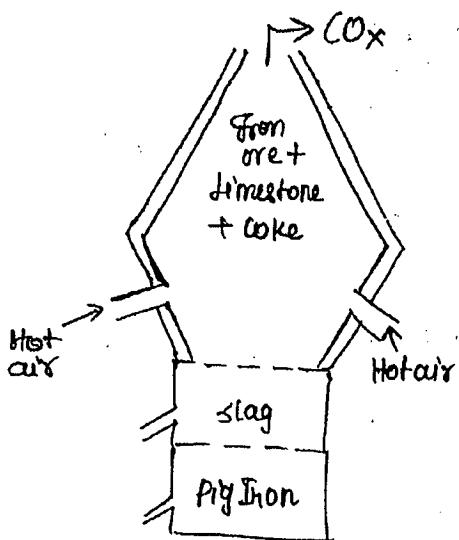
\rightarrow To remove Sulphur



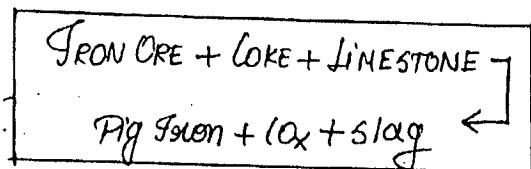
After Beneficiation \rightarrow Blast Furnace (BF)

From ore $\xrightarrow{\text{into}}$ Pig iron via BF

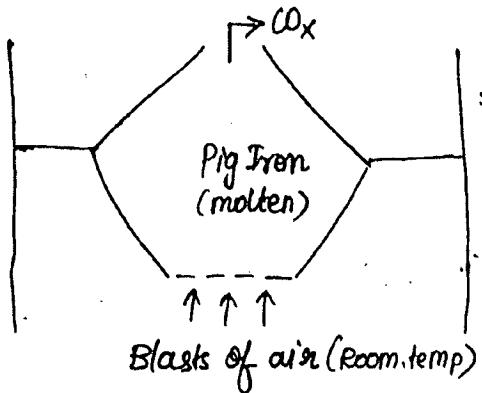
From ore in form of ✓ Fines
added in BF ✓ Pellets
 ✓ Sinter



Blast Furnace



Pig iron is brittle due to ↑ Carbon content - Hence to reduce carbon, it is put into converter.



Bessemer Converter

Coke - Reducing agent

- remove O₂

Limestone - flux

- bind with & remove

impurities - Si major

Temp. BF - ↑ high degree

- Iron ore melts

Oxides of carbon come out.

Si + other impurities - Slag

Substitute / additional ←
in Cement industry

also removes CO_x

Only Once flame → Blue,
all carbon removed.

Then req. amount of
carbon & other metals can
be added.

Then tilted & poured over.

moulds made of silica, an
impurity in BF.

lot of water req. for cooling
(Hence near Rivers)

Integrated Steel Mills / Industries

Steel from Iron ore in an integrated place.

Ex: TATA F&S - Jamshedpur (Subarnarekha River)

Directly Reduced Iron / Sponge Iron using natural gas.

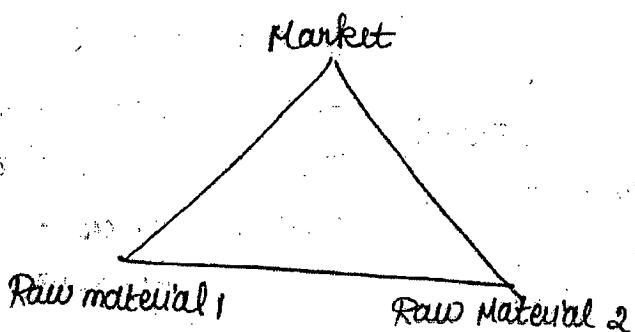
This is largely used in India. Solid state conversion ↑

BF not used much in India due to less available coking coal.

LOCATION OF STEEL INDUSTRIES

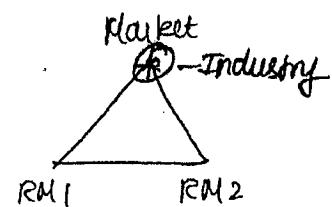
Qn# 2014 UPSC Qn: Discuss the changing location of F&S Industry in the world.

→ Raw materials mainly coking coal
 From ore. Unlike cotton, SC material



- Localised raw materials - specific to area, non-uniform in quantity Ex: Coal
- Abundant raw material - not specific, uniform Ex: Algo
- Weight losing
- Weight gaining.

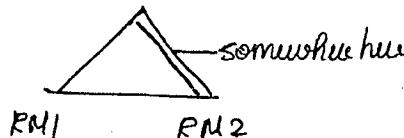
Case 1 : Both RM ubiquitous



- No transport cost -.

Case 2 : 1 RM ubiquitous & 2 not

so consider if it weight loses.



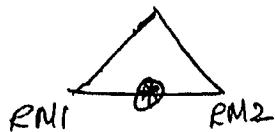
Case 3 : Both not ubiquitous

But not weight losing



Case 4 : Both not ubiquitous

But loses weight



Can come
towards here if
1 is more used.
& vice versa.

Before IR:

① Decentralised R & S production.

No large mills or industries.

In household enterprises / cottage

14th, 15th Cen \rightarrow BF

1856-1858 \rightarrow BC

charcoal, (not coal) was used from wood.

so nearby forests.

No mechanism for artificial air.

so, places of high speed winds - VALLEYS - well used.

During IR (1750s)

coal - most \circledcirc source of energy

Boulton - largest producer of coal. \sim 59 coal fields

Mine of Coal, 1 of Iron Ore. [8:1]

\rightarrow Pennine Coal fields.

so new location \rightarrow near coal fields \circledcirc - Britain, USA.

(Bikau, Jamshedpur (Gobain, R) - IND)

changes in Technology

Electric arch furnace } \rightarrow Coal : from ore

Hydro power } [1 : 2]

Move towards Iron ore mines \circledcirc - BRAZIL: Belo-Horizonte

KARNATAKA:

USA: Detroit

(L. Superior)

CHINA: Anshan in

Manchuria

RUSSIA: Novo Kuznetz

In South India

After Hydro power

1850s - 1980s

- USA undisputed in steel produ

1980s

- JAPAN took over.

2018

- Now 2nd largest is JAPAN.

② JAPAN

- mainly dep. on imported iron ore & coal.

- strong navy req. for island nation for ships - iron ore.

- Japan conquers Manchuria in China for iron ore.

Imported
Raw
Material
based

① CHINA

- Now largest steel producer.

- Very high from what domestic can sustain, so import from Africa, Pak.

Hence

Best
location

③ INDIA

COAST, near

ports

- 3rd largest now
- towards 2020 about to become 2nd largest

- No coking coal; from Sri Lanka; Aus.

↓
Visakhapatnam Steel plant

India - DRIL

Natural gas from West Asia.

IND: Essel steel plant — Recently acquired by Mittal

Coal mining — Deforestation, Habitat, Replacement of pop

F&S mining

'LEFT-WING EXTREMISM'

Mini steel Plants

Scrap steel as raw material instead of Iron ore

10 kg scrap steel → 10 kg of steel.

So, Market centre becomes important ⑤

Ex: Bhushan Steel plant (Market centre - Automobile scrap)

↳ Recently acquired by

LOCATION OF STEEL INDUSTRIES

→ It depends on the availability of Raw materials like:

- o IRON ORE
- o COKE/ COAL
- o LIMESTONE
- o WATER etc.

→ It also depends on the Technology because any change in technology also brings about a change in location of industry.

* During its evolution, this industry has seen foll. phases:

PHASE: 1 → Industry was decentralised with production in cottage centre. As charcoal was main source of energy, industry was located near Forest areas with preference given to VALLEY sides where winds blew at high speeds.

PHASE: 2 → Centralised production of Steel starts in IR where Coal emerges as main source of energy. The ratio of coal & iron ore is 8:1. So, industries were located near Coal fields. Ex: Birmingham in UK; Pittsburg in USA; Bokaro in India.

PHASE: 3 → With dev. of Hydro power and Electric arc furnaces, industries moved away from coal fields towards Iron ore mining regions. The ratio of coal & iron ore now is 1 : 2. Ex: Belo-Horizonte, Brazil; Detroit, USA; Anshan, China; Novokushnets; Bhadravati, INDIA; Russia

PHASE: 4 → Top 3 producers of steel today

[CHINA, JAPAN, INDIA] are dependent on imported raw material.

INDIA - Coking Coal, Natural Gas from CII

CHINA, JAPAN, S. KOREA - Seven one.

In this phase, Ports become most important centres for steel industry.

Ex: Shanghai, CHINA; Kobe-Osaka, JAPAN;

Hazira, Vishakapatnam, INDIA.

PHASE: 5 → With growing Environmentalism, the importance of MINI STEEL PLANTS increases. These steel plants use scrap steel as raw material & industries are hence market based.

Ex: Delhi; New York; Moscow [+ve-Tula Coal fields]

PROBLEMS

→ 2014-17 → Rough phase

↑ NPAs in Steel Industry

Why? China dumps steel here

China - 800 mn tons > 25-30% of demand.

Hence, it exports to many countries.

25% subsidy given to Chinese ~~steel~~ Industries by Ch. Govt

Larger the scale of production, lower the cost of production.

So domestic industries suffer from cheap imports.

CH, JA, S. K → Import from ore from India & sell product here

Many Steel Indus. gone bankrupt. - NPAs + stressed assets.

So, 30 mn t of capacity remains idle.

So, Banks don't give loans anymore.

Minimum Import Prices

Countervailing duties

Anti-dumping duties

So, now, Revival.

→ 2018 → Net exports of Steel - Revival.

By end of 2018, will overtake Japan.

2018 Aug → removed anti-dum. ~~tariff~~.

USA also wants to reduce dependence. So it wants to
put import duties - US, S.K, China, Brazil suffer & comes
many to India too - so Govt again anti-dumping duties.

Domestically Manufactured Steel - people in Infra (public).

Essar Steel - owned by Arcelor Mittal

Good record of turning around failed enterprises
works with high grade steel.

* \Rightarrow $\approx 25\%$ world's hematite deposits in India

But, import coking coal

\rightarrow Cautels - fluctuating pricing - instability

Yet, net imports of iron ore now

\rightarrow Mining permissions X

\rightarrow Railway - congestion - transportation

need dedicated freight corridor.

* \Rightarrow Export used main for many uses

Ex: Karnataka

But now, Export ban on iron ore & pellets.

But, now, ↑ demand for pellets esp. in China.

Sinter - more pollution than pellets. \uparrow

Smog - particulate matter rises - Hot

Smog - particulate matter subsides - Winter

Beijing; Shanghai - smog problem → Need pellets.

PMA (Pellets Manu.Ass) of India req. to remove ban.

⇒ ↑ Per capita consumption of steel

→ Infra & ↑ Machine & Industries.

Now: 68 kg/yr India - Very low.



160 kg/yr by 2030 needed

National Steel policy, 2017 ←

World avg: 280 kg/yr

⇒ 57% now form secondary steel sector in India

obsolete tech; ↑ Cost.

Prospects

→ Now very good due to govt. intervention

→ World demand also ↑ for steel.

<u>INDIA</u>	Production ²⁰¹⁸ <u>154 mnt</u>	Consumption <u>110 mnt</u>
--------------	-------------------------------------------------	-------------------------------

✓ 2016 - 62% of total steel by Infra sector

✓ 2018-19 Budget - 5.97 lakh Cr for Infra sector

✓ Roads, expressways

✓ Hub for automob. manufacturing

Export centre (Flat steel)

} ↑ demand

Future

O R & D - produce as per demand of which steel

Defence - High Nitrogen (0.9%) steel (HNS)

SAIL \Rightarrow TATA \Rightarrow TATA

\downarrow
DRDO - H.N.S

O Technological changes required

Coking coal market unstable

DRI - natural gas / non-coking coal

COREX - non-coking coal

POLYMER INJECTION - discarded tyres

National Steel Policy, 2017 — Read on PIB

* 500 mmt by 2030 - production

* 180 kg/yr - per capita consumption by 2030.

* SRTMI \rightarrow R&D - clean tech

↓ coking coal

↑ quality steel.

* Better tech to secondary steel sector

* Efforts to make RM available to steel industry

PROBLEMS OF STEEL INDUSTRY

- Almost 30 mnt of steel production capacity is by gone due to:
 - × Bankruptcy proceedings
- Steel industry had gone through a rough phase b/w 2014-17 due to:
 - × Dumping of cheap steel by CHINA, JAP, S. KOREA.
- 57% of production comes from Secondary steel sector which has × obsolet technology & high cost of production.
- Although India has around 20-25% of hematite ore deposits, × today we are net-importer of iron ore.
- Indian steel industry depends on coking coal, the price of × coking coal fluctuates a lot.

{ ENERGY }

ENERGY

⇒ Total installed capacity: 344 GW (full capacity & not actual total power generated)
 * ~65% of it is thermal power

Coal Based	Gas Based
~57% of total IC	~7.2% of total IC

* ~13% of it is Large Hydro (i.e.) > 25 MW

under H.O. Power & not under H.O. NRE (< 25 MW)
 small hydro

* ~2% of it is Nuclear power

* Sector with fastest growth

RENEWABLE → 20% of total IC.

COAL BASED THERMAL POWER PLANTS

→ Conventional; Non-renewable; cheap; ↑ Dependence

2009, Integrated Energy Policy by PC

Toughs

2017, National Energy policy by NITI Aayog

Both had said coal dependence will ↑.

NEP → coal capacity would double

	2012	2018
Actual gen:	57%	57%
Total IC :	289 GW	344 GW

Qn: Despite env. eff. of coal mining, it is necess. for development.

1st para: problems of coal mining.

2nd para: Why coal is important?

NMTI report

Cheap, Dependable, Reliable.

↓ Fluctuation of power gen, unlike solar

Next: Development angle.

Steel is \otimes - Infra + Autom...

→ & steel req. coal mining, also cement req.
cement is \otimes - Infra...

Problems

Centre for Science & Env. Report, 2017

>200 MW plants studied

i) Efficiency of coal based is $< 36\%$.

ii) Environmental effects.

- In Total particulate matter
- o 80% of PM 2.5 from coal based TPP
 - o 30% of NO_x emissions
 - o 50% of SO_x emissions
 - o 80% of Total Mercury emissions

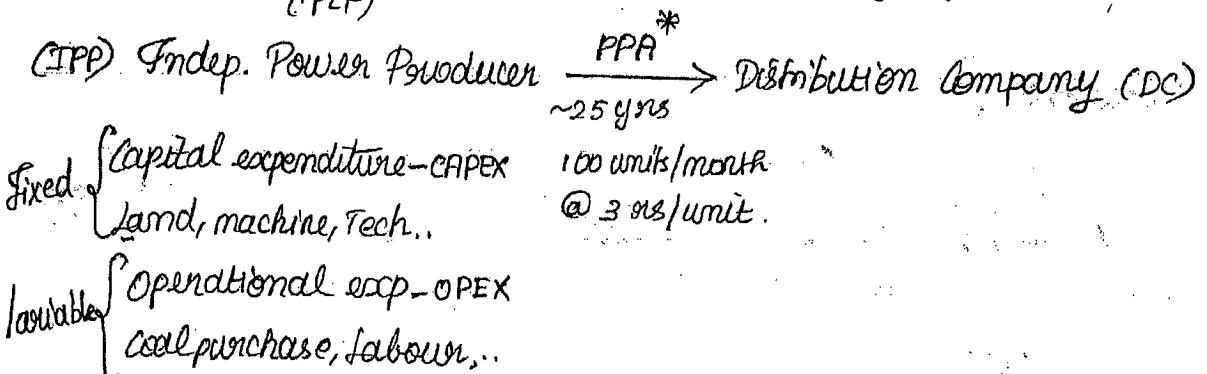
✗ Polluting source of Energy

✗ Climate change - CO₂ emission 1.08 kg / kW

TERI, 2017 report

iii) Industries use fresh water: 88% used by CBTTPP

v) Low Plant Load Factor $\sim 55\%$ and going down further
(PLF)



Fair exc: If CAPEX = 100 Rs. }
 If OPEX = 200 Rs. } for 100 units ; should be 150 for 50 units

Power demand fluctuates with season/months.

May - 100 units ; Nov - 50 units

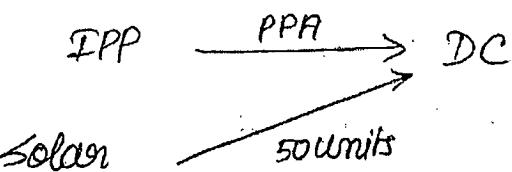
So where will extra 50 units go?

So DC asks only for 50 units, But problem is

IPP has by default of CAPEX as Rs. 100 & } But actually,
 reduced OPEX as Rs. 100 } Rs. 200 for 50 units.

Extra Rs. 50 by DC is POWER BACKDOWN COST (PBC)

If National Solar Mission produces also solar power,



Govt says not to give PBC on solar but only on IPP.

Thus, PLANT LOAD FACTOR of Thermal coal is ↓ due to replacement by other Renewable sources.

2022
Target 40 GW
from
Renewables

2022
175 GW

2022
227 GW

Govt is increasing the targets regularly
bounding PLF down further.

Solar
fluctuations
10 am - 10 units
2 pm - 40 units
5 pm - 10 units.

So demand for Coal Thermal
also fluctuations
10 am - 90 units
2 pm - 60 units
5 pm - 90 units.

N) But this flexibility is not with Coal [8-12 hrs required
unlike Gas based thermal & large hydro.]

✓
Coal is the most important source of
power generation in India.

57% of total installed capacity (IC) is
with Coal Based Thermal Power Plants (CBTPP)

As per National Energy policy, 2017, NITI
the IC of CBTPP will double by 2047.

Coal is conventional, cheap source of
energy where CAPEX is less.

But, CBTPPs have following Problems:

① The Efficiency of CBTPPs is low & found to be 36%.

in a report by Centre for Science & Env. (CSE), 2017.

② CBTPPs are the source of POLLUTING GASES like

NOx

COx

Mercury

SOx

etc.,

③ CBTPPs use 88% total fresh water used in industries, found from TERI report, 2017

④ CBTPPs are less flexible & cannot comply to POWER BACKDOWN INSTRUCTIONS (PBI) easily.

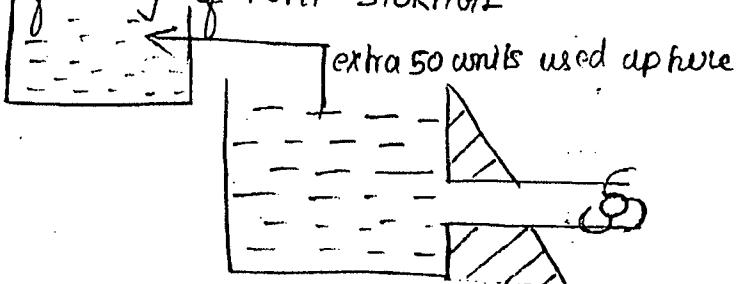
⑤ The PLF - Plant Load Factor is 55% and is likely to come down further as share of Renewables in energy mix increases.

LARGE HYDRO

→ H.O.F. Power ; capacity > 25 MW

- ✓ Very low OPEX once CAPEX is done with.
 - ✓ Not a polluting source but Renewable & Clean.
 - ✓ Very Flexible & Complying to PBI, due to the

facility of PUMP STORAGE



In case of PB1, extra 50 units will be used to transfer water from D/s to U/s reservoir.

	2012	2018
share	17%	13%
	289 GW	344 GW

y. comes down?

Many projects are stalled midway

why? i) very high CAPEX

ii) Setting up infra - not env. friendly - Forest land

(hence not under M.of NRE) • submergence of trees

iii) Displacement of ppl 2

Their Rehabilitation.

N) Avg. gestation period \approx 13 yrs

vi) ↑ Technical & Commercial transmission losses

- Submergence of trees

o Habitat loss

- Biodiversity loss

• Ecological problems

v) Earthquakes due to man-made acts

Pressure system is disturbed & seismic activity affected.

PRESOVOIR INDUCED SEISMICITY

Ex: Kolna dam - 1957 EQ - Maharashtra

Small Hydro ($< 25 \text{ MW}$) - Maf. NRE

→ Preferred source

✓ Run of River projects, no big reservoirs created, so

- o No displacement
- o No forest affected
- o ↓ Construction period
- o ↓ Transmission loss ($<$ distance)

✓ Decentralised employment. So, development of
remote areas. (@ village levels)

Ex: Lower Subansiri (trib. of R. Ganges) is $> 3000 \text{ MW}$
Project

Ass., Nam., Megh...

A good replacement for this would be small hydro in Ass. P.

Note: Offgrid Sources (?)

GAS BASED THERMAL POWER PLANTS (GBTTP)

2012	2018
7.2Y.	9Y.
Total. 289 GW	289 GW
IC 289 GW	344 GW

- Clean form of power.
- More efficiency. (\downarrow Gas for 1 unit of power than coal)
- Flexibility; compliance to PB1 (2 hrs)

Problem

- X Dependence on Imports
- X High price on Gas (2017-2018)
- X Rupee also is depreciation
- X Not enough ~~Energy~~ LNG terminals to store gas.

NUCLEAR ENERGY

→ 2% of total Power generation

✓ No combustion, only fission, so no poll-gases released.

2009, Integrated Power policy ↴

2017, National Energy policy ↴ ↴

✓ Only Nuclear energy can replace CBITPP.

Problems:

✗ Radioactive leakages

✗ Danger of catastrophe

Ex: Fukushima - Japan.

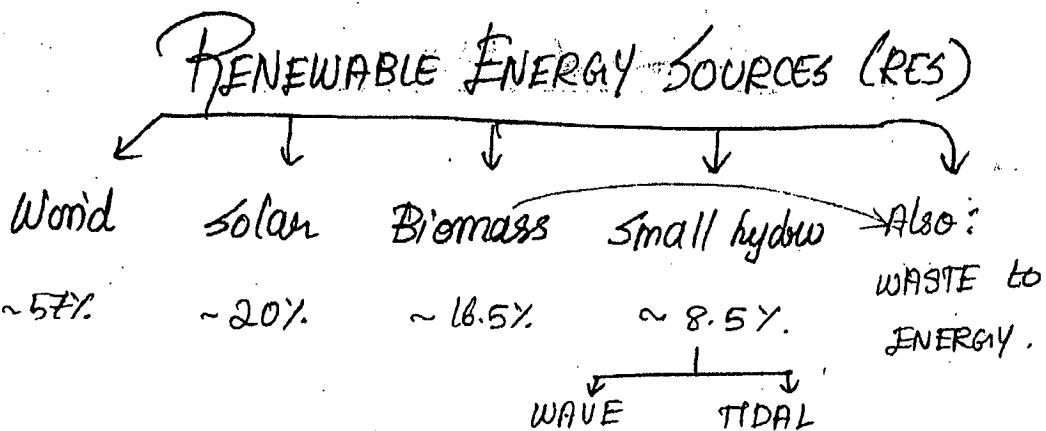
- So most countries disbanding it.

✗ Dependence on imports for nuclear imports

— Kerala — Monazite sand contains Thorium

- But Thorium is not fissile & can't be directly used.

- India's 3rd stage: To convert Thorium into fissile & then we would have unlimited source them.



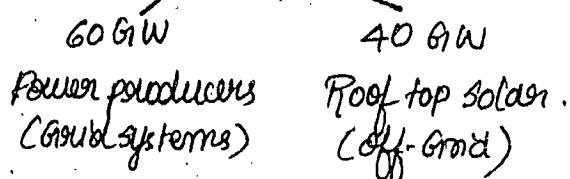
→ 20% of total ie of 344 GW & RES.

SOLAR

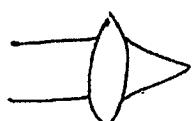
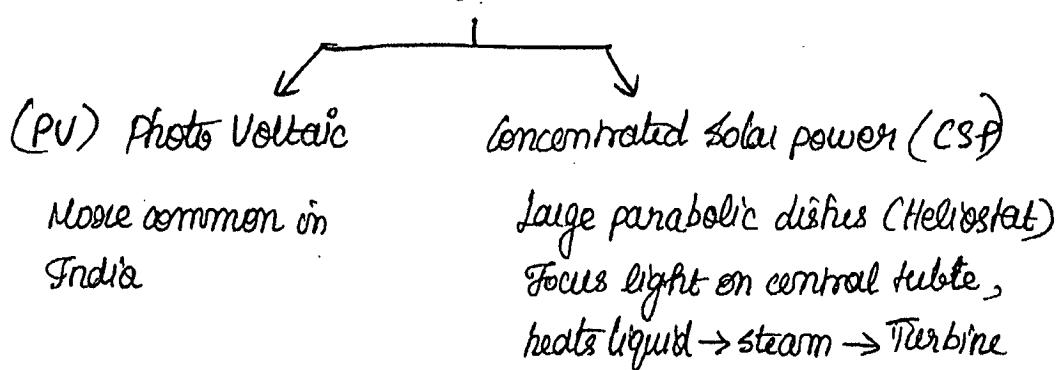
→ Tropical country

→ NSA - National Solar Alliance - Founding mem: INDIA

→ By 2022: 100 GW of power from Solar - Govt



→ Generation methods



Problems

i) Producing

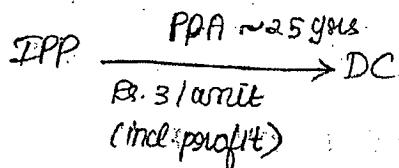
Germany is one of leading producers of solar energy



Growth due to Feed-in-Tariff system

Now: Reverse Auctioning mechanism

Feed-in-Tariff system (FiTs)



- ✓ Long term - assured profit.
- ✓ Easy avail of loan.

Reverse Auctioning system (RAS)

In 2017, introduced in RASTHAN.

✓ not FiTs? cost came down as much as 2.44 Rs./unit in RAS

Govt. announces basic price of auction - 3 Rs./unit

Solar Energy Corp. of India conducts auction.

Asks for discounts from companies:

IPP₁ - 2.75 Rs./unit

IPP₂ - 2.7 Rs./unit → Highest discount wins ✓

Problem: Many IPP don't turn up for auction.

- X Areas of ↓ sun rays & Producers have cost & difficulty with low price of ₹ 2.44/unit.
- X Also, No ASSURED PROFIT on RAS, unlike ATs.
- X Also, many IPPs have not started operation due to OPEX

CHINA - Large scale manufacturing of Solar panels - leading
 ↳ most countries get from it -

INDIA - producers not able to give competitive price wrt China and hence GOVT. imposes special safeguard duty of 25% for SP from CHINA & MALAYSIA.

One hand Base price decreasing	Other hand Costly solar panels ↑ cost of power production
-----------------------------------	-----------------------------------------------------------------

CHINA - IPP₁
 SP → DC

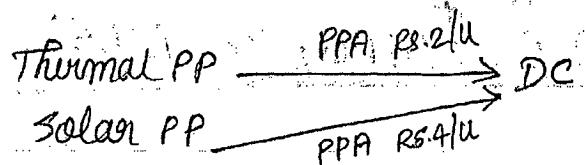
INDIAN - IPP₂ → 18P discount

SP

additional discount → so company with ↑ cost of production of 18P/unit by govt. wins contract.

20 GW - required

only 18% of this can be met by Indian SPs



⇒ RPO [RENEWABLE PURCHASE OBLIGATION]

Min. units of power must come from RES for DC.

⇒ National Electricity Policy, 2016

↳ "MUST RUN" policy → 1st own power from RES (all power & not min-units like in RPO)

Replaced by

PBI can't be given to solar / RES

→ "MERIT ORDER DISPATCH"

• If RPO is 10% - over & above 10% is DC's discretion

MP, TN - PBI on wind & solar

↳ Rejected demand of lending for RES under
power sector lending Why

CSP

~~PV~~

~~CSP~~ PV

↗ Land

↙ Land - so followed in India

↙ storage

↗ storage

Easy maintenance

Difficult maintenance

RENEWABLE ENERGY SOURCES

→ Of the total IC in country (344 GW), almost 20% is capacity of RES.

→ Govt. has a target of 175 GW of RES to be generated in India by 2022 — upscaled to 227 GW.

SOLAR

→ Under National Solar Mission (NSM), 100 GW to be generated from Solar by 2022.

→ India is a tropical country with:

- > 300 sunny days
- areas like RAS, LADAKH where more intense sunlight is available for > 330 days

→ Solar energy is a DECENTRALISED form of power generation which can provide

- > Decentralised employment &
- > spur growth in remote & inaccessible areas

→ Although we have an ambitious target of 100 GW, acc. to report by MCKINSEY, 2018 (ET) India will be able to achieve only 76% of target by 2022.

Problems in Solar Power Production

Some of problems with solar power production in the country are:

i) Much of success we've had in RE has been due to FITS [Feed-in-Tariff system] where an ASSURED PROFIT is given to PP [Power Producers] with Long term PPA [Power Purchase Agreements]. Under the system, it was easy for PP to avail loan.

But the govt has replaced FITS → RAS (Reverse Auctioning system) & a low BASE PRICE has been setup after Rs. 2.44/unit was achieved in BHADLA PHASE-II RAJASTHAN, 2017.

Since PP companies find this price as unsustainable, a no. of auctions have been cancelled or postponed and solar power production capacity added in 2018 is < 2017.

ii) To provide market for Domestic manufact of SP (Solar Panels), Govt. has imposed a 25% SSD (Special Safeguard Duty) on SP from Malaysia & China. This further increases the cost of Power Generation.

(Dumping of SP in India is likely to further increase because the demand of SP in China is less than before as Chinese govt. has withdrawn many subsidies to Sol. PoPs.)

iii) Many states have changed from

'MUST RUN' → 'MERIT ORDER DISPATCH'
states

as a result of which the state DISCOM's have given PBI (Power Backdown Inst) to Renewable PP.

iv) Against the demand of RE producers, govt. has not included Renewable sector under PRIORITY SECTOR LENDING.

*

Roof Top Solar

- Target: 40 GW by 2022
- By Aug, 2018: only 6% achieved
Why lag?

i) After Sale Service & Maintenance issue - not enough trained ppl.

ii) DISCOM 
Residential @ ↓ power - They will install roof top solar?
Commercial @ ↑ power +
Full capacity doubtful to be met

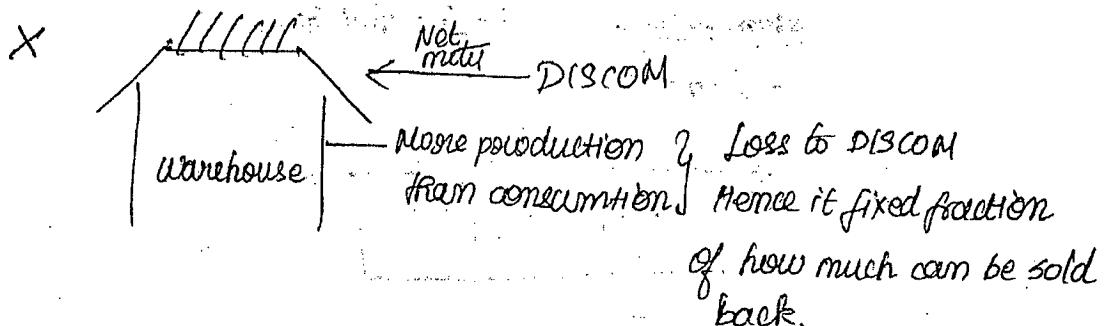
✗ System in developed countries:

Companies will setup rooftop in houses & charge only for power/unit. But this is absent in India.

✗ Bank officers - difficult disbursement of loan - how to value house & how much loan to give.

X Fluctuations \rightarrow Day - More solar
Night - less solar

So, DISCOM would setup Net meter on house & it would sell power to DISCOM during day & during night it would get power from DISCOM.



HW: Read schemes for SP

① SRIHATI — Sustainable Rooftop Implementation & Solar Transfiguration of India

② KUSUM — कृष्ण उन्ना सुनकेश एवं उत्तरान महाअभियान

③ Swya Nitra

④ Solar City program

Gujarat - Not permit 3rd party installation.

MH - limited permission

Uttarakhand -

SRISTI ; KUSUM ; surva nitra ; Solar City Program
solar pumps train technicians
to farmers

WIND ENERGY

- Max. Renewable energy
- $\frac{40 \text{ GW}}{56-57\%}$ from wind
- Long coast line $> 7500 \text{ km}$
scope for power generation
- Depends on speed : Productive wind speed ($4 \text{ m/s} - 30 \text{ m/s}$)
(min. speed req.)

$$\boxed{\text{Power Produced} \propto (\text{Wind speed})^3}$$

Factors for speed

PGF (Pressure Gradient Force) - α

FF (Force of friction) - $\frac{1}{\alpha}$

Westerlies in South \rightarrow Wind speed \propto Land mass \downarrow .

Urban areas - \uparrow temp ; \uparrow RF (due to $>$ Condens. Nuclei)

Rural areas

\uparrow Smog - (due to sinking air)

National Institute of Wind Energy

Total potential ~ 100 GW - Then for WE.

Assessment ~ 300 GW - Now

Tariffs has come down (~4 Rs) due to tech. changes

Ht. of wind mills - now possible Ht 100m.

Even small change in wind speed will expn. ↑ energy.

Many countries - Now offshore wind farms & not only in land areas.

Target: 60 GW by 2022

Very likely to melt PPA

solar:

2018 - less addition
2017 than in 2017.

Issues:

→ FITS replaced by RAS.

→ SECI conducts auction for both solar & wind.

→ Base price very low by Govt - hindrance.

Solar ; Wind.

2.44/unit 2.46/unit

→ Must own replaced by Next Order Dispatch

So, New purchase agreements not taken by companies

→ Since govt. started ISA etc.. wind is playing a 2nd fiddle. No. of benefits of wind now being withdrawn.

for TANU - inves 5-6 crores

Govt - used to give 1 GJ : Generation based incentive.

2017 - withdrawn

World

Affect of Wind Mills on Environment.

- ⇒ Lizards on West Ghats - Pop. ↑ due to ↓ Birds due to wind mills. → overall food chain (natural predators) affected.
- ⇒ Offshore wind farms on aquatic life.
lot of noise
- ⇒ Local precipitation patterns also affected in wind mills area.
At 100 m ht, churning of air - warm & cool air mixed & reduces condensation affecting RF.
(Germany)
- ↳ Highly variable sources of power. (Speed fluctuations)

[NOTE] Mention Env. problems of :

- # Wind energy - at last → bcos we are comparing it
- # Green. Rev - at 1st. with other sources & not the ideal situation.

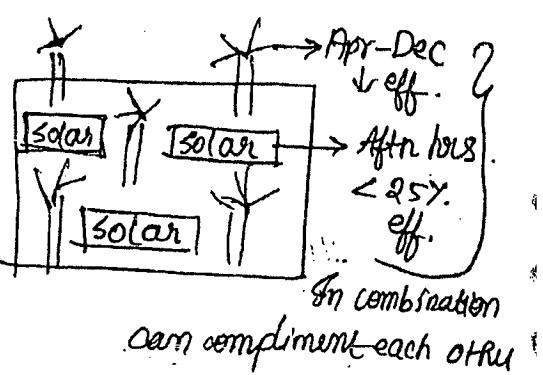
Faults:

HYBRID

No need to acquire full land but only req. But farmers found it uncomfortable to work

Note:

SOLAR + WIND



- Effective utilization of land
- Stable & less variability in power gen - consistency
- Reverse Auctioning & Competitive bidding for PPA
- Treated as separate entities & not as solar or wind
- ↔ less initial cost of invest. & production.
- ↔ Auctioning inactive due to low base price of Govt.
- ↔ In other countries, earlier Solar + Hydro - but now redundant - New tech to store solar energy cost efficiently. Read: "Sun in the Box" - study by MIT.

BIO-MASS (BM)

- ① Digestion
- ② Gasification
- ③ How Biomass power can reduce stubble burning?
o reduce Agri-waste?
- ④ Sugar industries - Bagasse - Biomass power
loss
- ⑤ Waste → Power gen.: Solid waste Management
of urban areas. (Landfill's problem) - How BM can help?

Other Renewable Energy (RE)

Type II: Scope for RE in India

Take a regional perspective: (J&K - Solar; NE - Small hydro;
Coasts - Wind; N. plains - Biomass;
Uttaranchal - Biomass)

Type 2: Benefits of RE.

① Environment, climate

clean.

Link it with INDC of India at Paris's Climate Conf.
(AOY. -)

② Balanced Regional Development

Dev. of SME in rural or remote areas.

③ Employment Generation - Decentralised

@ Village & local level.

Report: World Resources Institute - Read summary

(Article in TOI on this - How RE can help Poverty)

Type 3: Constraints related to RE in India.

(in each sector or combined)

See - Bio Fuels (Rahul Sir)

S. Hydro = Issues

→ Mapping of rivers - flow, potential - Not done

→ Disturbance to aquatic life - movement.

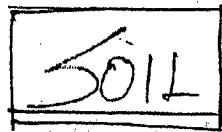
→ Problem of Grid Connectivity - off grid areas - Cost

→ Need Decentralisation in power gen.

Involvement of local community.

Report: NITI Aayog - Reads suggestions on Fwy.

PHYSICAL GEOGRAPHY



→ No single definition in one line.

* Soil is a Complex - Biotic factors + Abiotic components in continuous interaction - dynamic.

Properties change over a period of time.

Ex:- PUN, HR - Saline Alkaline Soil after GR.

colour, pH, porosity, permeability.

Components:

i) Mineral Matter:

Disintegration of rocks

Sand + silt + clay from parent rock.

Primary Minerals (PM) | Secondary Minerals (SM)

| Plants takes mostly PM.

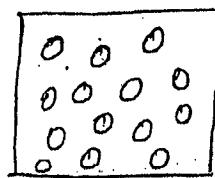
| So conversion of PM → SM is for plants.

PM
Feldspar → SM
Caleite → clay

Caleite → carbonate

Most factors of soil depends on mineral matter.

ii) Soil Airs:



CAPILLARY SPACE

Occupied by Gas \rightarrow Soil Air
(May be by liquid also)

\rightarrow This gas comp. will depend on atmospheric air.

\rightarrow The proportion of gas will vary from:

- ✓ One soil type to another [↑ organic matter]
- ✓ one region to another [↑ CO₂; ↓ O₂]

\rightarrow Properties provided by Soil Air to soil.

Ploughing is just Aerating the soil for ↑ productivity & mixing soil

iii) Soil Water:

incl. water, chemicals, acids, any secretions

water - continuous to move till reaching ground water.

* This gravitational direction of water is called

GRAVITATIONAL WATER (uphill 48 hrs after stop of RF)

* Even after water drains out, still the held water in capillary space is called **CAPILLARY WATER**

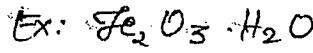
✓ Used by Plants

✓ Used for Evaporation.

* After some months of RF, even on absence of capillary water (loss in evap/transp) - very thin films of adhesion will be held by ^{solid} particles to hold water - **HYGROSCOPIC WATER**

- x Not available for plants ↴
 ↳ held so
- x Not available for Evaporation tightly.

* Water present as a part of molecular structure of some compound or minerals: COMBINED WATER



- x Not available for plants.

→ Except Gravitational water, all 3 include Field Capacity
(i.e) Total water held by soil.

iv) Humus:

→ Humified Soils - presence of humus
A humified soils - absence of humus.

→ Growth of plants $\xrightarrow{\text{Interdependent}}$ Growth of soil
Leaves fall - Decomposition

→ Vegetative / animal matter fallen to soil where the:

> Decomposition has just started \rightarrow Little

> Partially decomposed \rightarrow Duff $\xleftarrow{\text{HUMIFICATION}}$

> Fully decomposed \rightarrow Humus

Factors for humus presence:

Climatic condition

Hot & Humid	Cool & Humid
-------------	--------------

↳ More humus.

↳ Slow decomposition of matter

↑ Peat ⁱⁿ Marshy & swampy areas

Anaerobic - slow decomposition - Good Carbon Concent.

So, Slow DECOMPOSITION → ↑ CARBON CONCENTRATION

Hot & humid. Humus $\xrightarrow{\text{Conv. into}}$ Other compounds
↑ Bacterial action → Mineralisation of Humus
So ↓ Humus

Cool & humid

Slow Decomposition → ↑ Carbon, So ↑ Humus

Organic fertilizer + soil → Humus changes colour.

Structure of humus soil is changed by humus, thus changing:
o Water holding capacity
o Soil pH
o Dark colour to soil

v) Biotia

Microscopic or Macroscopic Biotic components

Faithworm - making faecation

Phizobium - $N_2 \rightarrow$ Soluble
Bacteria

SOIL

→ Although it is difficult to define soil, but for all practical purposes, Soil is considered as a COMPLEX with a no. of BIOTIC & ABIOTIC components, which are in a state of PATTERNED INTERACTION, which makes soil a DYNAMIC entity.

→ This soil complex includes:

- 1. Soil Air
- 3. Mineral Nutrients
- 5. Biota
- 2. Soil Water
- 4. Humus

→ Most of the properties of the soil are derived from these components & their interactions.

SOIL PROPERTIES

1) Soil Texture:

Depends on type of grain.

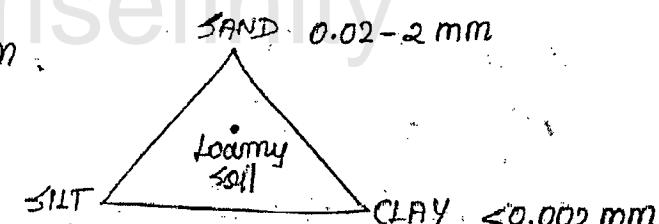
Sandy soil (85% sand)

Clayey soil (65-70% clay)

Silty soil. (More silt)

→ Fine texture

→ Coarse texture



Clay < Silt < Sand < Gravel (> 2mm)

what depends ^{size} the composition?

✓ Parent rocks

Ex: Sandstone

↓
Sandy

Ex: Shale Rock

↓
Clayey

ii) Moisture Holding Capacity of Soil:

* Depends on grain size.

Grain size $\propto \frac{1}{}$

Moisture holding capacity.

Ex: Black soil - can hold ↑ moisture

60-62% clay

> Shivalik \rightarrow Punjab Boundary Haryana \rightarrow Rajasthan

Ghaggar River: coarse soil - so long dist. water flow but

> Luni river \rightarrow Disappears in R. of. Kutchh., $\xrightarrow{\text{disapp. in}} \text{Raj. - soil fine}$.

Fine soil - holds water.

iii) Permeability & Porosity: cumulative space

Generally: ↑ Porosity \rightarrow ↑ Permeability.

Exceptions: Clay: ↑ porosity \downarrow Permeability.

why? Most water on clay - Hygroscopic water, so not allowed to pass through. + blocky in top soil
platy in sub soil

Loamy soil - ~50% sand
~50% silt & clay

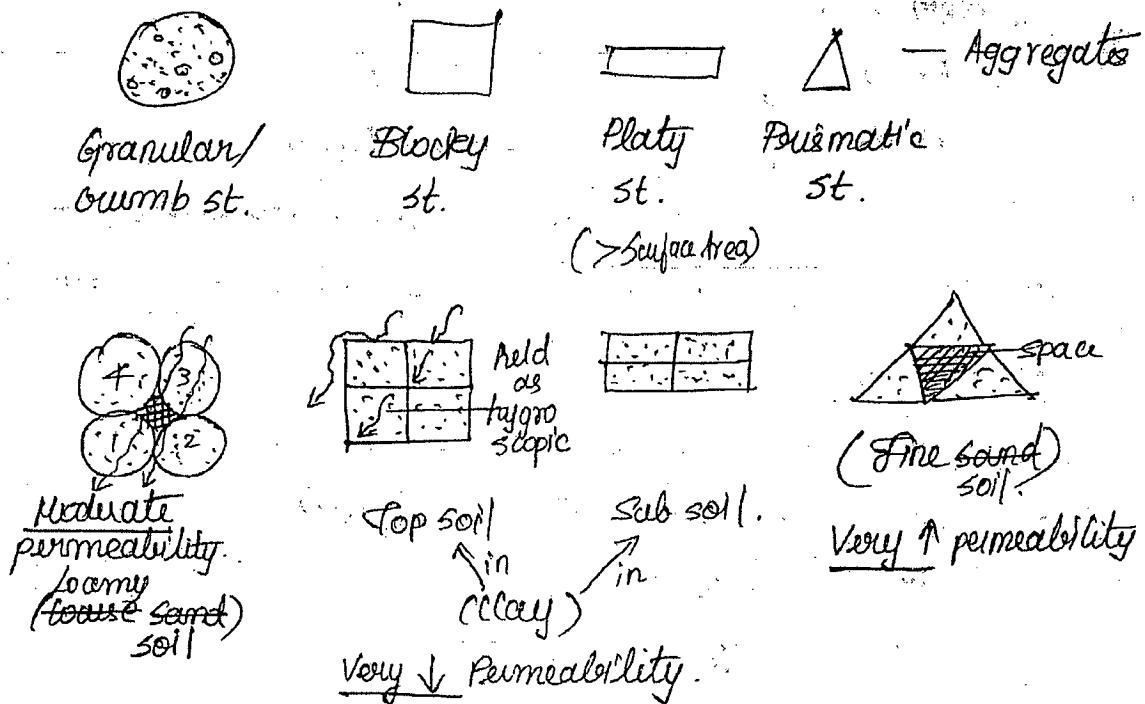
Suitable for all crops

Modulate moisture holding capacity.

\Rightarrow Permeability also depends on Structure.

Shape of aggregate of diff. types of grains.

IV) Soil Structure



* Humus makes the structure Granular,
Hence good for plant growth.

Basis: Moderate permeability optimum than very ↓ or ↑ P.

V) Soil Colour

Climate:

Ladakh: light brown - Desert (\downarrow Veg. - Ahumic)

Ar.P : Dark brown - Forest (\uparrow Veg - Humified)

Permafrost areas

Top soil	Active - thaw	Freeze
	Frozen - Always	
Sub soil	Frozen - Always	permafrost

$T < 0^\circ\text{C}$

Top soil	Both
	Frozen = Ahumic
Sub soil	

Anaerobic decomposition - due to frost, no O_2

Humified soil \rightarrow PEAT.

(Famida region)

<u>RAS</u>	<u>MH (Malwa plateau)</u>
Desert soil	Black Soil
L. Brown.	D. Brown.
No humus	Negligible humus So, colour due to mineral matter.

Indian plate: Gondwana land → Now present area

Northward.

Reunion Islands

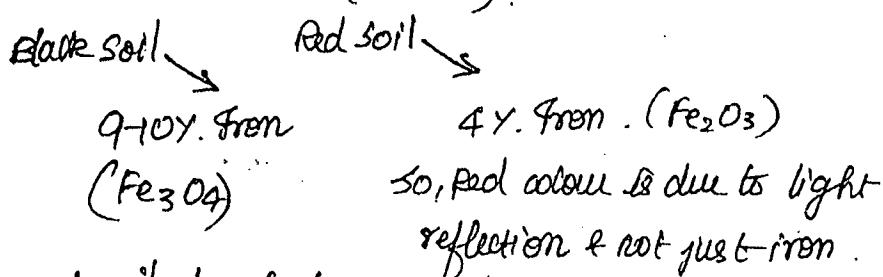
- Volcanoes - acidic lava - viscous - explosive
- Volcanoes - Basic lava - fluidic - quiet

HOTSPOT VOLCANOES

Lava from deeper part of magma

Reunion once had hot spot volcanoes.

Indian plate when crossing over it acquired
BASALTIC LAVA - (atm disintegrated from rock to Black soil)
Now DECCAN TRAP (Malwa) (↑ Magnetite-dark)



Colour of soil due to human acts

An. P → Salinity

Raj → SG canal

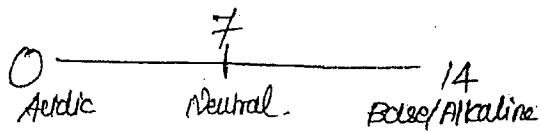
Punjab & Haryana W. UP → Over irrigation.

MH → SC in dry areas

Fertility does not depend on colour of soil.

Fertility depends on:

- Ex: Sodic soil \rightarrow i) Sodium \rightarrow Impermeable - Infertile.
ii) Permeability
iii) Nutrient content of soil
iv) Moisture holding capacity
v) pH Value



pH:

Gen, 6-8 \rightarrow Fertile, But depends on plant also.

- Ex: o Cereals req. alkaline soil (> 7)
o Tea, req. slightly Acidic soil (< 7)
Coffee,
Rubber.

pH depends on:

- i) Vegetation of area - plant secretions.

\Rightarrow Chil, ; Rhododendron & Oak,
 \uparrow Endemic
by built for
railways.

- multiplies fast &
not let other trees.

\Rightarrow Fir,
Needles fallen secrete
acids & doesn't let
other trees.

ii) Humus content:

↑ organic compound → ↑ CO_2 → Carbonic acid

Humus + Aerobic soil: ←

Coffee, Tea on hillstation (cool & humid)

Low productivity of Tea → Old Tea plants

↓ Alkaline Tea due to
flyash settlements

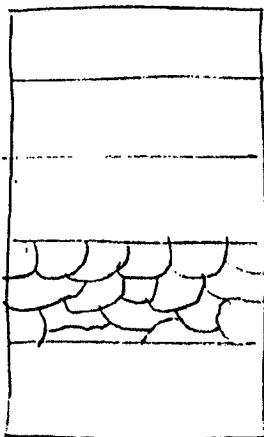
iii) Human Actions

iv) Mineral Content

Ex: Limestone - alkaline

Soil PROFILE (Vertical cross-section of soil)

Fine soil
or
Solum



'O' Layer
'A1' Layer
'B' Layer
'C' Layer
'R' Layer

Every soil

'O' Layer

Litter + Duff + Detritus + Dust + Rock fragments

May not be on all soils.

Not a proper part of soil.

Once Duff $\xrightarrow{\text{to}}$ Humus, it would go to 'A' layer.

'A' Layer (TOP SOIL)

Dark, Moderate Water holding capacity

Slightly acidic pH (< 7)

Finer than other below layers

Granular structure

'B' Layer (SUB SOIL)

→ Can be dark or light in colour

not due to humus but due to such mineral matter
as it is in 'A'

Ex: Eurasian grasslands / steppes.

Temperate

Semi-arid

Cool regions

Soil - BLACK EARTH

Topsoil - Black & Dark - Humus

Subsoil - Dark - Ca & Mg rich

More answers into:

Black Sea or S. of Azov.

Sediments of this
Black Earth.

→ Text: Coarse from A
fine from C.

→ Platy due to compression

→ Fettle.

'C' Layer

Disintegrated Rock Belt

A & B exerts pressure on C.

Agents of erosion here become very active.

So, 'A' layer is eroded. ↙

Some pressure released

'B' expands - stress. ↘

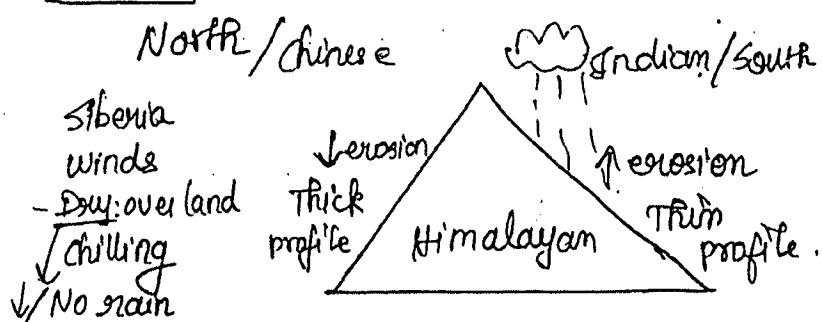
'C' - disintegration due to UNLOADING (one of the causes).

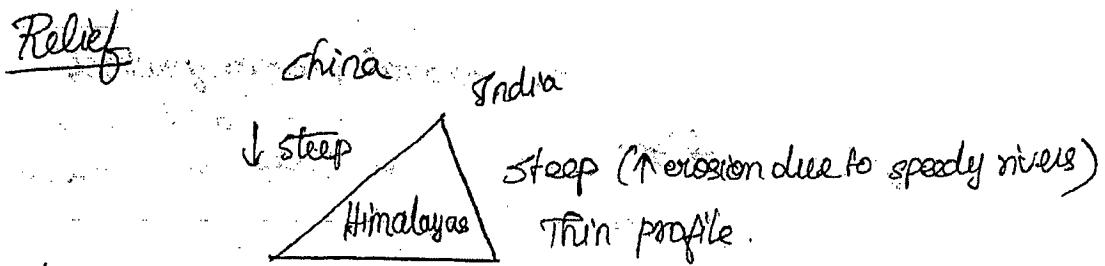
'R' Layer :

Rock layer intact w/o disintegration.

FACTORS AFFECTING SOIL PROFILE:

climate





Age

Nature soil profile → better devd. profile.

Recent origin → ↓ devd. profile.

But devd. profile doesn't necessarily means unfertile/fertile.

Alluvial soil → Not very devd. profile → But very fertile

Read:

Soil forming factors } NCERT or
Indian soil } Yell. Book.

Soil forming processes

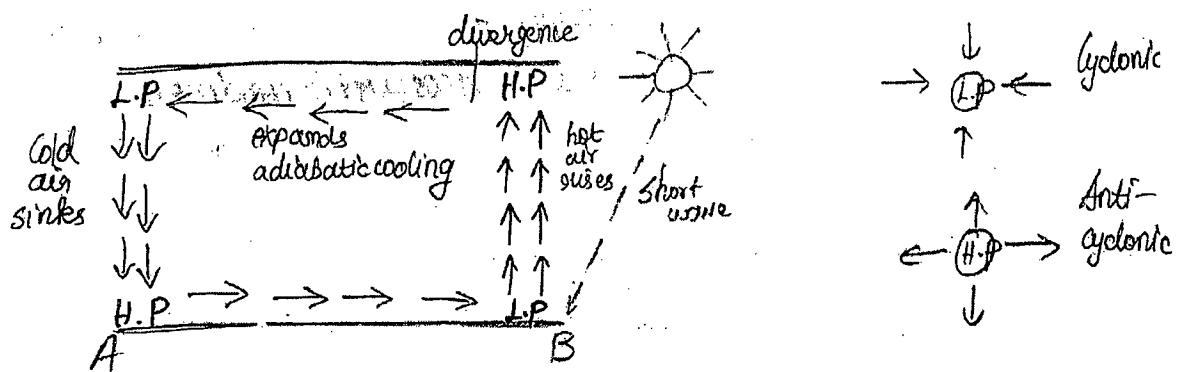
(Video)

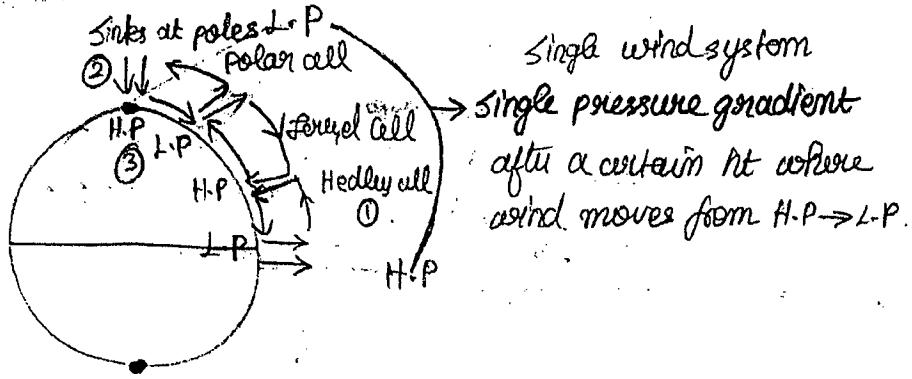
TET STREAMS (TS)

Tet streams influence a no. of climatic phenomena:

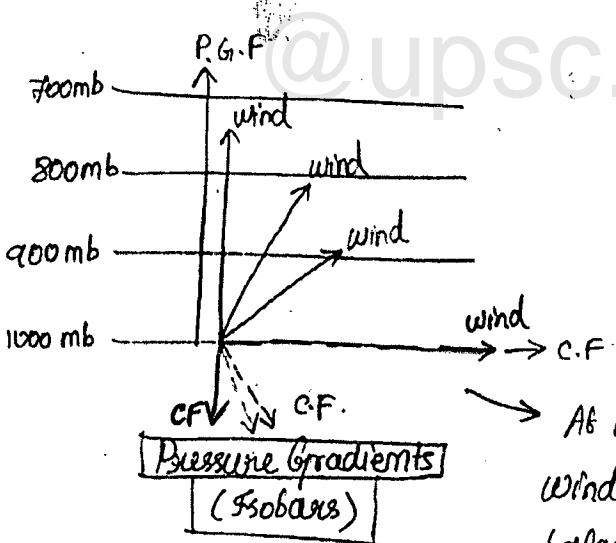
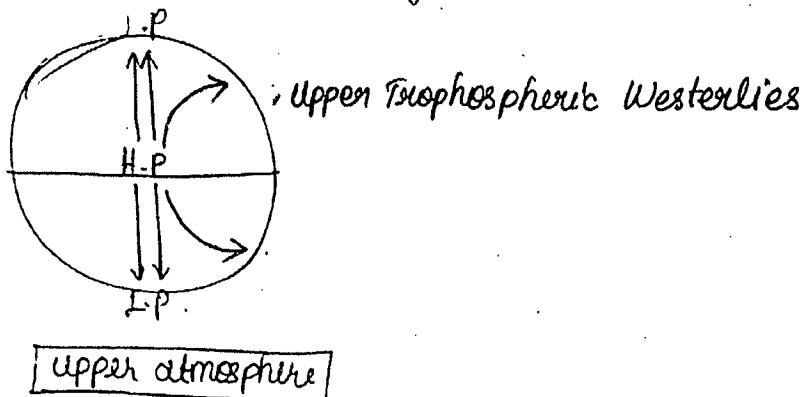
Ex: sudden cold wave; western Disturbances.

Simple surface circulations are not sufficient to understand TS, so we need to understand Tropospheric & other circulations also.





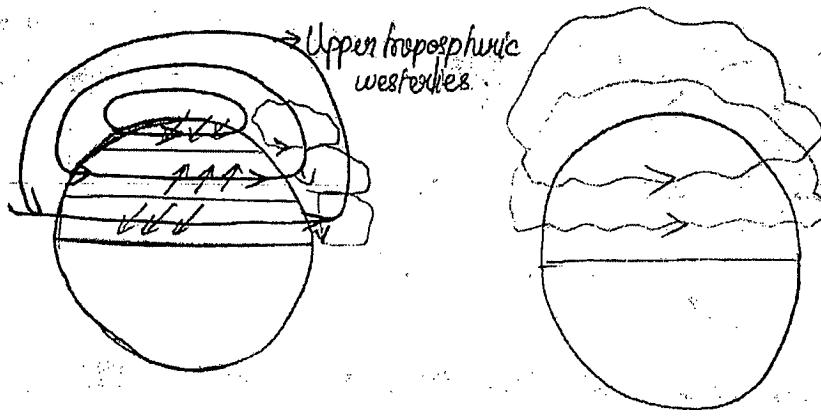
These 3 cells do not extend to full troposphere.



In upper troposphere:

About 30,000 ft, no any obstacles
so high speed of wind.
Greater the speed, greater the
deflection of C.F.

At one pt, due to ↑ speed & ↑ deflection
wind moves along isobars & C.F
balances P.G.F - This condition is
called Geostrophic condition

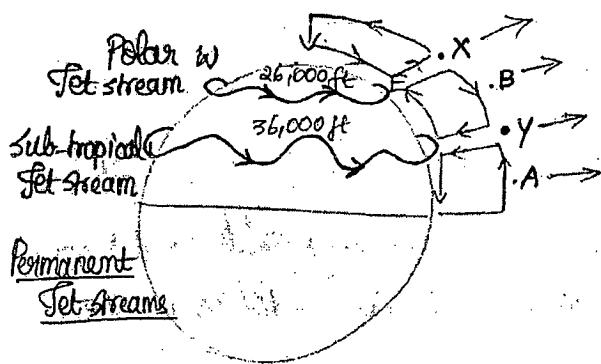
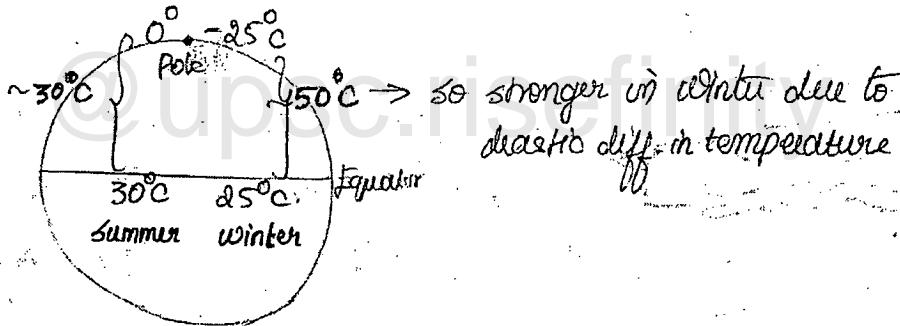


Surface Winds

Upper Tropospheric winds

(i-e) Geostrophic winds

More the difference b/w H.P & L.P in troposphere,
more the stronger the wind. (i-e) Greater the temperature
contrast b/w Equator & poles, stronger the winds.



At X & Y, no friction from surface winds for geostrophic winds so, very high speed from at A & B.

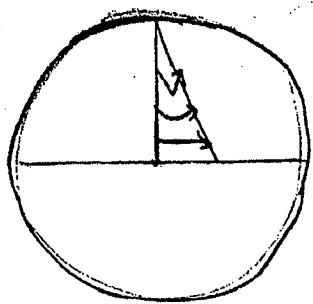
Jet streams

> 300+ km/hr.

Y name? Aided pilots during WW-II
less fuel consumption : $w \rightarrow E$

ST JS \rightarrow at greater ht as extent of atmosphere is more at Equator

Meandering path \rightarrow To conserve angular momentum



Radius \rightarrow Less at pole — More speed
 $L \propto MVR$
 (Angular momentum)

As we move from Equator to poles, the meandering gets sharper so that it reaches the same pt in same time as that like near equator so that no wear & tear happens in atmosphere.

For Air mass to acquire properties of its source (and on water), it has to stay there for a period before it moves. So it is more likely to happen in cold areas.



shift during winter (towards Equator) +
 sharper Meandering due to ↑ speed.
 (Hence US experiences sudden cold wave)

Temporary TS / Seasonal TS

Polar Night TS - over Arctic & Antarctic - during winter
 It prevents any hot air - wind & creates very cold conditions.
 Hence, reason for extreme sudden cold wave - Polar vortex

Maximum Ozone depletion

Antarctica, Arctic

In winter not possible due to absence of UV of sun for 6 mnts.

For depletion of ozone, substrate (ice crystals) is need for reaction to break it down.

Polar stratospheric clouds - due to extreme cold conditions.
contains lot of ice crystals during winter. polar vortex due to TS

September - Spring - 1st rays of sun

Antarctic Ozone depletion

Winter

Ice crystals UV rays

✓ X

March - Spring - 1st rays of sun

Arctic Ozone depletion

Spring

✓ ✓

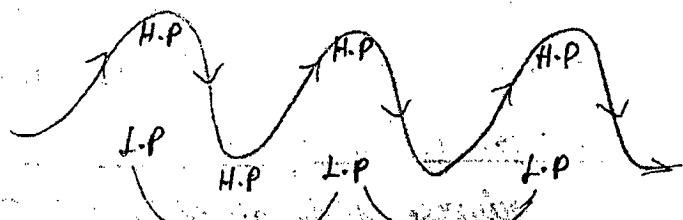
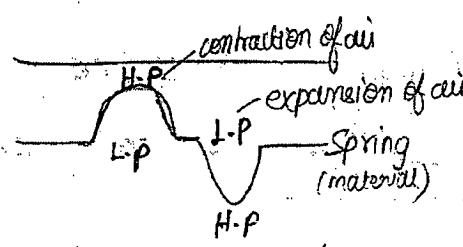
Depletion

Temperate Cyclones:

Its initiation can be due to:

- a) Fronts formation → cold air case by hot air push - L-P formation
- b) Jet streams

Meandering TS



Alternate bands of H.P & L.P - (\approx swimming

Western disturbances:

By sub-tropical TS from the West. (Mediterranean sea) BALLOON
HAW.

Good for economy: Showers in winter good for wheat

SET STREAMS

In the upper atmosphere, the conditions are not exact mirror opposite of the conditions at surface. Over a certain height in the upper atmosphere, there is a single pressure gradient with H.P. aloft Equator & L.P. aloft Poles. So, winds move from Equator to Poles & becomes Westerlies due to Coriolis Force (C.F.)

These UPPER TROPOSPHERIC WESTERLIES becomes stronger during winter when there is a greater pressure contrast.

Geostrophic conditions develop when the winds start moving along isobars & C.F. balances the P.G.F.

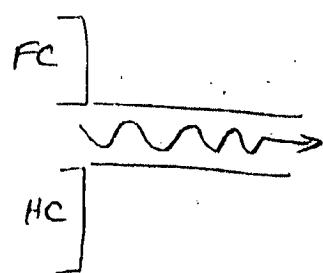
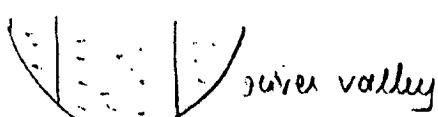
Embedded in these Upper Tropospheric Westerlies are:-

Bands of swift moving air which are formed at the Interface of Hadley, Ferrel & Polar cells. These are also known as reverse of the atmosphere.

Permanent SS

Sub-Tropical Westerly Jetstream

Polar Jetstream



Seasonal SS

May/may not be along the latitudes.

POLAR NIGHT JS → moves over Polar areas in winter

TROPICAL EASTERLY JS → over Indian Sub-cont. in summer.

SOMALI TS → move over NE Africa during summer.

⇒ TS follow a meandering path.

⇒ As they meander to conserve the angular momentum, meandering sharpens towards poles. TS with very sharp meandering cycles are called Rossby waves

⇒ TS influence a no. of climatic conditions like:

✓ Temperate cyclones in mid latitudes

✓ Western Disturbances

✓ Sudden cold wave over areas of America & Europe

✓ Monsoon in the sub-continent (India), etc..

Monsoon

Seasonal Reversal of winds

≈ Tropical Marine Climate Ex: Mexican.

→ Affects the eastern parts of continent - part of trade winds.



Tropical Marine Climate

Brazilian Coast

E. coast of Africa - Madagascar, Mauritius

N. part of Australia

Monsoon

Indo-china

Southern China

Indian sub-continent

N. part of Thailand

N. part of Australia

Monsoon

Max RF → Summer (Jun-Sep)

But, some dry months

Tropical Marine Climate

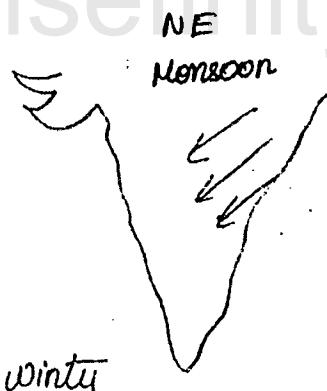
Summer.

No complete dry month.

(i) Seasonal Reversal of Winds / Retreat of monsoon by 180° .



Withdraws by Sep last or Oct first.



Arrival by Sep first or Oct first

ii) Temporal & Spatial Variability

Avg. Annual RF \Rightarrow 117.5 cm
(Since 50 years)

Aug. RF = 100 cm.

Normal Monsoon

> 95 cm &
< 105 cm

($\pm 5\%$) SW Mon.

2014 = 12 Y. Deficit

2015 = 14 Y. Deficit

2016 = Normal

2018 = 9% Deficit

More variation

Abnormal Monsoon

NE Mon. ($\pm 11\%$) - even more variation.

Chennai floods - 135 Y.

Worst drought in TN (> 50% from NE dependent
L 35% (65% deficit) RF)

24% deficit.

Chennai: 50% deficit

Tirunelveli: 17% surplus

INTRA-SEASONAL Variability

Sep 2018: 1st 5 days heavy rain; Next 15 days - dry - No RF;
But, overall month - deficit. last few days - Very heavy RF.

Production

2017-18: 32 mmt

2018-19: 33 mmt

But after Monsoon: ≈ 32 mmt

Y? UP: heavy rain - water log in UP: \downarrow SC production

Jan 2019: Dry but few days rained.

INTER-SEASONAL Variability

More in Summer, Less in Winter.

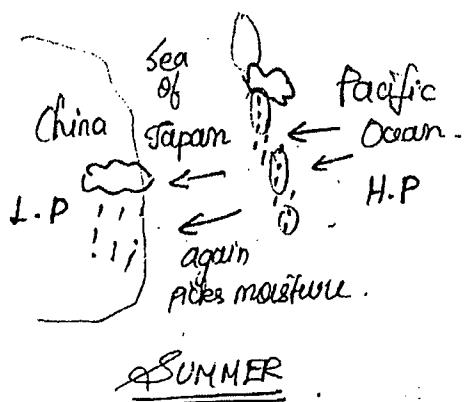
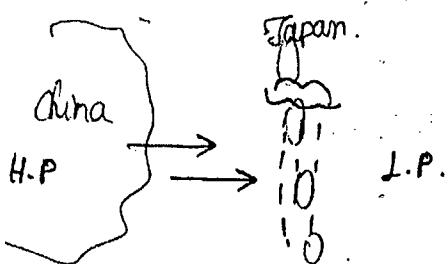
SPATIAL Variability

\uparrow RF in Tirunelveli during same period

\downarrow RF in Chennai

iii) Distinct Dry Season

Japan: RF due to temperate



Japan: RF during winter & summer

But more RF during summer: Hot wind carry more moisture.

This is Marine climate

But in monsoon: Dry (distinct) season.

iv) Sudden burst & Gradual advancement then onwards

We know what effects will El-Nino cause, but we don't know why El-Nino happens or how long will it stay & sometimes even we can't confirm if El-Nino happens sometimes.

IMD

Pre-monsoon showers wrongly communicated to farmers as Monsoon's early arrival - Double seed & fertilizer

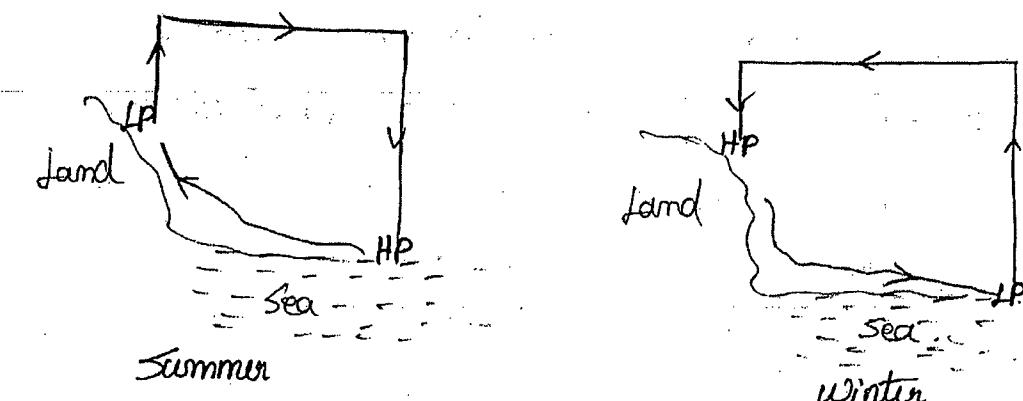
- NH farmers filed a case on IMD for this

⇒ Even with so much Tech, predictions of monsoon are really difficult.

Theories of Monsoon →

Monsoon limits to surface circulations. So incomplete in understandin

① HALLEY

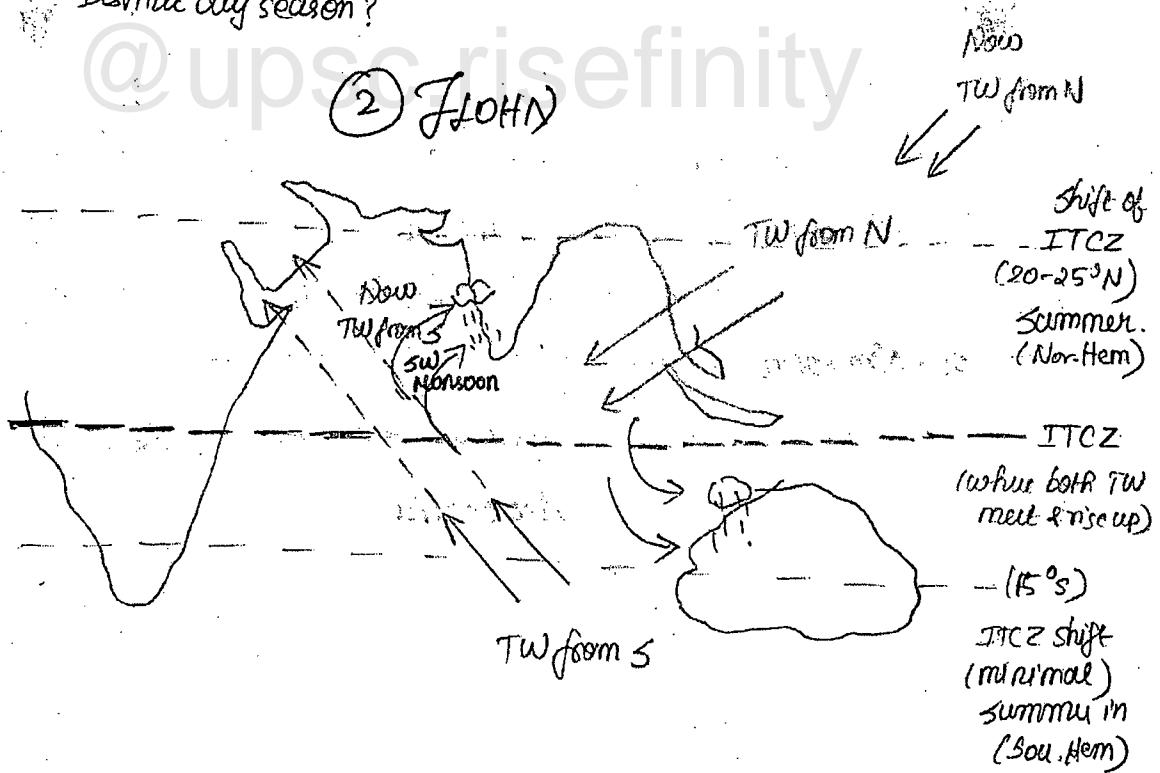


→ Monsoon - nothing but simple land & sea breeze.

→ Theory - not incorrect but not comprehensive.

- ✗ Why no monsoon in every coastal area?
- ✗ Int'l annual variation?
- ✗ Sudden burst?
- ✗ Distinct dry season?

② FLOHN



① HALLEY's Theory

It is one of the earliest expl. of Monsoon. He explains:

Monsoon → Simple land & sea breezes, which are the result of unequal heating of Land & water.

→ During SUMMER: Land-warmer - L.P
Ocean-cooler - H.P

As winds move from Ocean to Land, they pick up moisture & bring rainfall to the sub-continent.

→ Cold & dry winds bring conditions of ARIDITY during WINTER season.

② FLOHN's Theory

With apparent shift in position of sun, the ITCZ also shifts North or South of Equator.

SUMMER IN Northern Hemisphere → ITCZ shifts North of equator. The trade winds from South on crossing equator are deflected due to Coriolis force & enter on the sub-continent as SW Monsoon Winds.

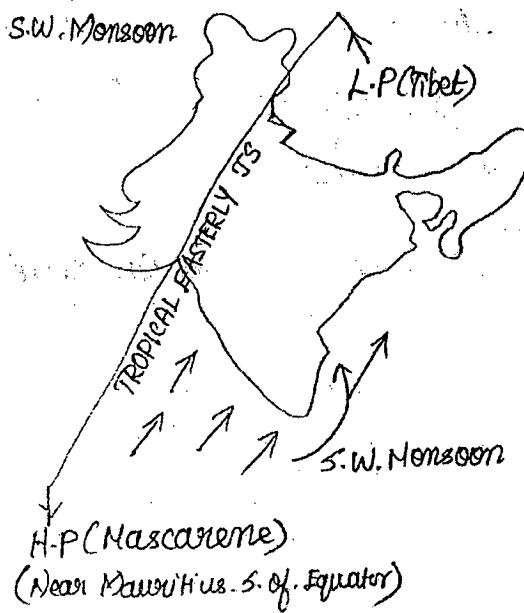
SUMMER IN Southern Hemisphere → Trade winds from North bring RF to parts of Australia.

ROOF OF TIBETAN PLATEAU

Higher the Heating
in TIBET
during Summer

→ Higher RF to India
from S.W. Monsoon

↓
Rises convect. current
& low TS formed & one
arm towards India



↑ Snowfall on
TIBET during
Summer

→ Drought like
conditions due
to ↓ S.W.MRF.

Recent study by Marshall in 2008:

Soot/dust particles by cold winds from Siberia to Tibet.

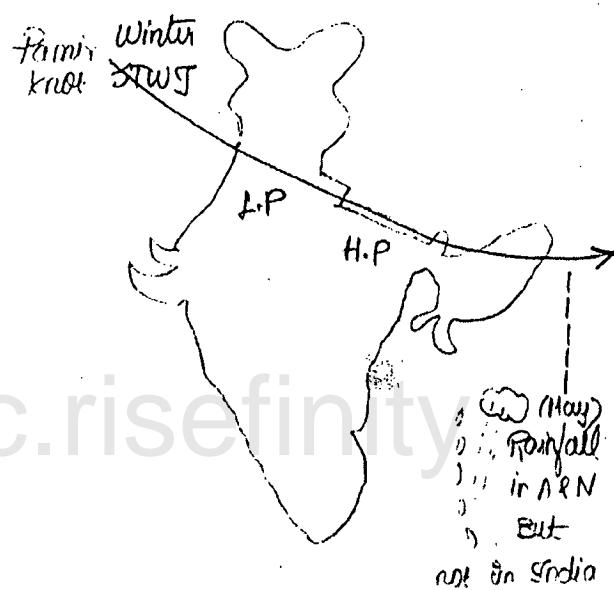
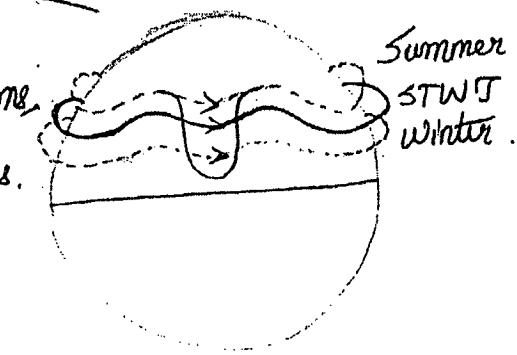
↓ Albedo → ↑ Heating of Tibet → ↑ RF by SWM.

SUB TROPICAL WESTERLY JET

One of the permanent jet streams over HP belt of sub-tropical areas.

It is directly related to the onset of monsoon.

MAY - strong SP in NW. INDIA



ROLE OF TIBETAN PLATEAU

HENRY BLANFORD in 1884 tried to establish a correlation b/w snowfall in Tibetan plateau & strength of S.W. Monsoon on the subcontinent. It was found that if there was:

Heavy snowfall in Tibetan plateau → Following summer season was drier.

KOTESHWARAM under MONEX Monsoon found Tibetan heating as one of the reasons for Inter-annual variability of monsoons.

During summer: Tibetan plateau gets heated & strong convectional currents develop → Air currents diverge on upper atmos. forming a low level jet called ^(TEJ) TROPICAL EASTERLY JET that sinks along Mascarene thereby intensifying HP on Indian ocean.

Winds diverge out from H-P along the surface & enter into the subcontinent as SW Monsoon winds.

Heavy Snowfall in Tibetan plateau → Heating is less intense in turn → Weaken the TEJ & Monsoon winds of RF to S-Asia.
Strong Tibetan heating corresponds to floodlike conditions
Heavy Snowfall might result in Droughts (If other factors remain constant)

WILLIAM LAC in a recent study of Maryland explains how dust particles deposited over Tibetan plateau influences Monsoons on South Asia.

ROLE OF SUB TROPICAL WESTERLY JET (STWJ)

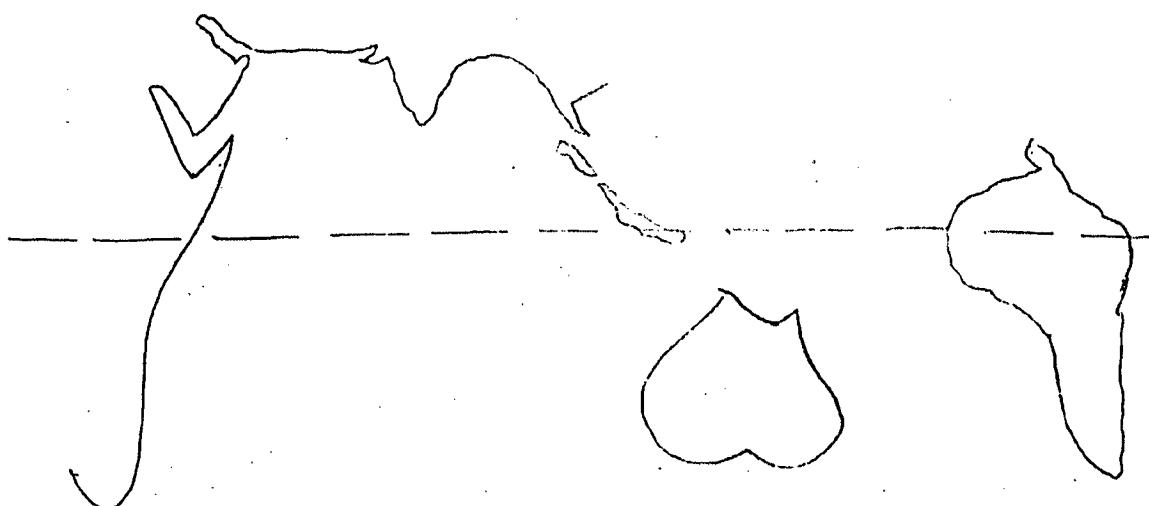
M.T.YIN explains the sudden burst of monsoon over coast of Malabar & breaks on the Monsoon season.

Summer Season: Strong depression develops over western parts of the country. This L-P though attracts the monsoon winds but the winds do not enter the mainland as an arm of STWJ is over the Northern plains which induces H-A on ground

1st week of June: STWJ migrates Northwards & strong L-P or Monsoon depression attracts the winds which bursts over the Kerala coasts.

If during Monsoon Season: STWJ meanders sharply & comes over Northern plains, it will bring a break on the monsoon.

EL-NINO

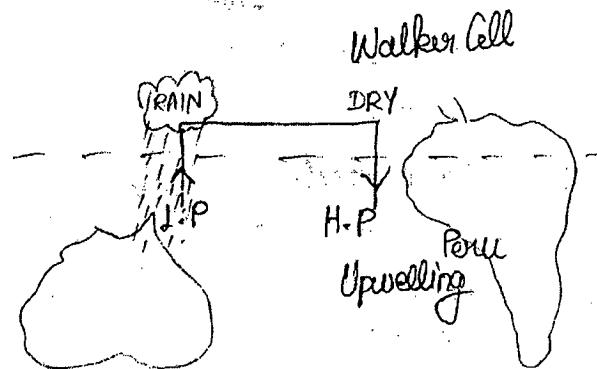
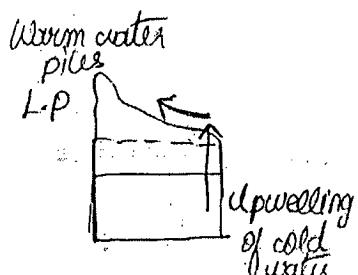
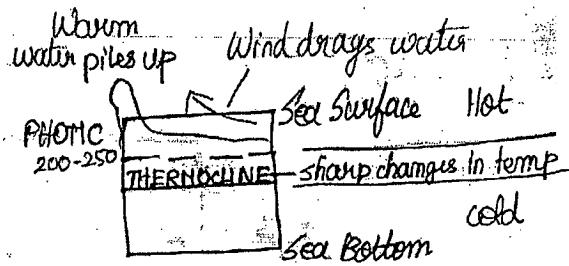


Heat of Ocean

99% - Insolation

Also, under water volcanoes,

Hydro-Acoustic winds



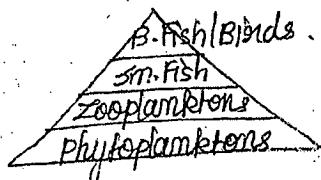
$\Rightarrow \uparrow$ FISHING VOLUME (Tropical)

1) China 2) Indonesia 3) India

$\Rightarrow \uparrow$ PER CAPITA CATCH (Temperate area)

✓ Rich fishing grounds usually have: Broad shelf (shallowest)

✓ Food pyramid.



\rightarrow Cooler water - None phytoplankton

\downarrow

\uparrow fishes

✓ Tropical areas: None species richness (variety in small area)

Temperate areas: Few species richness - Good for fishing

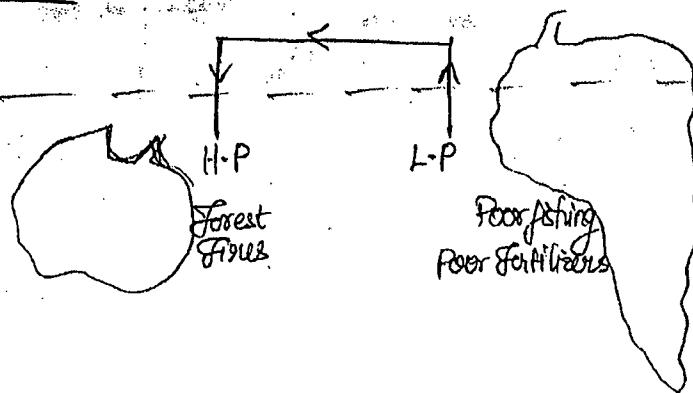
✓ W. coast of S. America - Narrow shelf - Yet due to upwelling - cold water - Good phytoplankton - Good fishing

Commercial imp. Ex: ANCHOVIES such in S. Am. coast due to Nutrients of upwelling.

✓ Excreta of Migratory birds (phosphates & Nitrate rich) \rightarrow Raw material for fertilizer industry

El-Nino

Reversed Walker Cell.



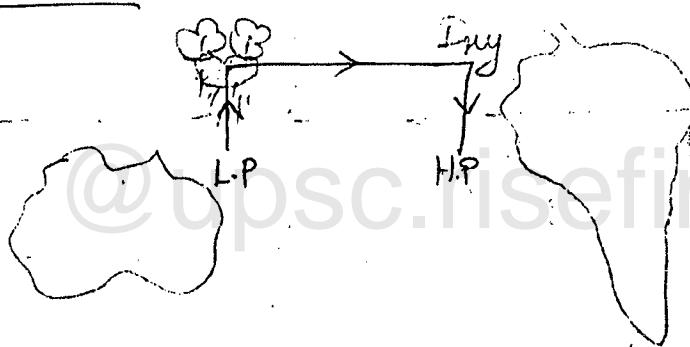
When trade winds weakens → Warm water comes back to S. America

why? Reasons unknown.

AUS: Forest fire

S.Am: Poor fishing

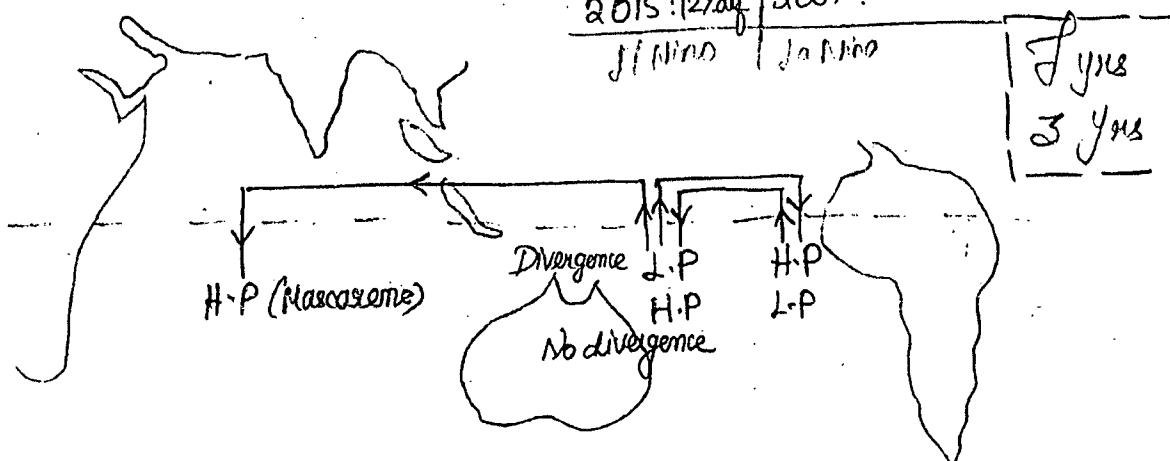
La-Nina



Intensification of Trade winds → More L.P in AUS ↑ RF → More L.P in S.Am. ↑ upwelling → ✓ Fishing.

In Indian Monsoons

2014: 14yrs dry	2010: Good RF
2015: 12yrs dry	2007: La-Nina



EL-NINO

- ⇒ The off-shore trade winds produce upwelling on the pacific coast of South America. These winds also drag water to the pacific coast of Australia creating a Warm western Pacific Pool.
- ⇒ WALKER CELL is formed with L.P off Australian Coast & H.P off Pacific coast of S.America.
- ⇒ Ports of Australia → Rainfall
South Am. Coast → Aridity prevails.

During some years, for the reasons not clearly understood, Trade Winds Weaken. Waters from Aus. coast moves in opposite direction & enters the S-American coast.

It changes the temp & pressure in Walker cell & this phenomenon is called EL-NINO.

LA-NINA

The Alter-ego of EL-Nino is LA-NINA.

The L.P of Aus. intensifies strengthening the Walker cell.

ON INDIAN OCEAN

The H.P in Indian Ocean is affected due to the change in temperature conditions in pacific. During EL-Nino years; the H.P is less intense & s.w. Monsoon winds bring RF deficit to S-Asia.

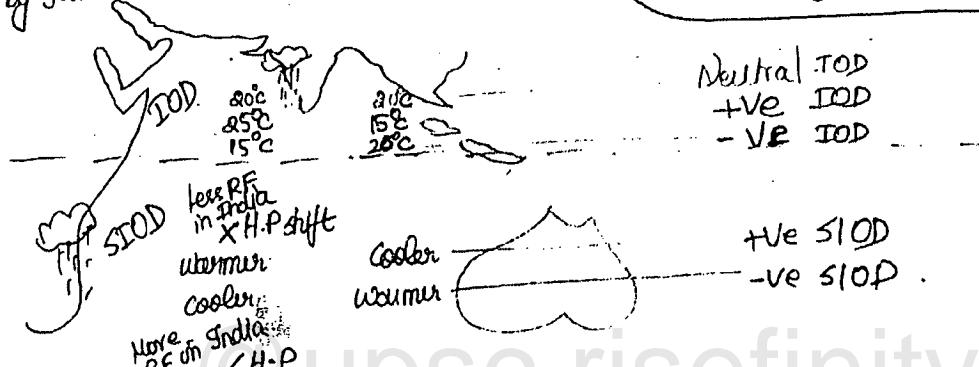
During La-Nina years, flood like conditions prevail due to strong s.w. Monsoon.

El-Nino Modoki is a temperature anomaly in central Pacific where Temp. fluctuates w.r.t. E & W. Pacific.

Decadal Pacific Oscillation is an oscillation system in the Pacific which bounds long term changes to climatic systems of Asia & America.

INDIAN OCEAN DIPOLe / IOD / SIOD / INDIAN NINO
f. 8 months
dies by June

(Stationary Oscillation)



[1997] El-Nino effect offset by strong +ve IOD - ↑ RF - moderate

[2007] La Niña + +ve IOD - Very heavy RF.

[2010] La Niña + -ve SOD. - ↑ RF - moderate.

	India	AUS
El-Nino.	Dry	Dry
+ve SOD	Wet	Dry

Only 6-7 months will IOD stay
El-Nino/La Niña - may stay for yrs.

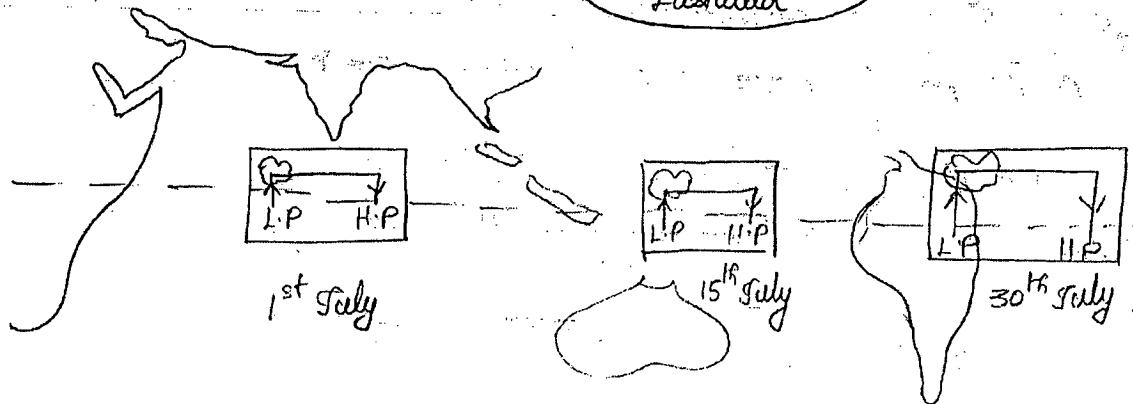
SIOD (Sub-Tropical IOD) - Since 3-4 yrs before.

+ve SIOD → Good RF in Africa

↓ RF in India as H.P. shifts East.

MADDEN JULIAN OSCILLATION

Dynamic Oscillation
Eastward



In Tropical areas; Dynamic - Moves eastwards.

Observing since 1973, yet causes unclear.

1 circle around Earth in 30-60 days.

2014 June - India - floods. The system stayed for 5-7 days over India.

MJO oscillations - 30 to 60 days

Indian monsoon - 90 to 120 days - can affect > 3 times in one monsoon season.

INDIAN OCEAN DIPOLE (IOD)

It is an oscillation system where 2 poles develop in the Indian ocean. It has a: * +ve phase * -ve phase * Neutral phase

> +ve phase → western S. Ocean ; E. S. Ocean } Stronger convection
warmer cooler Heavy RF : S. Asia

> -ve IOD → western S.O ; E.S.O } INDIA: Droughts : INDON; Aus
Cooler warmer } Droughts. (parts of)

SUB-TROPICAL IOD (STIOD)

It is an oscillation which develops in November peaks in February over Southern S. Ocean.

+ve STIOD → Heavy RF to Central Africa
Droughts to INDIA.

MADDEN JULIAN OSCILLATION

It is a moving oscillation system that has its own Enhanced RF ✓ suppressed RF.

It is an EASTWARD moving system that moves TROPICS. It has been observed that it completes 1 AROUND THE EARTH in 30-60 days.

It influences climate conditions across globe in Monsoons in SOUTH ASIA.

⇒ Some other factors also influence Monsoons:

Ex: Somali Jet - It moves over Africa & parts of It develops during summer season & aids SW

⇒ It has been also observed that while:

El Niño → brings deficit to SW Monsoon; But +vely related to NE Monsoon

Ex: Q2015 El Niño year - SW Monsoon - 14% deficit - NE Monsoon - >30% Scy

Oppatial variability of Monsoon
STUDY ON OWN

El Niño [H.P.] 100 mb [I.P.] Normal
[10 mb] 50 mb [I.P.]

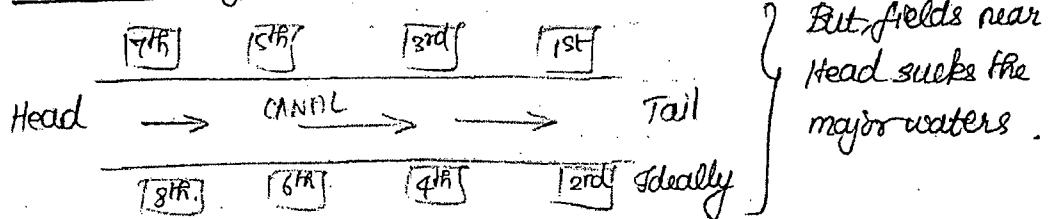
More intense IP
sub NE-strengthens.

IRRIGATION

CANAL IRRIGATION

- i) Very low efficiency - seepage, Evaporation, loss during application also.
- ii) High cost of construction of canal; It needs reservoirs also.
Economic + Ecological
- iii) Distribution problem: ✓ N - Perennial R. + soft Alluvial soil
✗ S - Seasonal R. + hard rocks.

Venabandhi system



iv) During Independence - 50-60% area under Canal Irrig.
But now: Only $\approx 26\%$ area under Canal Irrig.

Why? CENTRALISED form of Irrigation. [Tube well: decentralised]

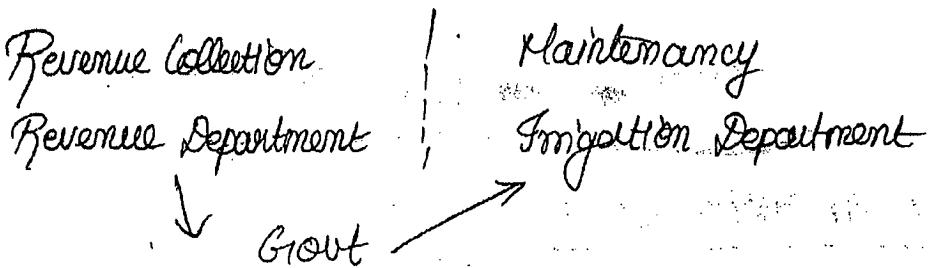
Central agency maintains volume & time & end user has \downarrow say.
So, Today: $\approx 50 \times$ Tube well (areas under)
 $\approx 65\%$ Ground Water (areas under)

v) Operation & Maintenance

↓ Siltation problem \rightarrow Every year Dredging to be done after Monsoon
 \downarrow Canals own under capacity

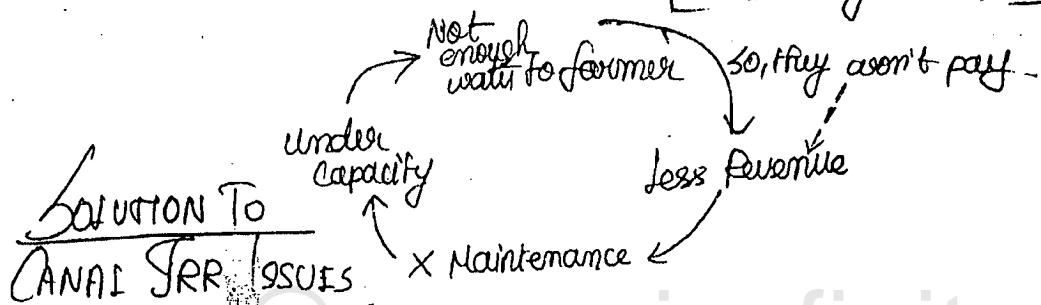
↓ REVENUE ISSUE \rightarrow Canal Irrigation fees - not revised
Since 1980s in most states. \rightarrow Reverse the fees.

BIHAR \rightarrow Cost of Revenue Collection for Officials $>$ Revenue itself



- ② So, need to streamline the process & just ↑ revenue is not enough.
- ③ No cap on water usage as same cost for any amount of water usage. So, charge the farmers as per their water usage. — 1 amount over a certain limit

DALWAI Committee
on Doubling F. Income



SOLUTION TO
CANAL IRR ISSUES

PARTICIPATORY IRRIGATION MANAGEMENT

* Decentralisation * Democratisation * Participation

How? By making Farmers/users by Owners - Ownership Rights.

WUA (Water User Association) - PANI PANCHAYATS.

Formed by users. They should be given Rights to :

- ✓ Decide distribution
- ↓
- For equitable distribution
- ✓ Decide fees
- ✓ Collect fees
- ✓ Maintain canals
- SGI oppose it as it will lead to Corruption.

Teknical expertise needed. But even WUA can hire Engg.³ if they have money

Enabling provisions needed to be made in laws by SGI to make it happen.

KULHS

Lahul & Spiti → Cold conditions → During summer,
Melt water of snow diverted to fields.

- ✓ Best maintained systems in the country. Fully by users & not much by Govt.
- = This can be done in WUA also =

WATERSHED MANAGEMENT

Govt Measures for flood management:

- ✓ Creation of embankments
-
- ✓ $\approx 35,000 \text{ km}$
- Flood prone areas
- | | |
|---------|----------|
| 1950-51 | 26 mn ha |
| Now | 49 mn ha |

- ✗ Area doubled due to Encroachments \rightarrow Structural solutions ineffective
- ✗ Also these embankments are now ineffective due to breaches.

Ex: BIHAR, 2008

R. Kosi (Son of Bihar - frequent changes of course)

\hookrightarrow Breached embankments - Devastating floods.
(7th/8th time since Independence)

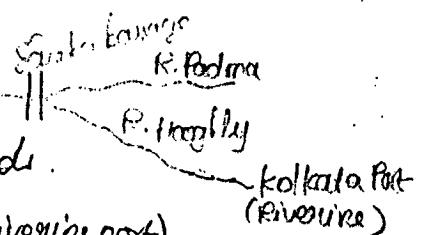
Ex: KERALA, 2018

Dams - Flooding

Ex: BIHAR plains, 2016

Tarakka barrage is reason for floods.

\hookrightarrow to desilt the kolkata valley port (Riverine port)



Root of the problem (R. Kosi)

In Nepal - Arun Kosi River - Runs in deforested areas -

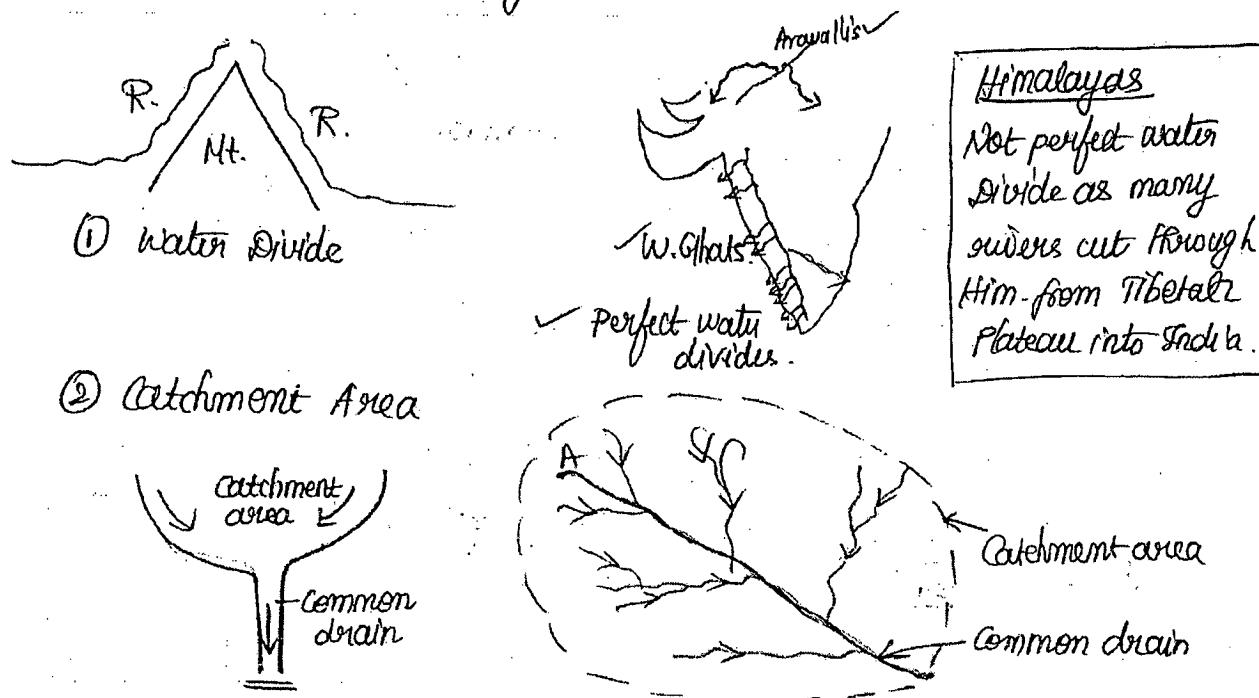
Soil erosion - steep gradient, silt carried down the mountain -

Gradient becomes gentle down - silt/sediment accumulation -

R. unable to cut through it - So R. changes course often -

Floods. Solution: ENVIRONMENTAL CONSERVATION - But, must bring tangible
- Long term; Sustainable - & direct results

So, as part of this solution, came the concept of:
Watershed Management

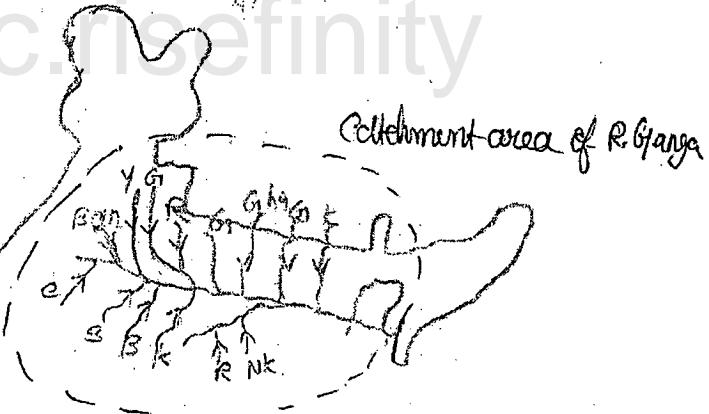


WN aims to improve the overall catchment area.

Components of catchment area / watershed

- 1) SLOPE
- 2) SOIL
- 3) VEGETATION
- 4) RIVERS
- 5) HUMANS*

SYSTEMS
APPROACH



Idea of WN:

→ To undertake those activities that doesn't disturb the balance of the interactions b/w these components

Ex: If we modify slope → soil erosion → Galis → Ravines
 ↓ River capacity ← Silt ← X Vegetation

Activities under W.M.

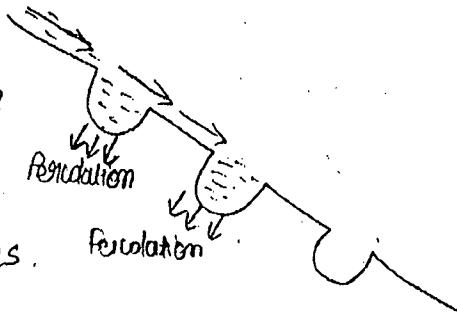
① TRENCHING

Retention basins at regular intervals

✓ ↑ Groundwater recharge

✓ ↑ Springs

✓ ↓ Deforestation ; ✓ ↓ Forest fires.



Himalayan region → Rapid & strong surface runoff

But now springs decreasing ← Main source of water ←

drying

Spring water

Spring

Spring water

Permeable

Saturated soil

Impenetrable

when more & more water puts wt,
water comes out due to pressure.

* NAULA - Spring system

Deforestation in tropical areas of world:

X Manly Forest fires - Trenching can help reduce it.

Ex: Uttarakhand forest fires, 2016

→ 2014, 15' - drought years.

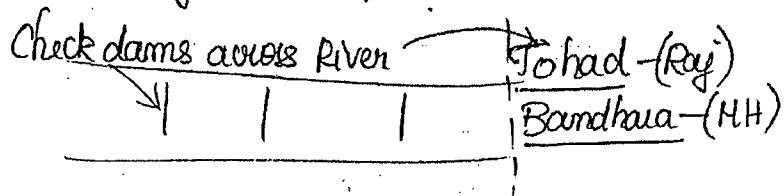
→ Pine trees - Pine needles have resins (industrial application),
but they catch fire easily & also spreads easily

Areas of trench systems will have moist soil & leaves falling
on moist soil won't catch fire easily

② WATER HARVESTING:

Rajasthan - Aravali River Project
under WATERMAN OF INDIA.

Once dry - Now a perennial river



AHAR PYNEES - Irrigation system in Bihar to carry rain to fields
(rice cultivation highly depends on water)

ZABO - (Nagaland) - Water + cattle excreta - to fields
diversion (Manure) Fertilization

BAMBOO DRIP IRRIGATION - (Meghalaya) - for coconut plants

(Kerala) - Horizontal tunnels + wells

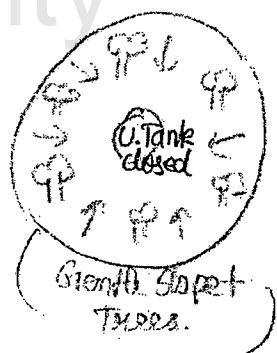
Surangam

Tanka - (Gujarat) - underground tanks
(Drinking water)

Afforestation

Now, MNREGA labour used to maintain & create these systems.

Snow melt water to fields
kuls - Lahul Spiti, HP
Zings - Ladakh.



(3) AFFORESTATION:

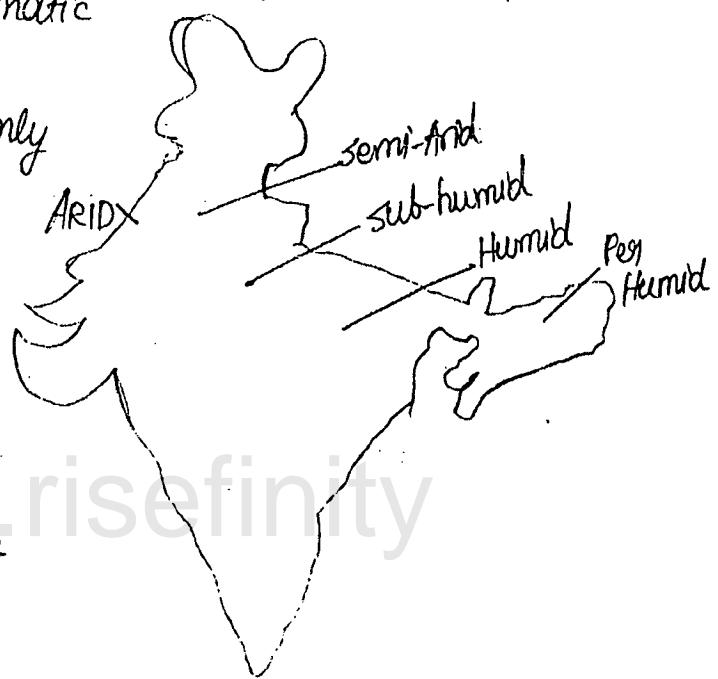
Trees on slopes, river banks.

[Animal husbandry with too much chemicals - don't come under sustainable, hence not under WN]

(4) AGRO CLIMATIC REGIONALIZATION:

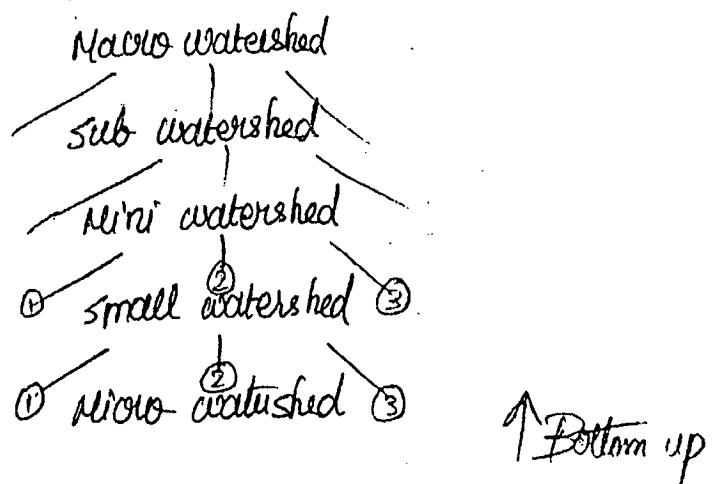
Dividing areas into climatic zones.

Growing plants / agri. only
Naturally suitable for those areas.



→ Involvement of local community in planning & implementation crucial for WN.

Classification of watersheds based on size of catchment area:



PC → Top-down plans ineffective -

Bottom up approach required to involve locals

Starts with Micro-watershed $\xrightarrow{\text{then}}$ small watersheds →

1977-78 - DESERT DEVELOPMENT PROGRAM (DDP)

Hot deserts (RAJ) - To stabilise sand dunes to reduce the spread of deserts.

Cold deserts (Lad, HP) - To make water available to ppl.

1990s - HANUMANT RAO committee

No success in DDP due to ↓ locals involvement

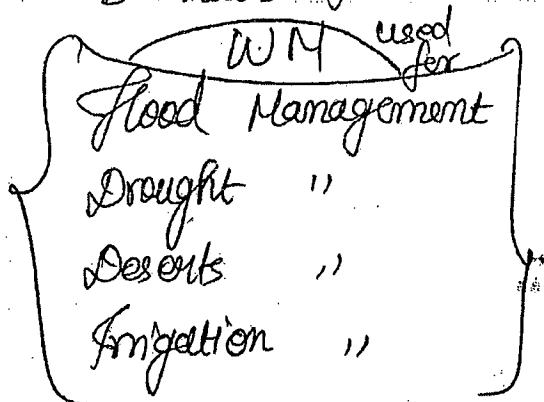
Need to include watershed Mngt.

2008 - INTEGRATED WM Program

DDP subsumed under this + DPADP subsumed.

2016 - MH - Drought Prone Area Dev^t Program

Farm ponds } water harvest of
Bundhara } WM. (DPADP)



PM KSY
PM Krish Samachar
Yojana.

Notes:

⇒ Most of our problems related to land, water, forests, etc are interrelated. Our efforts to solve these problems in ISOLATION have been less effective.

It is now well acknowledged that ENVIRONMENTAL CONSERVATION is the key to solve above problems.

But at the same time it is also understood that Environmental conservation is less likely to produce results if it doesn't bring tangible & direct benefits for humans.

It is under this idea that WATERSHED MANAGEMENT (WM) holds relevance.

⇒ Watershed → can be seen as a:

> water Divide

> catchment area

It is best conceived as a Geo-hydrological basin with its components as:

o slopes	o soil	o Humans
o Trees	o rivers	etc...

All in a state of interaction.

⇒ Under WM, we plan for the Development in such a* way that the balance b/w above components is not disturbed.

⇒ Activities under WM

✓ TRENCHING ✓ CONTOUR BUNDING

✓ TERRACING ✓ SOCIAL FORESTRY

✓ Creation of WATER HARVESTING systems etc.

⇒ Active participation from local community in planning & implementation is a prerequisite for success of WM.
The planning has to follow a BOTTOM-UP Approach.

⇒ Today many of our programs for:

- ✓ Drought Management
- ✓ Flood Management
- ✓ Desert Development etc..

use the concept of WM.

⇒ WM is also a very important component of

PMKSY (PM Kisan Sinchay Yojana), 2015

→ It subsumed all irrigation programs problems:

see Ch- 2

- ✗ less area under irrigation
- ✗ Low water use efficiency (\downarrow productivity)
- ✗ Ground water depletion due to overuse of tube wells (free elect.)
- ✗ Technique of irrigation is wasteful (flood irrigation)
- ✗ Micro irrigation-costly-confined to high value crops.

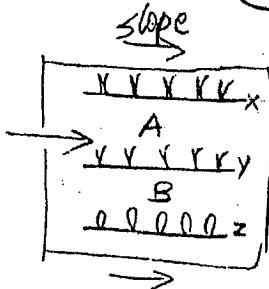
Features of Indian Agriculture

Objectives of PMKSY:

- i) Haar keth ke panni
- ii) Per drop more crop
- iii) Tal samachay (water conservation)
- iv) Tal sinchay (Better technique for irrigation)
- v) Recycle & Reuse

(Peri urban areas can use recycled water of urban areas, which are e.g. water for drinking & sanitation).

Drip Irrigation



flood irrigation into fields:

✗ evaporative losses ↗

✗ soil salinisation ↘ (in arid regions)

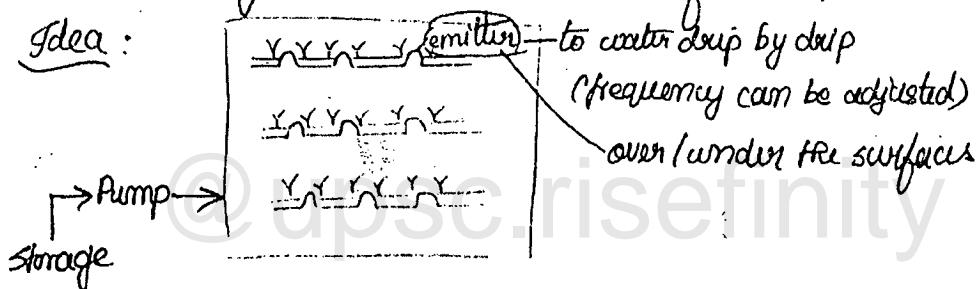
✗ sheet erosion of soil

✗ water not only to X, Y, Z but also to

A & B (non-crop areas) → ^{unwanted} Grasses grow < Fertilisers (excess soluble) (weeds) go to A & B also
Labour + Cost for uprooting

Drip Irrigation can solve most of these problems.

Idea :



✓ water directly at root of plants → Efficiency = 90%

✓ No problem of soil (sheet) erosion of water

✓ soil salinisation reduced

Ex: Israel (60% desert); California

✓ efficiency of fertiliser usage - Fertiligation

✓ water & nutrients not available for weeds to grow.

✓ Even less capacity pumps can be used as water amount is less → ↓ power consumption.

challenges :

- Initial Cost
- Technical training for Maintenance

@upsc.riseinfinity

PMKSY

Toruk
farming

(*) Accelerated Irrigation Benefit Program

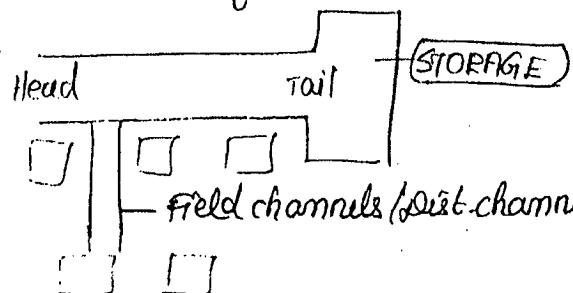
- Financial assistance for completion of major & medium irrigation projects.

>10,000 ha 2000-10,000 ha

Minor - <2000 ha

- Creation of storage systems at tail end of canals.

- Creation of Field channels & distribution channels.



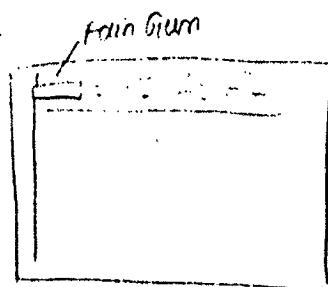
- Creation of lift irrigation for fields at higher slope.

(KUSUM - lift irrigation power)

M.o.-Water Resources & Ganga Rejuvenation

(*) On Farm Water Management

Farm Guns }
Sprinklers } at subsidised rates.
Sprinklers }



M.o. Agriculture Co-operation & Farmers welfare.

(*) Integrated WM Program

I.T. subsumes

- ✓ Desert Devt Program
- ✓ Drought Prone area devt Program
- ✓ Integrated watershed devt program.

M.o.-Rural Development

DRAINAGE SYSTEM

Avg. Annual RF : 117.5 cm

- > 4000 Bn cub. Ntre
- > ~ 3000 BCM - wasted/unused

Per capita availability

1951 = > 5000 m³

2011 = \approx 1545 m³

WHO - 1700 m³ per capita necessary - if not water stress

< 1000 m³ per capita - water scarcity.

\Rightarrow ↑ population; ↓ depleting water resources

Water Stress & Scarcity.

\Rightarrow Floods & Droughts

Have become integral to Indian monsoons

\Rightarrow ↑ Power demand for Industries - must be cleaner & cheaper

(40% by 2030 ... must be from non-fossil fuels)

\Rightarrow Drinking water stress - Himalayas.

\Rightarrow ↑ Logistics costs - 90% higher than China

102 - National waterways to be developed identified.

6 - 1, 2, 3 - operational

4, 5 - not open

6 - under construction

\Rightarrow Over dependency on monsoons - ↓ Productivity, crop failure.

VIDEO

Soil forming process

Soyland Agri.

Tute industry

Drainage system

Some topics.

INTERLINKING OF RIVERS

To use surface runoff for irrigation & drinking water.

* Srinagarin lotton

1980s-National Perspective Plan

16 - for peninsular rivers

14 - for Himalayan rivers

DPR (Detailed Project Reports) submitted for many projects recently (2014-18).

i) Ken-Betwa river linking - NATIONAL Project
In Bundelkhand area.



ii) Damanganga-Pinjal river project

Pinjal is tributary of Vaitarna R. passes through Mumbai metropolitan.
water from R. Damanganga $\xrightarrow{\text{to}}$ Bhugad Reservoir
 $\xleftarrow{\text{to}}$ R. Vaitarna
R. Pinjal $\xleftarrow{\text{to}}$ Khargil Reservoir
 $\xleftarrow{\text{to}}$ Drinking water to Mumbai.

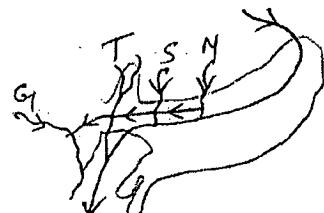
iii) Par-Tapi-Narmada River Project

R. Par - starts from NH into GUJARAT \rightarrow Arabian sea.
 ↓ to
 R. Tapi \rightarrow R. Narmada \rightarrow Dry areas of Kutchh & Saurashtra region of Gujarat.

iv) Mandovi-Sankosh-Teesta-Ganga River Project

R. Mandovi \rightarrow R. Sankosh \rightarrow

R. Teesta \rightarrow R. Ganga.



Area under irrigation.

Total irrigation: 140 mn ha + 35 mn ha

\Rightarrow If 16+14 completed: \rightarrow 175 mn ha

\Rightarrow Storage capacity: 1850 BCN
to be increased to

\rightarrow 35 GW of hydro power - clean energy
to be added.

\rightarrow Equitable distribution \rightarrow Flood & Droughts can be solved.

Irrigation Drinking water

challenges:

1) Environmental Issues

Ecological losses. — Ex: Panna tiger reserve submergence in K-B. project.

\Rightarrow G-Brahmaputra \rightarrow largest delta in world.

\downarrow silt if dams \rightarrow \downarrow delta formation

- ⇒ Mangroves trees affected.
- ⇒ Good for controlling floods - Buffer zones for Tsunamis, storm surges.
- ⇒ Movement of aquatic animals.

(2) More area under irrigation means ↑ Canal irrigation

South India ← + Ineffective
 Head works tough to create canals.

Flood control } contradictory to each other.
 Full Hydro power generation. } Not possible together.
 Empty X.



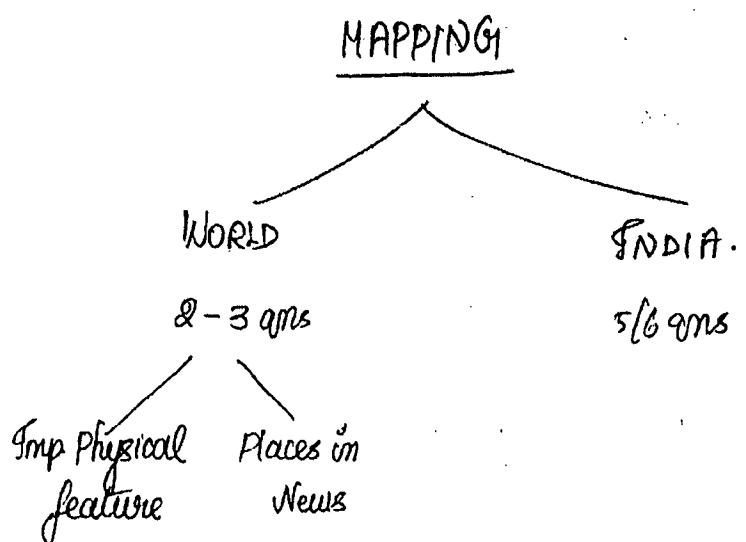
~~Small storage systems~~

~~Better than large systems~~

~~Decentralisation; Discretion to local users.~~

~~Bangladesh - NE dynamics~~

@upsc.risefinity



Encl: Map handout

- ①-④ Map 4 classes
- ⑤ Tide
- ⑥ physiography

Tropic of Cancer

(NA)	Africa	Asia	Pacific Ocean
Mexico	Bolivia	SUQIBM CT	Hawai Island
	W M M A N L E	Saudi Arabia	Not through land but south of Necker Island.
	Western Sahara	UAE	
	Mauritania	Oman	
	Mali	India	
	Algeria	Bangladesh	
	Niger	Myanmar	
	Libya	China	
	Egypt	Taiwan	

Equator

E C B	Sao Tome & Principe	G C D U K S	Maldives	Indonesia
Equador		Gabon	(Not land but through Huvandhu Atoll*)	Kiribati Island (Aranuka Atoll)
Columbia		Congo		
Brazil		D.R. of Congo		
		Uganda		
		Kenya		
		Somalia		

*Atoll: Ring shaped coral reef

Tropic of Capricorn

South America

- C Chile
- A Argentina
- P Paraguay
- B Brazil

Africa

- N Namibia
- B Botswana
- S S. Africa
- M Mozambique
- M Madagascar Island

Oceania [AUSTRALIA + NEW ZEALAND +]
Pacific Ocean Islands

Australia

New Caledonia (under France)

TONGA Island (indep)

COOK Island (under New Zealand)

FRENCH POLYNESIA (under France)

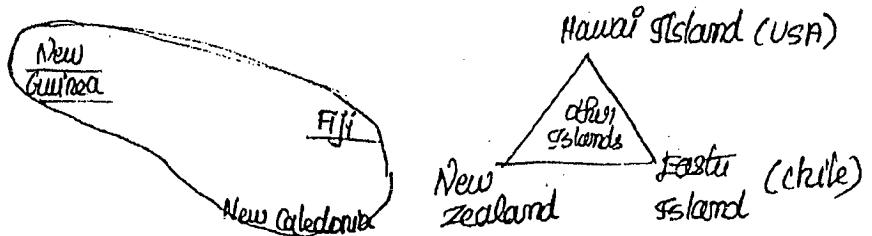
@upsc.risefinity

WORLD. PACIFIC

① MICRONESIA

② MELANESIA

③ POLYNESIA



MELANESIA

Region in PO from NEW GUINEA to FIJI ISLAND.

Fiji → • Dlsp - Many PO-ppl of Indian origin.

MICRONESIA

North of Melanesia

FEDERATED STATE OF MICRONESIA

KIRIBATI

MARSHALL ISLAND.



@upsc.risefinity

Gulf of Aqaba

AFRICA

Sinai peninsula

Gulf of Suez

Arabian peninsula

Gulf of Aqaba

BRAZIL

RUSSIA + TURKEY + EGYPT.

GIGS + BD

Gold Coast — Sierra Leone + Liberia

Fooly coast — Côte D'Ivoire

Gold coast — Ghana

Slave Coast — Togo + Benin + Nigeria

@upsc.risefinity

BAY

GULF

STRAIT

Water having land on three sides - WIDE MOUTH.

Technical Name for bigger Bay

Narrow water way connecting

to large water bodies

ISTHUMUS

Lowland strip of land connecting 2 large masses.

@upsc.risefinity

But actually first they named due to saline water

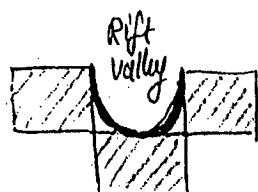
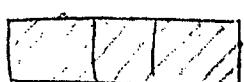
But now we can have saline water lake - But no change in name

CHINIAN SEA - Actually larger lake but called sea - they say due to

O ARAL SEA - So small, but thus too sea

size]
\$ 90

FOLD.



Earlier Red sea was not there
& these lands were connected.

~~so~~ ~~future~~ this rift valley ~~will be~~ formed many seas.

Great Rift Valley

- 1). Divergent plate boundary
- 2). It will split African plate into two plates

It stretches Northward towards

ZAMBIA → MALAWI → KENYA and extend to Red Sea upto
↓
TANZANIA → ETHIOPIA BEQAA Valley in LEBANON

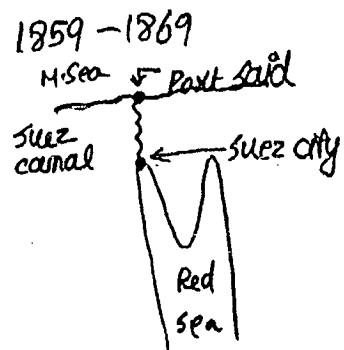
- 3) LAKES → ✓ L. Turkana ✓ L. Tanganyika X L. Tana
✓ L. Albert ✓ L. Malawi X L. Victoria
✓ L. Edward
✓ L. Kivu

SUEZ CANAL

- i) Artificial Sea level water way connecting MEDITERRANEAN ↔ RED SEA

ii) Constructed by Suez Canal company in b/w Port SAID - towards N.Sea

iii) 2 Terminals
SUEZ CITY - towards R.Sea



Lake Nyasa / Malawi

- ✓ 3rd largest lake of Africa
- ✓ Rift Valley lake

Lake Tanganyika

- ✓ 2nd largest lake of Africa

→ World's longest fresh water lake

[World's largest fresh water lake
L. Superior (N. America)]

Lake Victoria

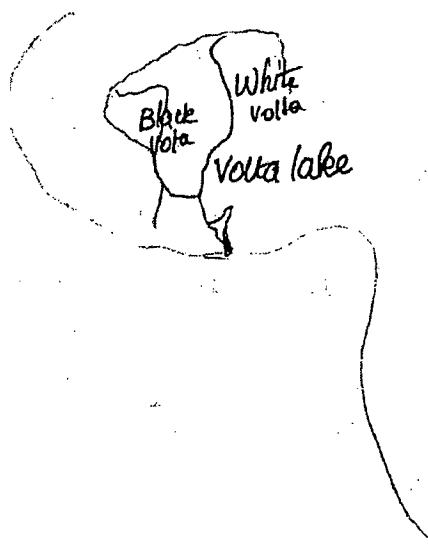
- ✓ Africa's largest lake
- ✓ 3rd largest lake in world

[Africa Caspian sea &

superior lake

(It is a remnant of Tethys Sea (formed bcs of Himalayas))

- ✓ Source: White Nile River
- ✓ Formed bcs of DEPRESSION



Lake Tana

- ✓ Source of Blue Nile River

- ✓ Formed bcs of Volcanic activities

CHAD LAKE

Ex. loc in P. of kutch.

✓ Lake of INLAND DRAINAGE

- ✓ Formed bcs of Depression + water from inland river. Chari.

- ✓ Loc: At the conjunction of 4 countries

CHAD

CAMEROON

NIGER

NIGERIA

- ✓ Chari river drains in chad lake

VOLTA LAKE

- It is manmade lake on VOLTA river.
- It is contained behind AKOSUMBO DAM.

KARIBA LAKE

* World's largest Manmade Lake

ASSAL LAKE

* Lowest/Deepest point of Africa continent.

RIVERS

NILE RIVER:

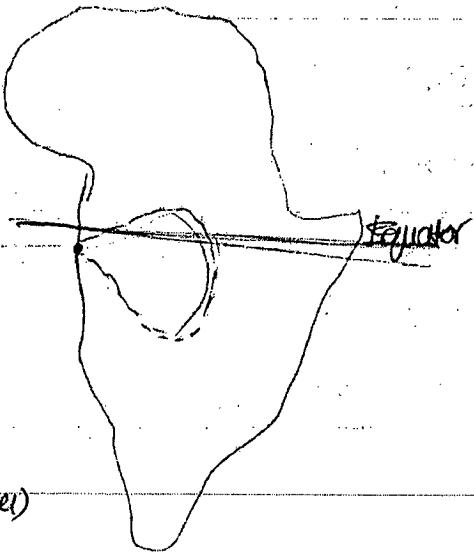
- Source: L. VICTORIA - White Nile } Confluence
2. Source: L. TANA - Blue Nile } @ KHARTOUM
3. Della: ARCUATE Delta (Ex: Ganga delta too)
Arc shaped delta
4. DAM: ASWAN Dam.

Nile River & Tributaries pass through 10 Countries:

- | | |
|---------------|------------|
| ① Egypt | ⑥ Tanzania |
| ② Sudan | ⑦ Rwanda |
| ③ South Sudan | ⑧ Burundi |
| ④ Ethiopia | ⑨ DRC |
| ⑤ Kenya | ⑩ Uganda |

CONGO RIVER / ZAIRE:

- ✓ Meets Atlantic near
PORT OF MATADI
- ✓ Cuts Equator at 2 places/points
- ✓ Some places - depth 220 mts as
compared to its own surface (river)
- * 2nd longest River in AFRICA
(Only after Nile)



NIGER RIVER :

- * 3rd longest River of Africa.
- Source: GUINEA Highland
- Outflow: Gulf of Guinea
- port: Port HARCOURT of NIGERIA
- located on this river.

R. LIMPOPO

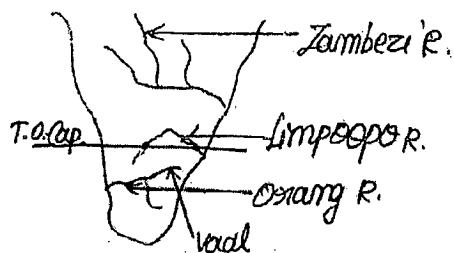
- ✓ cuts T-O. Cap twice

R. ORANGE

- Source: DRAKENSBERG Mts.
- Tributary: Vaal.

VOLTA RIVER

- Black Volta White Volta
- AKOSONBO Dam here



ZAMBEZI RIVER.

- * VICTORIA Waterfalls
- Source: KATANGA Plateau
- ✓ MARIBA Lake & Dam
- outflow: Mozambique channel

5 Distinct Kinds of Desert Landscape

- 1) HANADA 2) REGI 3) ERG 1 4) BAD LAND 5) MOUNTAIN Desert
- ✓ Rocky ✓ Stony ✓ Sandy ✓ Infertile
(Pointed)
Desert of
Arizona)
- ✓ Mt. Hoggar
✓ Mt. Tibesti
- Basis of water action. ↓

[The extent of water action on hill slope & rock surface was so great that entire region was abundant by the inhabitant, hence the region became infertile]

SAHARA DESERT

- ✓ 5° N - 30° N
- * World's 3rd largest Desert
 - [1. Antarctica 2. Arctic Desert]
- * World's largest HOT DESERT.

Include:

- HANADA (Rocky)
- ERG (Stony)
- MT. Desert (Mt. Hoggar & Mt. Tibesti)

LIBYAN DESERT

- ✓ Stony desert of Libya
- ✓ Pebbles & gravel

NUBIAN DESERT

- Between - NILE R. & Red Sea.
- Arid + Rocks + Sand dunes.
- It also contains many 'WADIS'

Note - 'WADI'

- ✓ It is an Arabic term referring to a Valley.
- ✓ It refers to Dry River Bed that contain water only during heavy rain time.

KALAHARI DESERT

- Semi arid Region.
- It encompasses:
- Most of BOTSWANA +
 - ✓ Part of NAMIBIA & SA.

Tribe: BUSHMEN Tribe

- ✓ Okavango River - Only permanent river of Kalahari Desert.

NAMIB DESERT

- ✓ Coastal desert south of Africa
- ⇒ ANGOLA + NAMIBIA + SA

ATLAS MOUNTAIN:

- ✓ High Atlas
 - ① ✓ Middle Atlas
 - ✓ Anti Atlas
- ② Saharan Atlas
- ③ Tell Atlas [TUNISIA + ALGERIA]
- ④ Aures Atlas [TUNISIA + ALGERIA]
- ✓ Highest peak: Mt. TOUBkal ▲
- ✓ They are Fold Mountains.

JOS PLATEAU

- It is located on Northern part of NIGERIA.
- Famous for TIN Deposit.

KATANGA PLATEAU

- * Largest Copper & Diamond producing Region of ZAIRE (DRC).

— Old name of Congo Land
— Name of Congo - watu silver

DRAKENSBERG SCARPLAND

- High Escarpment in Southeast Africa
- Formed because of lava flow
- Escarpment: Long cliff or steep slope.

Mt. Cameroon

→ Active volcanic Mtn. of Africa.

Mt. Ruwenzori

→ Near Lake Albert

* Called 'MOUNTAIN OF THE MOON'

Mt. Elgon

→ North of L. Victoria

Mt. Kenya

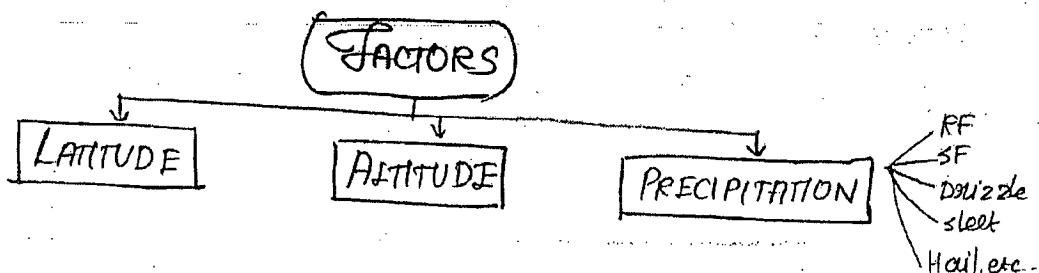
* 2nd highest peak of Africa

Mt. Kilimanjaro / M. KIBO

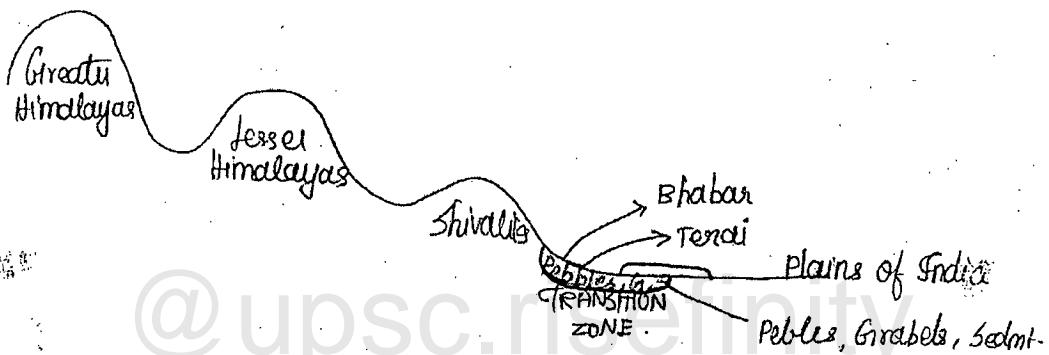
* Highest peak of Africa

→ Extinct Volcano.

NATURAL VEGETATION IN INDIA



ALTITUDE



Bhabar:

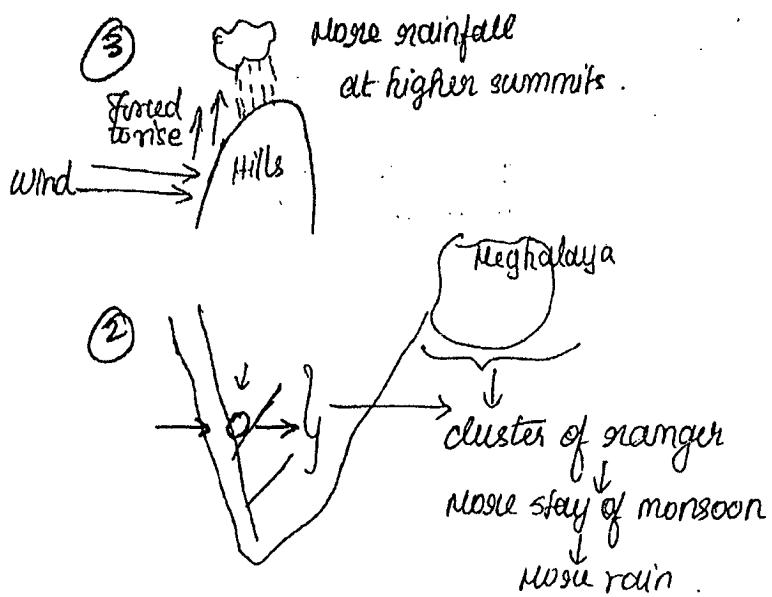
- Gently sloping Alluvial zone
- South of shivaliks
- ✓ Here streams disappear under Pebbles, Gravel & sediments.
- Again these streams rises to surface in Terai region

Terai

- Few belt of Marshy land
- Lies btwn Bhabar & Plains of India

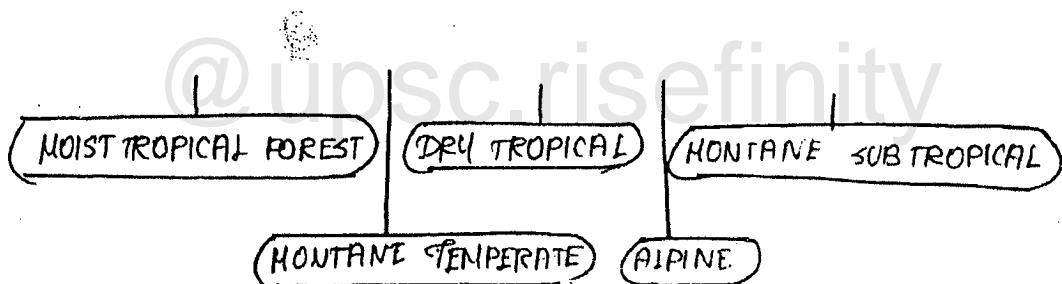
Indo-gangetic plain + Brahmaputra plain

WESTERN GHATS



Himalayas
Western & E. ghats
Garo, kasi, Tewa hills
Mizo, Naga, Manipur hills.

- ① West of WG get ↑ RF
- ② South of WG get ↑ RF
- ③ Higher places of WG get ↑ RF



I. MOIST TROPICAL FOREST

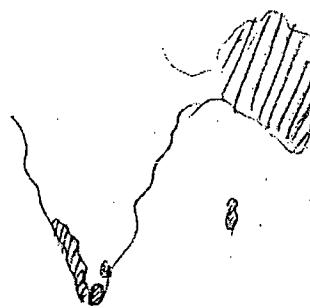
- ① Tropical Wet Evergreen
- ② Tropical Semi Evergreen
- ③ Tropical Moist Deciduous
- ④ Littoral & swamp

} RF > 250 cm
RF: 200-250 cm

1. Tropical Wet Evergreen

Area

- i) South of western ghats
- ii) Patches on TN
- iii) NE states [AP, Upper Assam, Nagaland, MP, Mizo, Megh & Trip]
- iv) A & N islands



@upsc.risefinity

Make chart

RF	Temp.	Hum.	Area	Tree species	Other info
----	-------	------	------	--------------	------------

T.W.E

T.S.E

:

(RF) Annual RF > 250 cm

(Temp) Avg annual temp: $25^{\circ} - 27^{\circ}$ C

(Hum) Avg. ann. hum > 77%

Vegetation

→ Trees do not shed their leaves together in one season.

- i) Mesua ii) White Cedar iii) Calophyllum
- iv) Palaegium v) Hopia vi) Tarnum vii) Cane etc.

Tropical Semi Evergreen

Area

7250
200-250

- i) Western side of western ghats bordering the area of wet-evergreen
- ii) Northern part of western ghats
- iii) Lower ^{slope} part of Eastern Himalayas
- iv) Some parts of Assam & Odisha
- v) Some parts of A & N.

RF 200 - 250 cm

Temp 24°C - 27°C

Harm ≈ 75 Y.

Vegetation

→ Less dense tree canopy than wet evergreen
(Less no. of trees & ↓ height than wet evergreen)

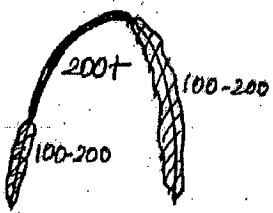
→ i) Kadam ii) Laurel iii) Mesua } iv) Rosewood v) Bamboo } West Ghats

→ i) white cedar ii) Indian chestnut iii) Litchi } } Himalayas

3. Tropical Moist Deciduous Forests

Area

- i) Western & Eastern slope of western Ghats surrounding the belt of Evergreen forests
- ii) A strip along shivaliks including Terai & Bhabar region.
- iii) NE states (some parts of Assam, Megh, NP, Mizoram)
- iv) Some parts of MP, Chatt, Chotanagpur plateau, WB, Odisha
- v) Some parts of A & N islands.



(RF) 100 - 200 cm

(Temp) 27°C

(Hum) 60% - 75%

Vegetation

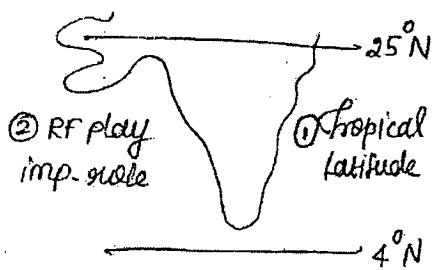
- i) Teak ii) Sal iii) Laurel iv) Rosewood
- v) Mahua vi) Semul vii) Bamboo

Y Tropical moist?

4. Littoral & Swamp / Delta / Tidal Forests

↓ ↓
Sea shore & Marshy
Lake shore

→ Forest occur on & around the deltas,
Estuaries & creeks, prone to tidal influences



Area

- 1 → Delta of i) Ganga ii) Mahanadi iii) Godavari
 iv) Krishna v) Cauvery

2 → Dense mangrove occur all along coast line.

Feature

estuaries & grow in both FRESH & BRACKISH water.

* Most pronounced is the SUNDERBANS in Ganga delta.

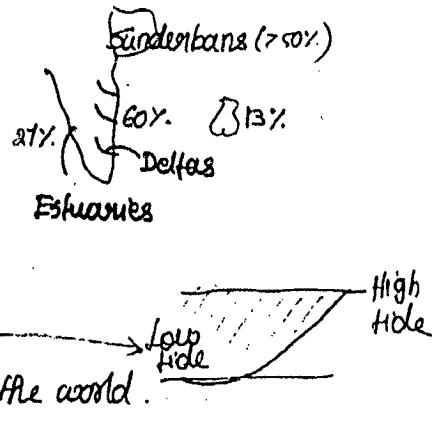
Here important species is i) SUNDARI (Heritiera)

- ii) BURGUILERA
- iii) Sonneratia
- iv) Rhizophora
- v) Screw Pine
- vi) Palm, Cane, etc..

Mangrove

State of Forest Report - 2017 (Read - 200 pg)

Mangroves are a diverse group of SALT TOLERANT PLANT communities found in TROPICAL & Sub-Tropical, Frater-tidal region of the world.



(RF) 100 - 300 cm

(Temp) 26°C - 35°C

(Lat) 25°N - 25°S

Mangroves are spread over an area of 4921 km^2 in India, which is nearly 3.3% of world mangrove vegetation.

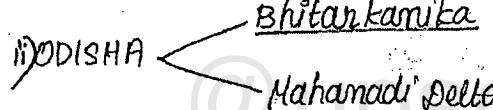
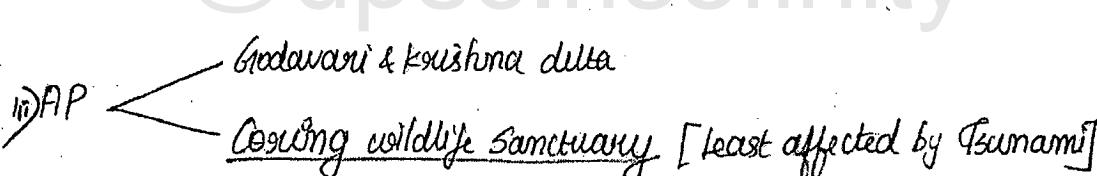
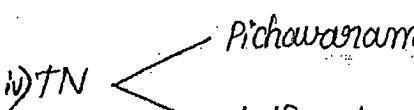
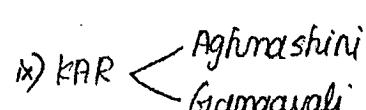
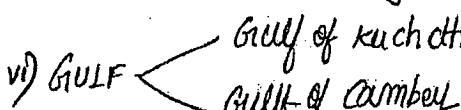
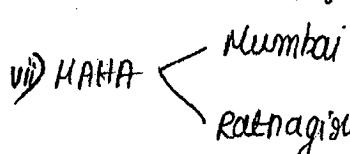
VERY DENSE	MODERATELY DENSE	OPEN
1481 km^2 (30.10%)	1480 km^2 (30.07%)	1960 km^2 (39.83%)

* SUNDERBANS in WB accounts for almost $\frac{1}{2}$ of total area under mangroves in India.

(Area)

Notes of

- ✓ Rivers via Biosphere reserves
- ✓ Ecological \oplus places

- i) WB — Sunderban [Biosphere Reserve too]
- ii) ODISHA 
- iii) AP 
- iv) TN 
- v) GWA 
- vi) KAR 
- vii) A&N — Baratang
- viii) GULF 
- ix) KERALA — kumarakom.
- x) MAHA 

Andaman & Nicobar Islands

N. Andaman

Baratang

Tarewa tubes

N. Andaman

* Highest peak in Andaman

- SADDLE POINT

* Ross & Smith Islands



S. Andaman

Mt. Haru'o'i

M. Grandhi MNP/

Wander

National Park

Port Blair

o

south

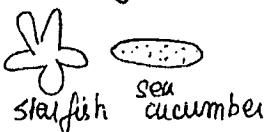
o

little

TOTTY BUOY ISLAND

10° channel

- shocking



starfish sea cucumber

o North

Great

Andaman

ANDAMAN

o Middle

o South

o Little

o Can

o Namcoomoy

o Little

o Great

India Point

NICOBAR

Districts

Volcano

i) North & Middle andaman dt. — Nancondam (Extinct)

ii) South andaman dt. — Barren (Active)

iii) Nicobar dt.

@upsc.risefinity

I. DRY TROPICAL FORESTS

- ① Tropical dry evergreen
- ② Tropical dry deciduous
- ③ Tropical thorn.

Tropical Dry evergreen

NE Monsoon (\downarrow RF)

Only on Tamil Nadu coast,
during winter - RF

RF \rightarrow 100 cm

stunted trees (\sim 12m)

Tropical wet evergreen

SW Monsoon (\uparrow RF)

RF \rightarrow 250 cm

tall trees (30-40 m)

1. Tropical Dry Evergreen

Area Along Coast of TN

RF Annual \sim 100 cm

Mostly from NE Monsoon [Oct-Dec]

Temp 28°C

Hum $\approx 75\%$

Chauras short trees (upto 12m)

Vegetation

i) Kharai ii) Kokko iii) Neem iv) Teddy Palm v) Gairamani Cane

Tropical Thorn (Dry)

RF → < 75 cm

North west part (Raj, H, P, Guj)

Rainshadow of west Ghats

Tropical Dry Deciduous

(Area) Irregular wide strip running from foot of Himalayas to Kanchiakumari except:

x RAST x West-Ghat x WB x NE

(RF) 75 cm - 125 cm

(Temp) 25°C - 27°C

(Hum) 50% - 60%

(Vegetation)

- i) Teak ii) Axlewood iii) Bamboo
- iv) Satinwood v) khair

Tropical Thorn

(Area) i) NW part of India

ii) Rain shadow region of western Ghats

RAST
PUN
HAR
GUJST

(Vegetation)

- i) khair ii) Neem iii) Babul
- iv) Thorn v) karanji

(RF) < 75 cm

(Temp) 25°C - 30°C

(Hum) < 50%

III. MONTANE SUB-TROPICAL FORESTS

- ① Sub-Tropical Broad leaved HILL FOREST
- ② Sub-Tropical MOIST
- ③ Sub-Tropical DRY

1. Sub-Trop. Broad leaved Hill Forest

[Area]

i) Some part of E-Himalayas

ii) Nilgiri

iii) Palkonda Hills

iv) Mahabaleshwar

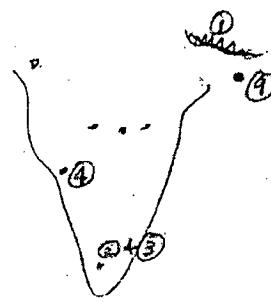
v) Saltpura

vi) Maikal range

vii) Bastar plateau

viii) Mt. Abu Hills

ix) Jaintia hills



[RF] 125 cm

[Temp] $18^{\circ}\text{C} - 21^{\circ}\text{C}$

[HUM] $\approx 80\%$

[Vegetation] • Oak • chestnut • Sal

2. Sub-Tropical Moist

Area

i) Western Himalayas

✓ $73^{\circ}\text{E} - 80^{\circ}\text{E}$

✓ 1000-2000 m above Sea Level (ASL)

ii) Eastern Himalayas

✓ East of 80°E

✓ 1000-2000 m ASL

iii) Khasi Hill of Meghalaya

RF 100-150 cm

Temp 18°C

Hum 70%

Veget i) Chir or Chil ii) Stunted Oak

These are often grassy floor with Bulbous Plant

3. Sub-Tropical Dry

Area Bhutan & Shivalik [upto 1000 m ASL]

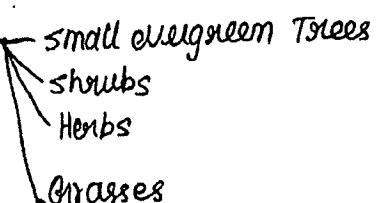
RF 100 cm

Temp 20°C

Hum 60-70%

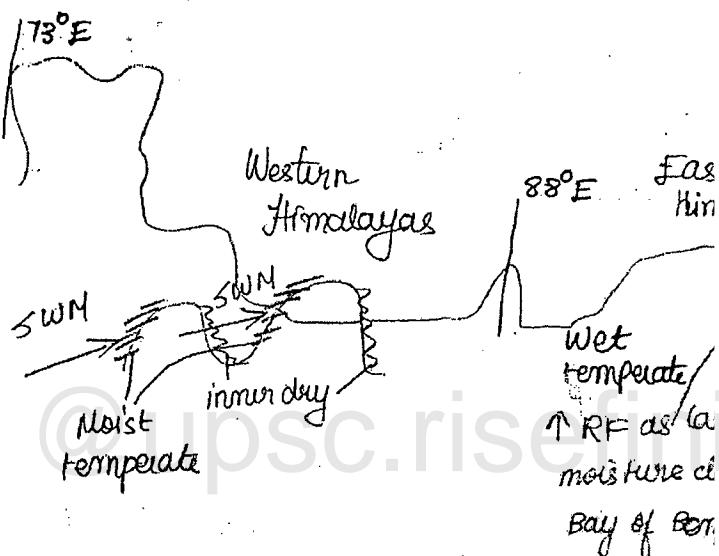
Veg i) Olive ii) Acacia modesta iii) Pistacia
iv) Palm Nannospalp

These are SCRUB FORESTS



IV. MONTANE TEMPERATE FO

- ① Montane wet temperate forest 150-3
- ② Himalayan moist temperate forest 150-2
- ③ Himalayan Dry temperate forest <100



1. Montane wet temperate forest:

(Height) 1800 - 3000 m ASL

(Area)

i) Higher hills of TN & KERALA

ii) Eastern Himalayas (Sikkim; Arun.P; Upper Ass)

(RF) 150 - 300 cm (Tree) ✓ Deodar ✓ Birch
Precipitation

(Temp) 11°C - 14°C ✓ Indian chestnut ✓ Hamlock ✓ Blue pine

(Hum) 80%

2. Himalayan Moist temperate forests:

- Temperate zone of Himalayas b/w 1500 - 3000 m ASL
- SW monsoon facing side of Himalayas.

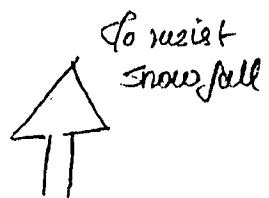
Area

- i) Kashmir ii) Him. Pradesh iii) Uttarakhand

An. prec 150 - 200 cm

Temp $11^{\circ}\text{C} - 14^{\circ}\text{C}$

Hum 60% - 75%



Tree

- ✓ Mostly composed of Coniferous species
- ✓ Pine Cedar ✓ Silver Fir ✓ Spruce

3. Himalayan Dry temperate forests:

- In inner dry regions of Himalayas, where the SW monsoon is very weak

An. prec < 100 cm - mostly snow

Area o Jodakh o Lahaul Spiti o Chamba o Kinnaur etc.

Temp $\simeq 11^{\circ}\text{C}$

Hum 50%  xeric-Dry

Tree CONIFEROUS forests with XEROPHYTIC shrubs in which

- ✓ Deodar ✓ Chilgoza ✓ Oak ✓ Maple ✓ Olive ✓ Sare important tree species.

Xerophytic:

Plants which can survive with little water & adapted to 'xeric' (dry) environment.

V. ALPINE

- ① Sub Alpine
- ② Moist Alpine Scrub
- ③ Dry Alpine Scrub

1. Sub Alpine:

Nature of CONIFEROUS &
BROAD LEAVED trees.

Coniferous trees attain ht of 30 m;
Broad leaved trees - ht of 10 m.

(Tree) ✓ Fir, Kail, spruce ✓ Rhododendron ✓ Plum etc..

2. Moist Alpine Scrub:

Low Evergreen growth of ✓ Rhododendron
o Birch o Honey Suckle.

They occur from 3000m ASL extend upto SNOWLINE.

→ Above Snowline, no other vegetation;

— 4600m ASL

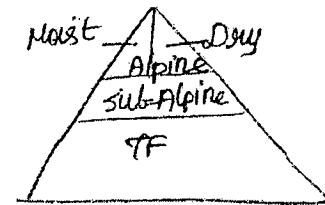
→ Needle like leaves so that snow
don't settle on leaves.

— 4300m ASL

— 4000 m ASL

Scrubland

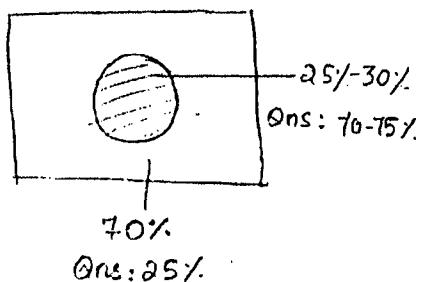
- ✓ Trees +
- ✓ Shrubs +
- ✓ Herbs +
- ✓ Grasses .



3. Dry Alpine Scrub:

Upper most limit of XEROPHYTIC shrubs over 3500 m ASL
Found on DRY zone.

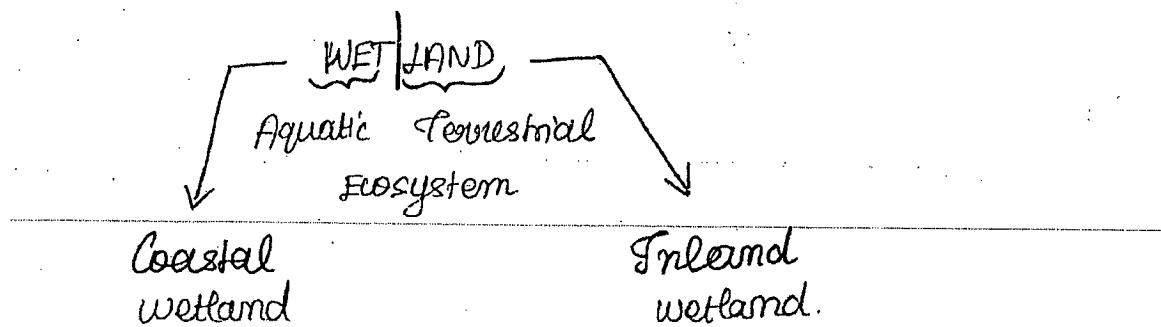
(Tree) ✓Juniper ✓Honeysuckle



@upsc.risefinity

RAMSAR CONVENTION ON WETLANDS

= Hospital



Ramsar → city in IRAN

2nd Feb 1971 → World Wetland Day

Introduction:

→ International treaty for the conservation and sustainable use of wetland.

> It is named after the city of Ramsar in Iran

> It was signed on 2nd Feb, 1971.

Every year '2nd Feb' is celebrated as 'WORLD WETLAND DAY'

"Wise Use" — philosophy of Ramsar convention

↳ Maintenance of ecological character within the context of sustainable development.

(≈ 100)

"Montreux Record"

It is the Register of wetland sites of international importance where changes in Ecological character have occurred, are occurring and likely to occur as a result of

- Technological development
- Pollution
- Other human interferences

① KEOLODEO GHANA National park (1990)

② LOKTAK Lake (1993)

CHILKA Lake (1993 - 2002)

→ Removed in 2002 from Montreux record as a result of improved condition.

It is 1st Ramsar site in ASIA to be removed from Montreux record.

J&K

(i) Wular lake

- Largest freshwater lake in India
- On R. Jhelum
- ✓ Tullbul project

(ii) Tso Moriri

- Brackish water lake
- @ 4600 m ASL.
- Provides breeding ground for:

Endangered > BLACK NECKED CRANE
> BAR HEADED GEESE

The Goat > TIBETAN SHEEP } Endemic to
> TIBETAN WILD ASS } Tibetan plateau.

(iii) Srinagar Mansar

Tammu hills are part of Shivalik hills
↳ Erosion → siltation

→ Located in Tammu surrounded by lower Shivalik hills which are highly prone to erosion, leading to siltation on Srinagar Mansar lake.

JK

Pangong Tso } Brackish lake
Tso Moriri } ↓

Remnants of TETHYS SEA.
Evidence of presence of
Sea before Himalayas.
Now fresh water ingoing
—nature changing

(iv) Hokersar:

→ Located near Srinagar.

→ WATER FOWL species like

> GREAT CRESTED GREBE

> COMMON SHELDUCK

> TUFTED DUCK

> Endangered WHITE EYED POCHARD

They come from Siberia & C-Asia to Hokersar in winter.

Himachal Pradesh

(i) Pong reservoir

→ Constructed in 1975 in Beas R.

→ o Bar Headed GEESE

o RED NECKED GREBE

(ii) Renuka lake

→ Largest lake in HP

→ Goddess Renuka, mother of Parashuram

> CRIMSON BREASTED BARBET

> MYNNA > HERON

> BULBUL > MALLARD

(iii) chandrabhaga tal:

Lahaul Spiti |
Kozila (Hast Kal pass)
Chandrabhaga Bandolacha lake
R. Chandra

→ In Spiti part of Lahaul Spiti dt.

→ Moon shaped lake.

|| Rohtang pass

Kulummandi

Moss & Temp forest

Punjab

(i) Harike:

→ R. Beas meets R. Sutlej here

→ Also called Hari-ke-Pattan.

> YELLOW CROWNED WOODPECKER

> GREAT CRESTED GREBE

(ii) Ropar:

→ Manmade wetland, formed by construction of barrage for the diversion of water from R. Sutlej in 1952

> SMOOTH INDIAN OTTER

> HOG DEER

> ENDANGERED INDIAN PANGOLIN

(iii) keungli:

→ Manmade wetland, created in 1870.

Kerala

(i) ~~Sasthamkotta Lake~~:

Largest fresh water lake in Kerala,
situated in KOLLAM dt.

(ii) Vembanad kol/kayal:

→ Largest lake in Kerala

→ Famous tourist places:

> Alappuzha } Located near here.

> Kumarakom

> Parma

> Achenkovil river } drain in kol

(iii) Ashtamudi

→ Octopus shaped

→ R. Kallada & R. Pallichal drain in it.

Rajasthan

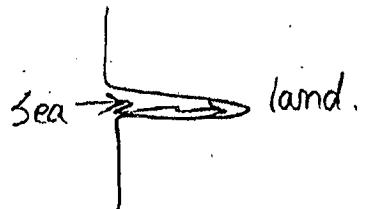
(i) Sambhar Lake

→ Example of Centripetal drainage

→ MEGHA & KHANDEL streams drain in it.

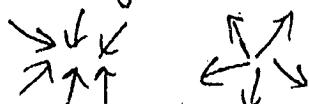
→ Largest Freshwater salt lake in India

Backwater
(kol/kayal)



@upsc.risefinity

Centripetal drainage Radial drainage



(ii) Keoladeo Ghama NP :

- Placed on Montreux record in 1990 due to
 - water shortage & unbalanced grazing regime.
- Invasive growth of grass - PASPALUM DISTICHUM - has changed its ecological character & Reduced its suitability of SIBERIAN CRANE.

Odisha

(i) Chilika Lake

- Brackish water lagoon ; → Nalbana island is in core area of chilika lake.
- In 1981, it was designated as 1st Ramsar site in India.
- 1993-2002 in Montreux record.

(ii) Bhitar Kanika Mangroves

- Core area was declared as Bhitarkanika NP.
- BKM includes: * GAHIRMATHA MARINE NLS.
- Famous for * OLIVE RIDLEY SEA TURTLES.

1 Ramsar site status premonies

A A G I M M U T T

(AGIMUT) cadre.

ASSAM → Deepor Beel

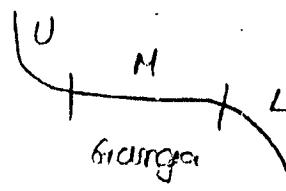
Rn. P → Kolleru lake

GUGARAT → Nal Sarovar

MP → Bhoj tal

MANIPUR → Loktak lake

UP → upper Ganga River stretch
(Boujhat to Narora)



TA. NADU → Point Calimere wetbs

TRIPURA → Rudrasagar

WEST BENGAL → East Calcutta wetland

Deepor beel - ASSAM

→ FW lake on Guwahati

→ SPOT BILLED PELICAN found here.

Kolleru lake - AP.P

Located b/w GODAVARI & KRISHNA delta

See
Hyd location

Nal Sarover - GUJARAT

Declared as Ramsar in 2012

Lifeline for Endangered INDIAN WILD ASS who use this wetland during dry season.

Bhoj Tal - Bhopal, MP

Bhojtal

Lower lake

Lakshmi lake - MANIPUR

→ Largest fresh water lake in NE.

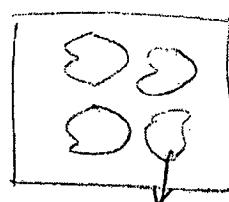
→ Example of centripetal drainage.

Keibul Lamjao - only floating NP

in the world famous for FLOATING PHUMDIS

phumdis: Heterogeneous mass of

✓ Soil ✓ vegetation ✓ organic matter



Floating Phumdis

(Soil, vegetation,
organic
matter)

Point Calimuri WL & BS - TN

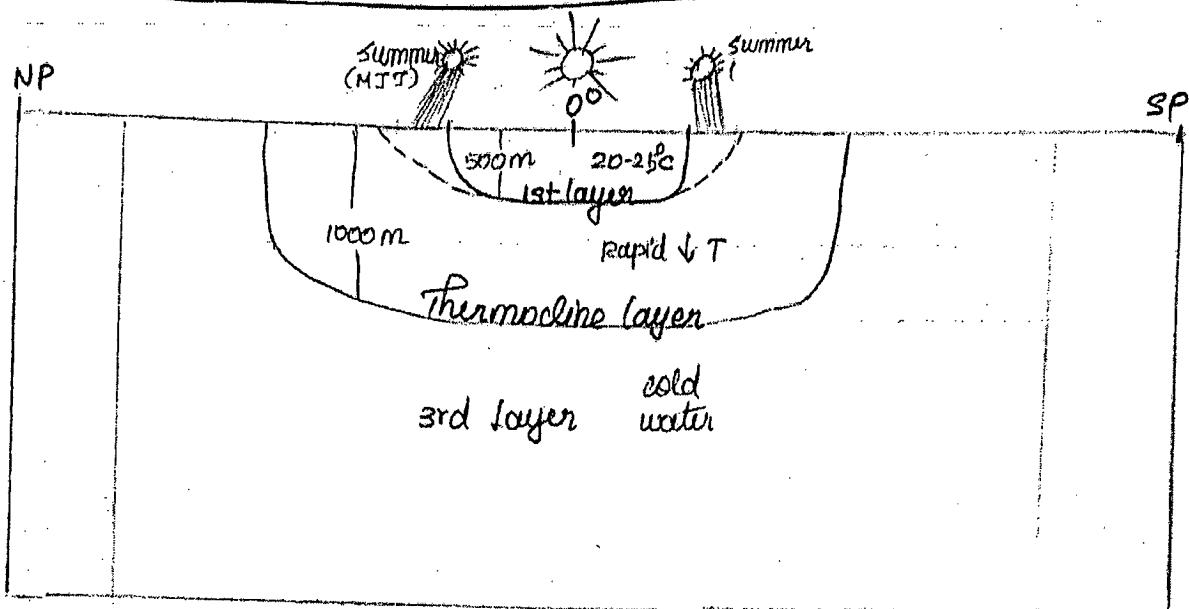
- Created on 1967
- For the conservation of :
- Near Threatened BLACKBUCK ANTELOPE
(Endemic mammal species of India)
- One of the remnants of Tropical dry Evergreen forests
(NE monsoon RF)

Rudrasagar - TRIPURA

- > Endangered BOER'S POCHARD
 - > Near Threatened FERRUGINOUS DUCK
- ↳ sworded here.

@upsc.risefinity

TEMPERATURE DISTRIBUTION IN OCEAN



VERTICAL DISTRIBUTION

1st LAYER :

- Top layer of WARM WATER
- ≈ 500 m thick
- Temp: $20^{\circ}\text{C} - 25^{\circ}\text{C}$
- ✓ Present within the tropics throughout the year.
- ✓ But it also develops in middle latitudes in summer.

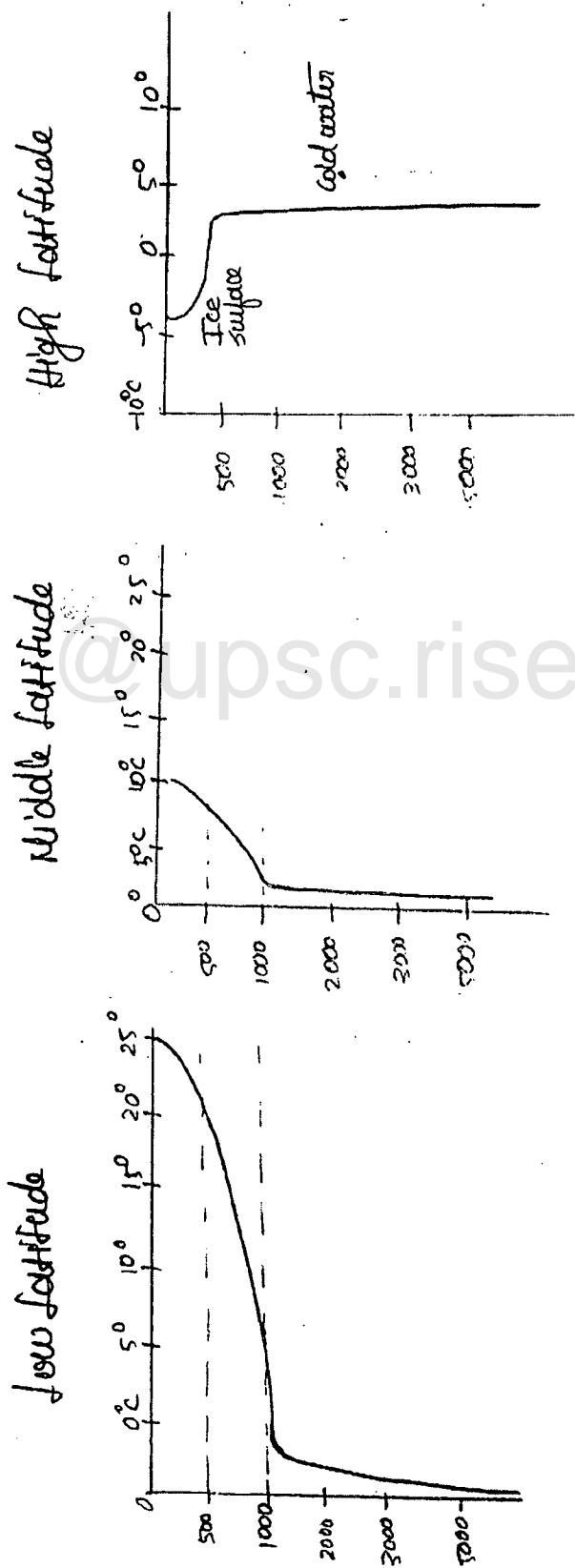
THERMOCLINE LAYER

- characterised by Rapid rate of decrease in Temperature with increase in depth.

3rd LAYER

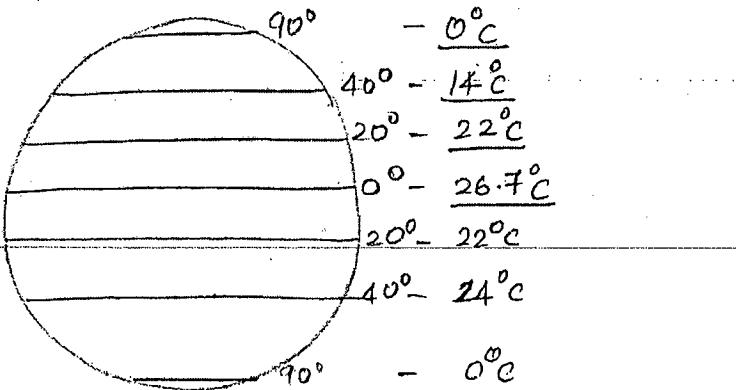
- cold water — extend upto Deep ocean floor.

✳ The polar areas have only one layer of cold water from Surface to Deep ocean floor.



HORIZONTAL DISTRIBUTION

Note



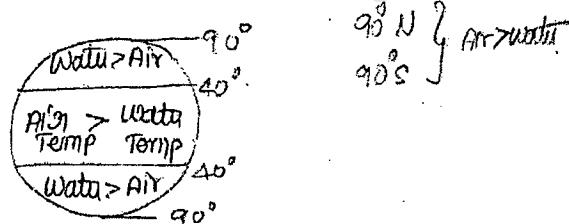
From Equator to pole on both Hemisphere, there is

Avg: $\frac{1}{2}^{\circ}\text{F}$ temp decrease with every latitude.

4 Factors

1) Latitude Heat

water \rightarrow Ocean surface water



The T of surface water b/w 40°N & 40°S $<$ Air T.

The T of surface water b/w 40°N/S & 90°N/S $>$ Air T.

ii) Unequal distribution of heat of water

Isotherms: Lines that join the point of equal temp. in aquatic system.

→ Isotherms are not regular & do not follow latitude in Northern hemisphere bcos of dominance of land in NH.

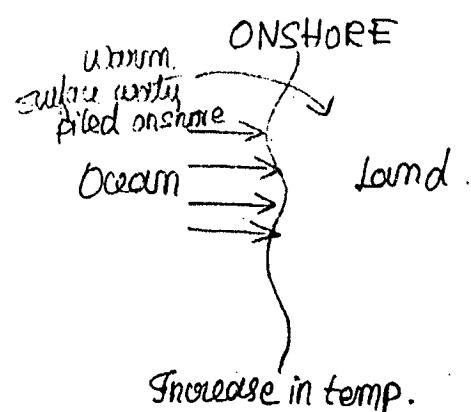
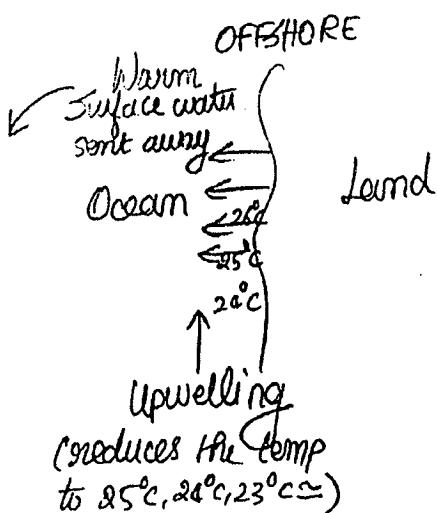
→ the temperature in enclosed sea in lower latitudes become high bcos of influence of surrounded land area.

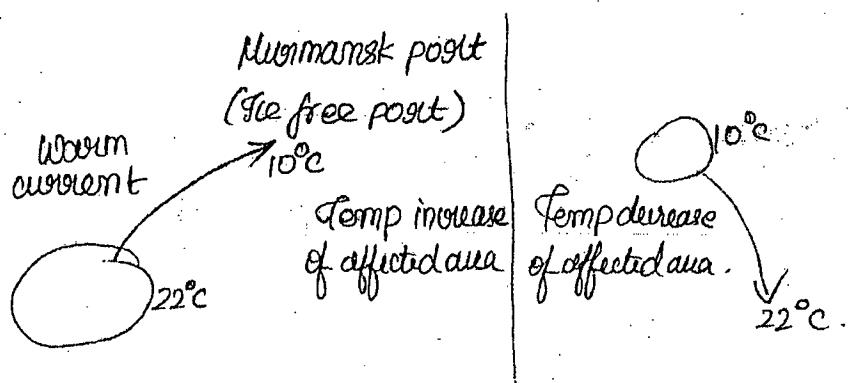
Equator Red Sea
 26.7°C 37.8°C

Enclosed sea
 No exchange
 of water, hence
 no redistribution
 of temp; influenced
 by sun. deserts.

Equator	Red Sea	Persian Gulf
26.7°C	37.8°C	34.4°C

iii) Wind:





SALINITY

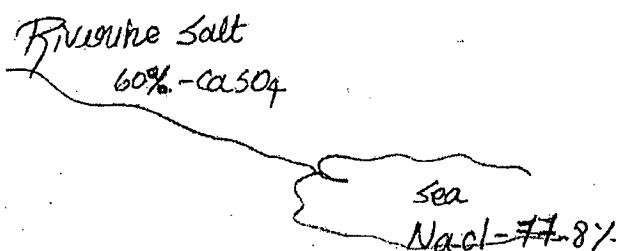
Percentage - %

Part per 1000 - ‰

Salinity is defined as the Ratio:

$$\frac{\text{wt. of dissolved Material}}{\text{wt. of sample sea water}}$$

Generally, salinity is defined as the total amount of solid material in gram contained in 1 kg of sea water. It is expressed on Part per thousand (ppt) (%)



Source of Oceanic Salinity

River bearing salt in solution from continental area to Oceans.
But there is lot of variation in composition of Riverine Salt & Sea Salt, RS contain more CaSO_4 (~60%) & SS - NaCl (~77.8%)
With further studies, geographers found following reasons for variation

- Major portion of the Ca carried by the river is consumed by marine organisms.
- Salt carried by the river is bit modified in Oceans with some chemical reactions.
- Volcanic activities also provide some salt to the oceans.

Significant salt:

S	M	M	C	P	C	M
C	C	S	S	S	C	B

sodium chloride - NaCl - 77.8%

magnesium chloride - MgCl_2 - 10.9%

magnesium sulphate - MgSO_4 - 4.7%

calcium sulphate - CaSO_4 - 3.6%

Potassium sulphate - K_2SO_4 - 2.5%

calcium carbonate - CaCO_3 - 0.3%

magnesium bromide - MgBr_2 - 0.2%

Factors Controlling Salinity:

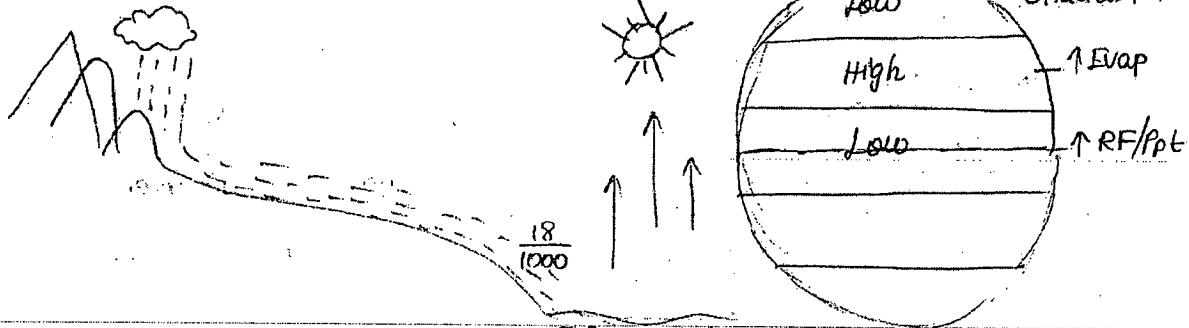
$$\textcircled{1} \quad \text{PRECIPITATION} \propto \frac{1}{\text{SALINITY}}$$

$$\textcircled{2} \quad \text{EVAPORATION} \propto \text{SALINITY} \quad (\text{Rate of})$$

Ppt \uparrow \rightarrow Sal \downarrow

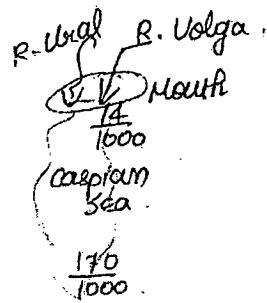
Evap \uparrow \rightarrow \uparrow Sal.

③ Influx of RIVER WATER



River carries earth + salt & settles it in sea permanently by ≈ 19 per year ... as salt doesn't evaporate.

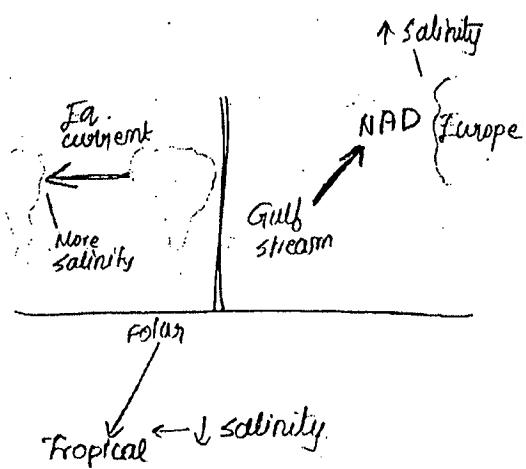
At mouth of water - ↓ Salinity bcs
River has $>$ fresh water than salt.



- Low salinity is found near the mouth of:
- > R. Ganga > R. Congo > R. Niger > R. Amazon
- R. Danube ; R. Dniester ; R. Dneiper reduce the salinity of BLACK SEA upto 18 ppt (18/1000)
- Salinity reduces to 5 ppt ~~near~~ in Gulf of Bothnia bcs of influx of river water.
- In northern Caspian sea, salinity is 14 ppt bcs of influx of R. Ural & R. Volga, whereas on southern part of caspian sea, salinity is as high as 170 ppt.

④ CIRCULATION OF OCEANIC WATER

Equatorial warm current drive away saline water from the western coastal area of continent & accumulate them along the E. coastal area of another continent.



NAD (North Atlantic Drift) extension of Gulf stream increases salinity along the NW Coast of Europe. (salt from more saline area to less saline area)
 [Polar → Tropical : salt from less saline area to more saline area - Result in ↓ salinity in Tropics]

Distribution of Salinity

I. HORIZONTAL

1] Equatorial Zone of Relatively low salinity.

Due to excessive RF

2] Tropical Zone of Maximum salinity.

Due to JRF & ↑ Evaporation

3] Temperate Zone of low salinity.

4] Sub polar & Polar Zone of Minimum Salinity.

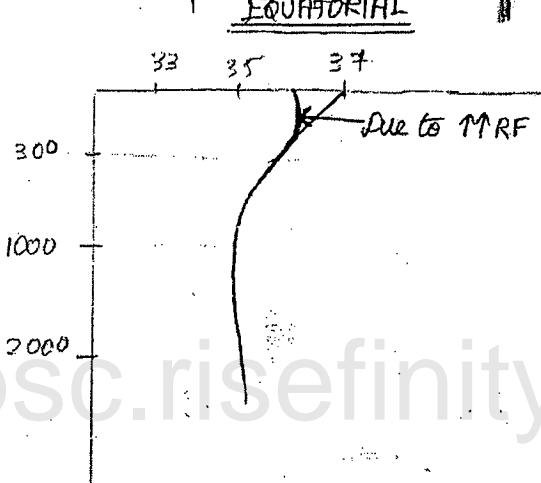
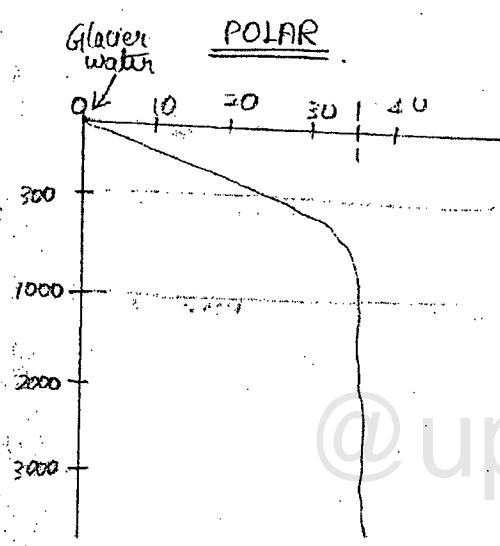
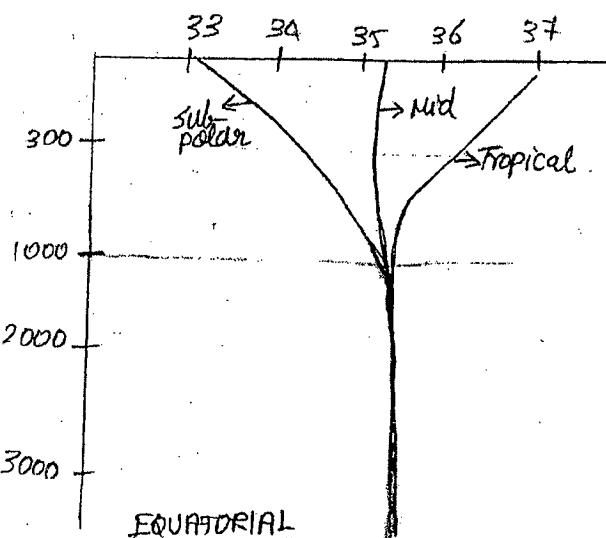
II. VERTICAL

(Aug: 35 ppt.)

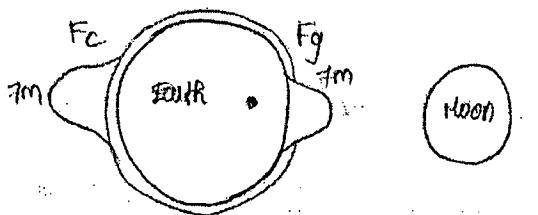
▷ Halocline Zone

300 - 1000 m depth

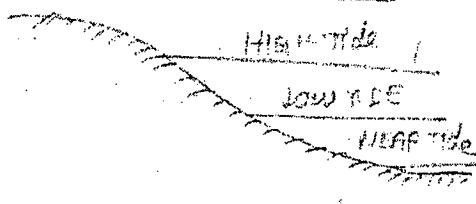
Sharp change in salinity



TIDE



SEASIDE



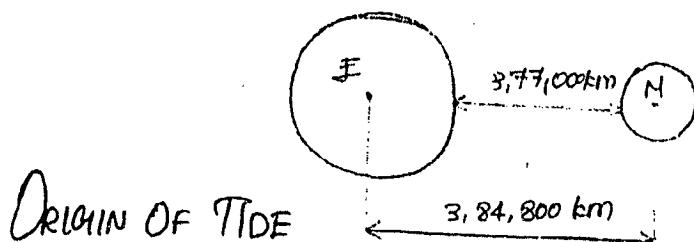
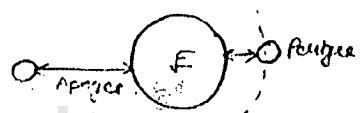
- Rise & fall of sea water due to gravitational force of Earth & Moon & Sun are called Tides.
- Sea waves generated by Tides → Tidal Waves.
- Generally 'Tide' means "High Tide".
- Rise of sea water & its movement towards coast is called TIDE
A resultant high water level is called HIGH TIDE WATER (HTW)
- The fall of sea water & its movement towards sea is called EBB
& resultant low water level is called LOW TIDE WATER (LTW)
- The Difference b/w. HTW & LTW is called TIDAL RANGE.

Perigee : Nearest distance b/w E & Moon.

(~3,56,000 km)

Apogee : Farthest distance b/w E & Moon.

(~4,97,000 km)



ORIGIN OF TIDE

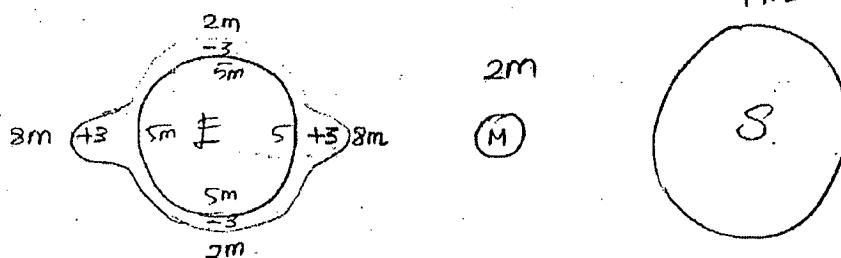
> water of earth surface facing moon is attracted by gravitational force & high tide occurs.

> High tide is also formed in opposite side simultaneously because of centrifugal force (this force bcos - E & M move around common centre of mass. (Don't confuse it with CF of spin of Earth))

NOTE: $\frac{G_1 m_1 m_2}{R^2}$ → Lakes do experience these forces but due to their mass ↓ relatively from sea water. Hence ↓ effect.

Ex: L. Superior experiences only 5cm tide.
2nd largest

Tide causing force of Moon is greater on earth due to less distance (but sun's force is greater, it is the distance that reduces its effect)

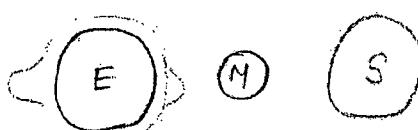


TYPES OF TIDE

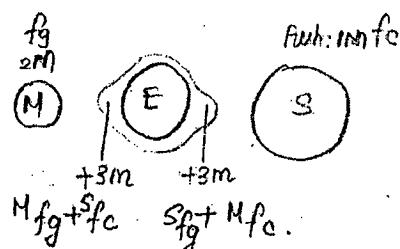
There is lot of temporal & spatial variation in the TIDE PRODUCING FORCE because of diff. position of sun & moon with respect.

Syzygy: The position of E, N & S on the straight line.

Conjunction - Sun & Moon are on the same side of Earth.

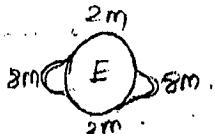


Opposition - Earth b/w sun & moon.



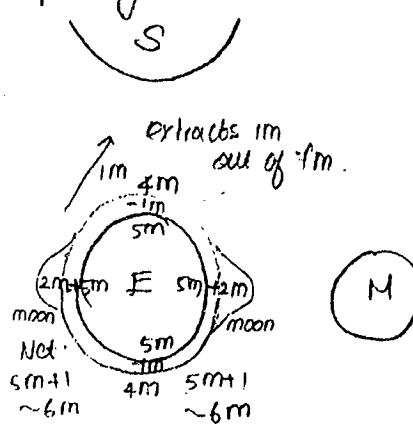
① Spring Tide

Very high tide is caused when Sun, Moon & Earth are on the almost straight line, called Spring Tide. ($\sim 8\text{ m}$)



Quadrature

When Sun, Earth & M @ Right angles.



② Neap Tide

When S, E & M are in position of quadrature on 7th or 8th day of every fortnight, NEAP Tide gets formed.

③ Perigean Tide

Tide formed when moon is at nearest position.

When Spring Tide & Perigean Tide occur at same time, resultant tide becomes abnormal.

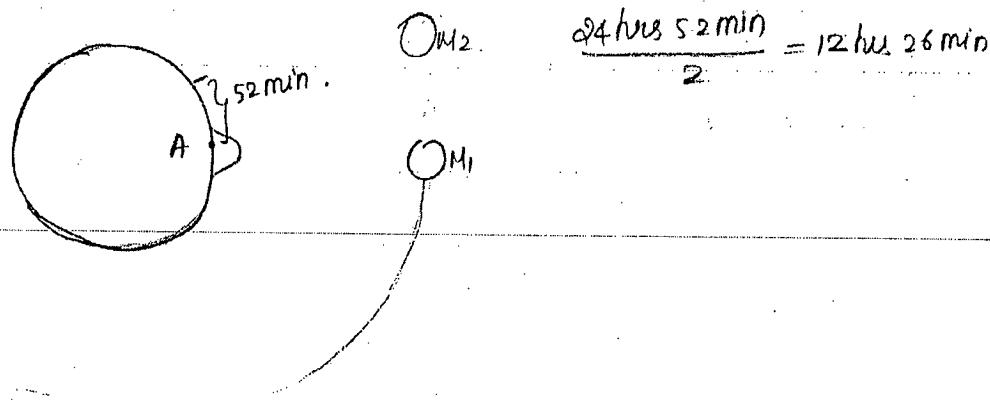
④ Apogean Tide

Tide formed when moon is at the farthest distance.

When Neap tide & Apogean tide occur at the same time, then water level becomes significantly low.

TIME OF TIDE

M: 27 days 7 hr 43 min.



Since E rotates from $w \rightarrow E$, Tide centre shifts westwards.
(Japan \rightarrow Thailand) . . .

When tide centre completes one round in 24 hrs, the moon position is ahead of tide centre by that time because the moon also revolve around the earth. As a result, Tide centre takes 52 mins extra to come under the influence of moon. Thus a particular tide centre takes total time 24 hrs 52 min to come under the influence of moon but by that time, another tide at opposite side is also experienced. So, ^(i.e.: High Tide) tide is experienced at every place after every 12 hrs 26 min

Tidal Bore (Grescent on ^{wall} ~~the~~)

A steep wall of sea water moving upstream when the tidal wave enters the narrow opening. The following conditions are conducive for occurrence of Tidal bore:

- ③ Narrow & low lying coastal river with gentle slope
- b) A bay with narrow opening
- ⑨ Large tidal range usually $> 5\text{m}$ - odd or condition only

It is not the tidal range which always determine the ht of tidal ~~wave~~ ^{wall} bore. For ex: Bay of Fundy of Nova Scotia has the largest tidal range of 17m but the tidal bore has ht of 1m only.

SALINITY - Some Facts

High Salinity

Red Sea - 34-41%

Persian Gulf - 37-38%

Medit. Sea - 37-39%

Normal Salinity

Carribean Sea - 35-36%

Gulf of Mexico - 35-36%

Gulf of California - 35

Low Salinity

Bering Sea - 28-33%

Chun'a Sea - 25-35%

Baltic Sea - 3-15%

Great Salt Lake - 220%
(Utah)

Lake Varn - 330%

Dead Sea - 230-240%

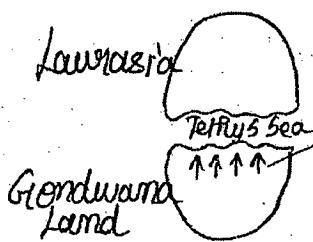
II. I. S
III. II. J. S.P. A.
IV. I. P. S. G. O. E. I. G.
V. I. P. C.
VI. I. P.

PHYSIOGRAPHY OF INDIA

- ① HIMALAYAS
- ② GREAT PLAINS OF INDIA
- ③ PPR
- ④ COASTAL PLAINS
- ⑤ ISLANDS.

① HIMALAYAS

120 mn years ago:



1st stage of compression = Greater Himalayas
2nd stage of compression = Lesser Himalayas / Middle Himalayas
3rd stage of compression = Shivalik / Outer Himalayas.

PANGEA

About 120 mn years ago, the arrangement of continents & oceans was quite different. There was a supercontinent known as Pangaea.

Northern part of Pangaea was called Laurasia;
Southern part of Pangaea was called Gondwana Land.
In between there was a long, narrow & shallow sea - Tethys Sea.

Majority of scientists believe that it was the Northward movement of Gondwanaland which caused compression of sediments at the floor of Tethys Sea. Sediments got folded in 3 successive phases giving rise to 3 important ranges of Himalayas.

It is believed that Indo-Australian plate is still moving Northwards & Himalayas are still rising further.

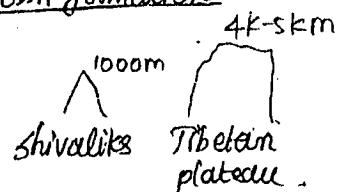
Evidences to prove Himalayas are still rising:

① Fossil Formation: Some fossil formation found in Shivalik hills are also found in Tibetan plateau. It indicates that past climate of TP was somewhat similar to the climate of shivaliks.

② Isostatic Equilibrium: Frequent occurrence of EQ in Him. region shows that Himalayas have not yet attained Isostatic equilibrium.

③ Rivers Youthful: H. Rivers are still in youthful stage. River rejuvenation in Himalayan region indicate about the upliftment of Himalayas.

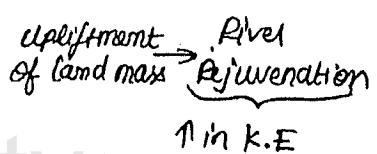
1) Fossil Formation

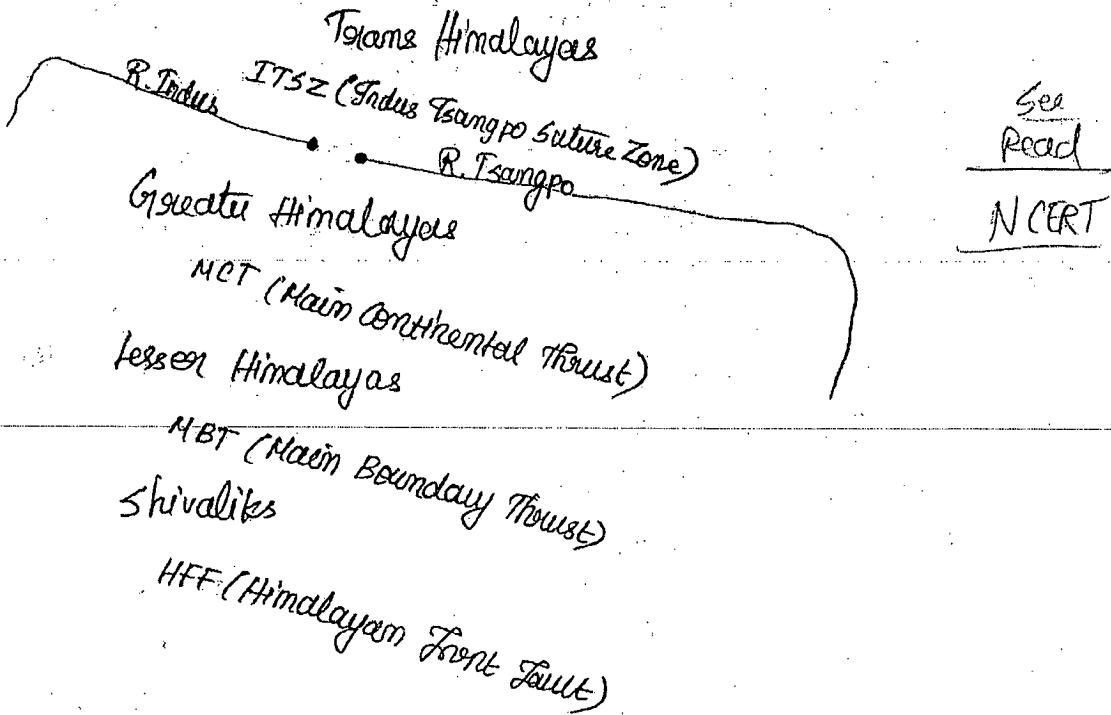


2) Isostatic equilibrium

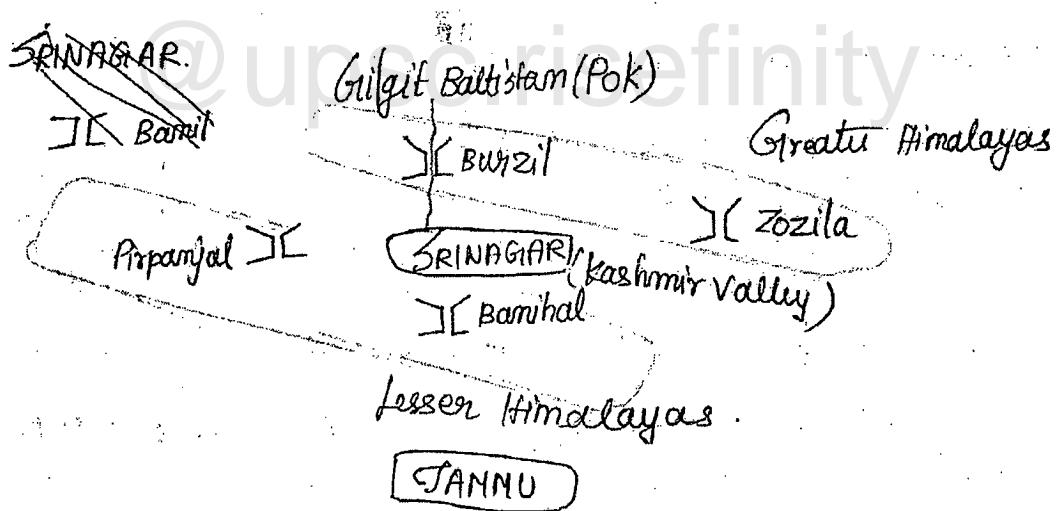
Not yet attained. EQ.

3) Youthful Rivers





PASSES



Passes in Great Himalayas

* Burzil Pass:

Srinagar ————— Deosai Plateau —————> Gilgit & Skardu (PK)
connects

* Zorila Pass:

Zorila 9 km
Sonamarg

Gulmarg Srinagar Palghar

→ It connects Kashmir Valley with Leh, Ladakh.

→ NH 1D passes through Zorila.

* Bara Lacha La:

→ It connects Lahaul Spiti with Leh, Ladakh

→ It is along Leh-Manali Highway

* Shipkila Pass:

→ Gateway of R. Sutlej

→ It is @ India-China border

* Lipu Lekh:

→ @ border of Ok-Nepal-Tibet

* Nathula Pass:

→ Connects Sikkim with Tibet

→ closed by India after 1962 Indo-China war

→ Reopened in 2006.

Passes in Lesser Himalayas

* Pir Panjal Pass:

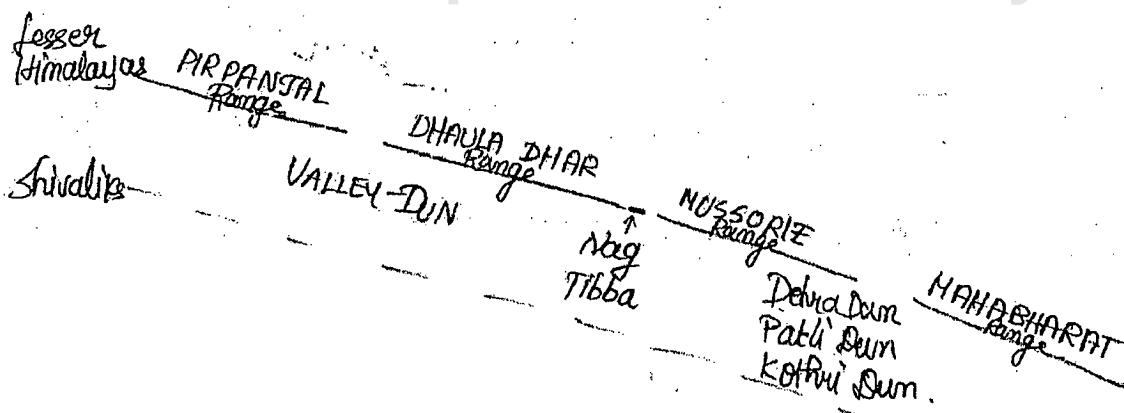
- West side of Srinagar
- Hizpora town is located near Pirpanjal.
- Old imperial road constructed by Mughals passes through it.

* Banihal Pass:

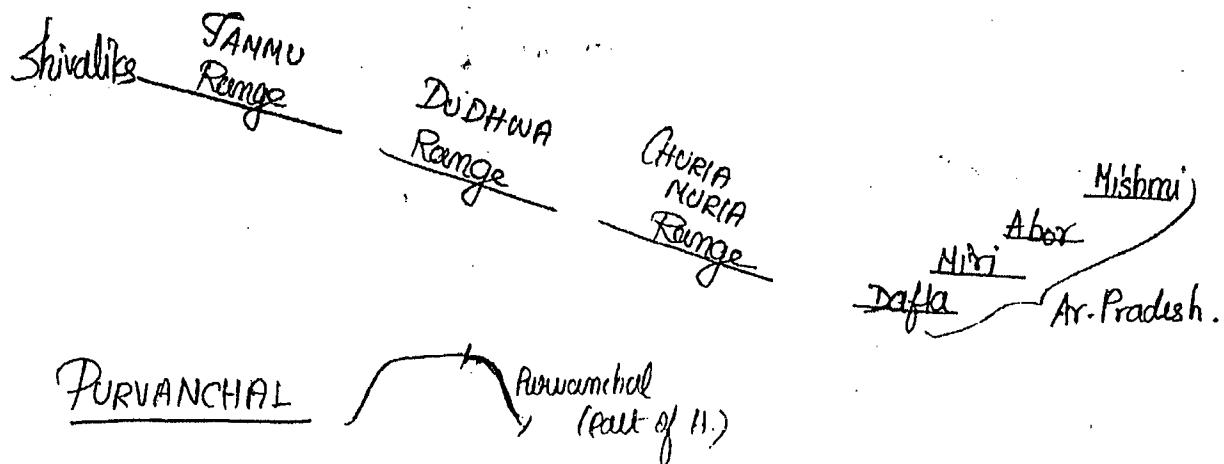
- Connects Kashmir valley with Jammu.

* Rohthang Pass:

- Connects Kullu/Naldehra with Lahaul Spiti
- North of it - Chenab R. Valley
- South of it - Beas R. Valley

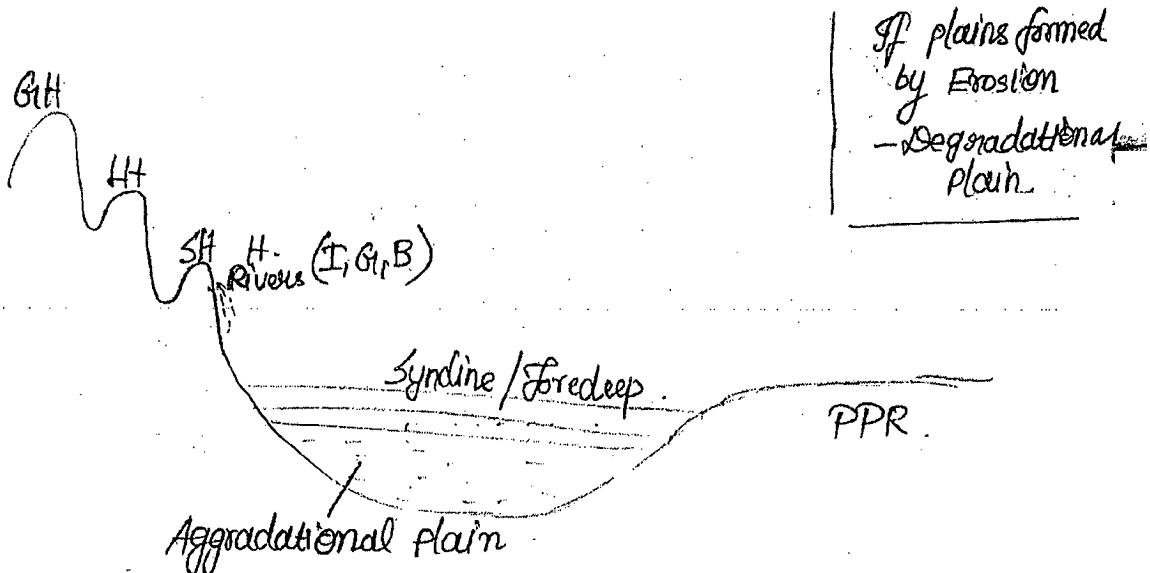


- Lesser H & shivaliks are separated by a valley called DUN.



- ① Purna NEFA
Patkai Bum
- ② Naga Hills
Saramati - Highest peak.
- ③ Manipur Hills
Loktak Lake - Contour petal drainage
- ④ North Bachan Hills
Separates Naga & Manipur Hills
Barail Range from Negh. Plateau
- ⑤ Mizo Hills
Blue Mountain - Highest peak
- ⑥ Tuiriala Hills





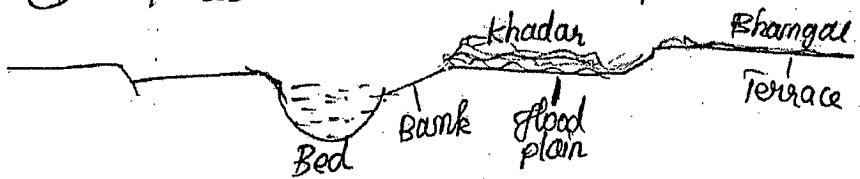
GREAT PLAINS OF INDIA:

These are Aggradational plains formed by Depositional work of 3 main Rivers - Indus, Ganga, Brahmaputra - also called Indo-Gangetic-Brahmaputra Plain.

Foredeep was like a large Syndine on which alluvium brought by H- & Perennial rivers got deposited.

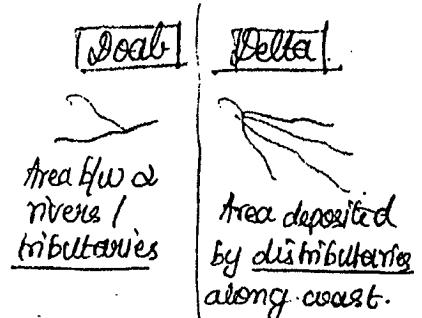
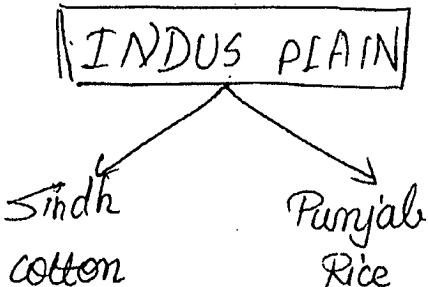
Geomorphology of Plains

- ① **Bhabar** — south of shivaliks : R. disappear under pebbles
- ② **Terai** — south of bhabar : R. emerges to surface again.
- ③ **Bhangar** — Old alluvium deposit.
- ④ **khadar** — New alluvium deposit



Khadar → is composed of new alluvium & form the flood plain along the R. bank.

Bhangdar → is composed of old alluvium & form the alluvial terrace above the level of flood plain.



HARYANA-PUNJAB PLAIN

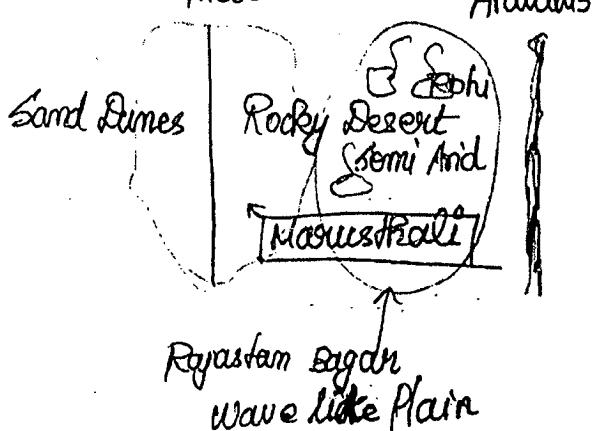
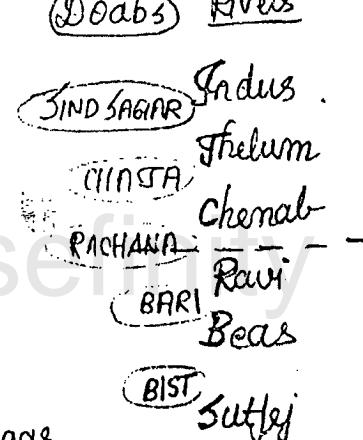
→ In Punjab Khadar belt is called Betland.

→ Area b/w Sutlej & Ghaggar R. is called Malwa Plain. R. Sutlej

MALWA PLAIN = R. Ghaggar.
Named after 'Malwa' state

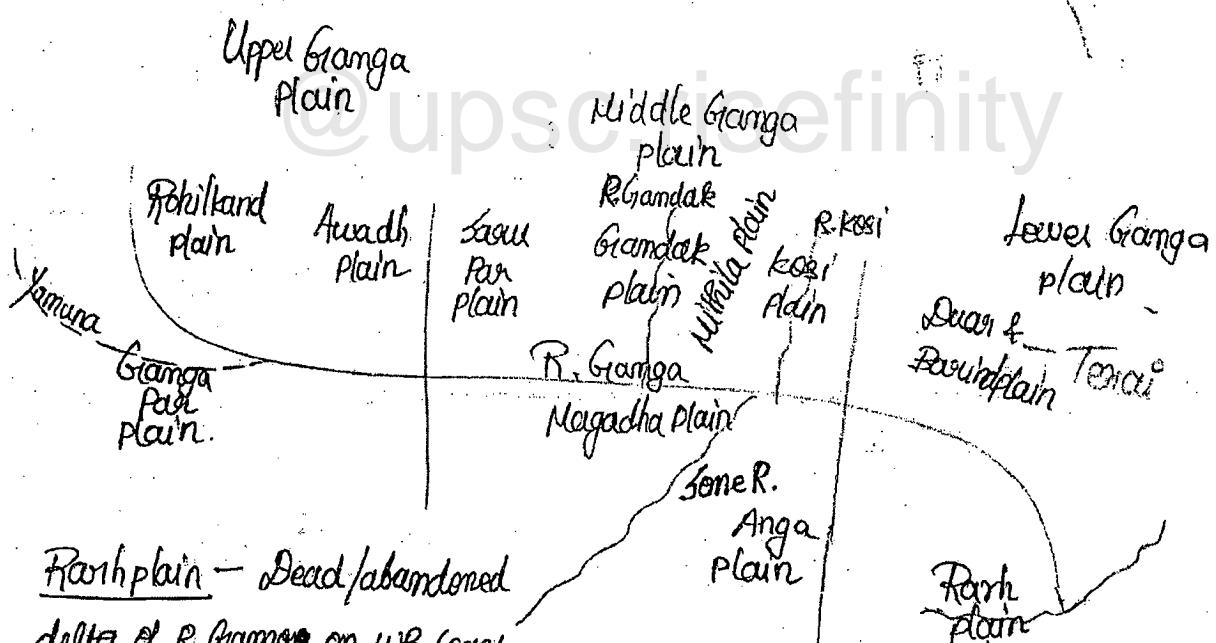
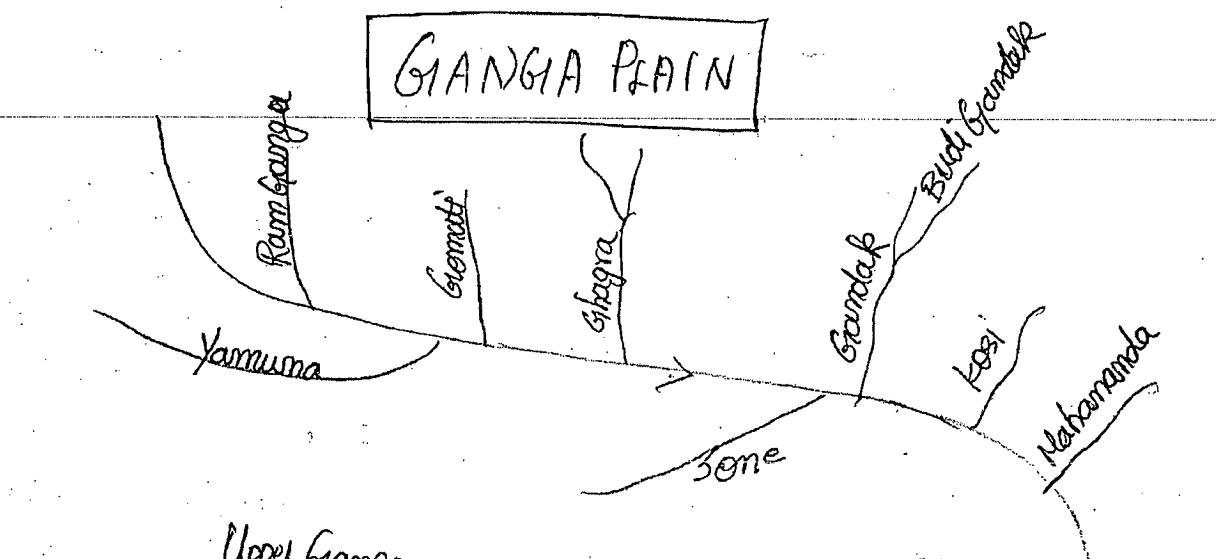
RAJASTHAN PLAIN - diff from H. plain. Thar Aravallis

Tumble patches along the seasonal streams in Rajasthan Bagar are called ROHI



THALI PLAIN

→ Area North
of R. Luni
Thali Plain (Sandy Plain)
R. Luni



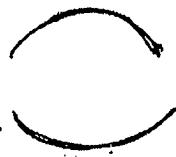
Rarh plain - Dead/abandoned delta of R. Ganga on WB coast.

Magadha plain - Area b/w R. Ganga & R. Sone

Mithila plain - Area b/w R. Gandak & R. Kosi

Duar & Barind plain - Terai region in Darjeeling & nearby areas is called Durar & Barind plain

Upland in lower Ganga plain called - chur
Lowland in lower Ganga plain called - Bheel

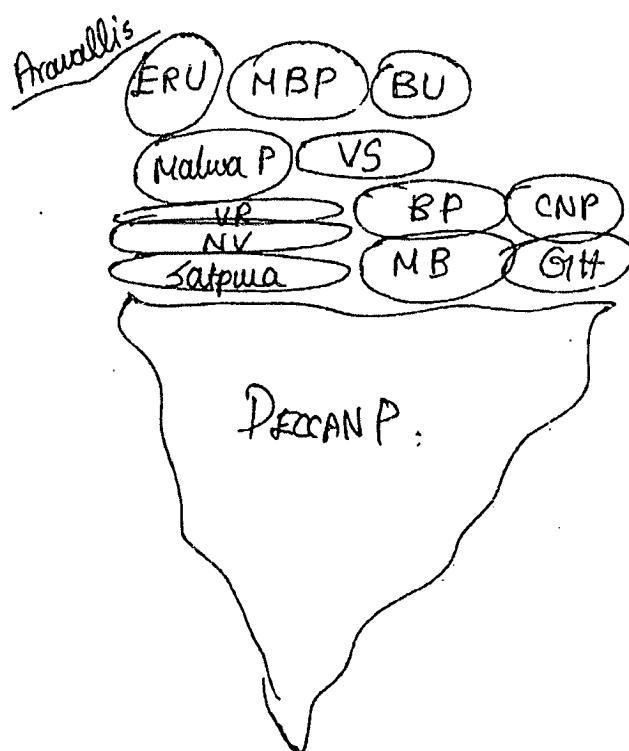


BRAHMAPUTRA PLAIN

- It has been formed by deposition of alluvium by R. Brahmaputra & its tributaries.
- Also called ASSAM PLAINS / ASSAM VALLEY / BRAHMAPUTRA VALLEY.

PPR

@upsc.risefinity



ERU → East Raj. Uplands

- East of Aravallis.
- It has been carved into rolling plain (wave like) by erosion work of R. Barnas & its tributaries.

NBP → Madhol Bhandat

- Most of it comprises of R. Chambal basin,
- Composed of sandstones.

Bundelkhand Uplands

- Bound by R. Yamuna & Vindhya
- Composed of Granite & Gneiss

Malwa plateau

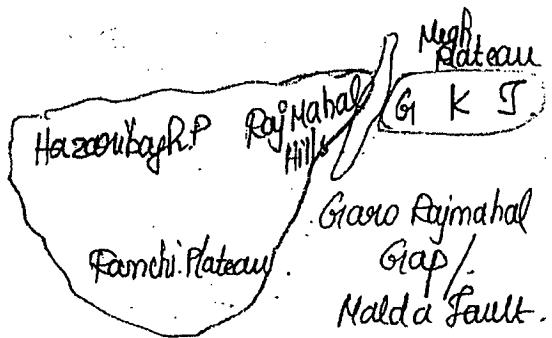
- Parabangle shape - Bound by Aravalli's, NBP & Vindhya Range
- It has 2 systems of drainage:
one towards Arabian Sea &
another to Bay of Bengal.
- It is an example of Dissected lava plateau,
covered with black soil.

Bagalkot plateau

- East of Malvak Range
- Composed of Limestone, Sandstone, Granite.

Chota Nagpur Plateau

- It has Radial drainage
- R. Damodar
R. Sabarnrekha
R. North Koel
R. South Koel.
- GIARO-RAJMAHAL GIAP / MALDA FAULT
 - Formed bcs of Down faulting.
 - Then filled by alluvium & is now plains.
- N. of Neg. plateau - Brahmaputra V.
S. of " " - Meghna & Surna V.



DECCAN PLATEAU

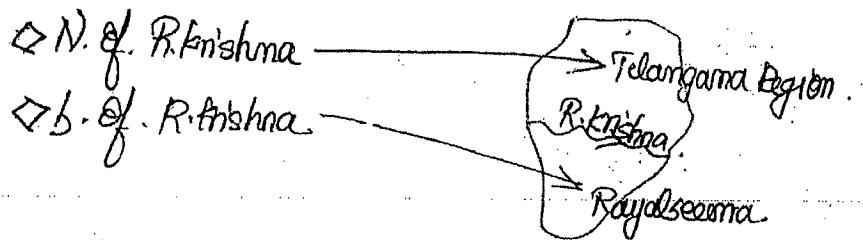
- Largest unit of PPR
- South of Satpura Range
- (i) → Maharashtra Plateau
 - > Deccan Lava Plateau Region / Deccan Trap.
 - > Basaltic lava.
 - > Black colour Regur Soil.

Karnataka Plateau

- o Nalnad - Hilly & dissected
- o Mardam - Large Rolling plain (Wave like)



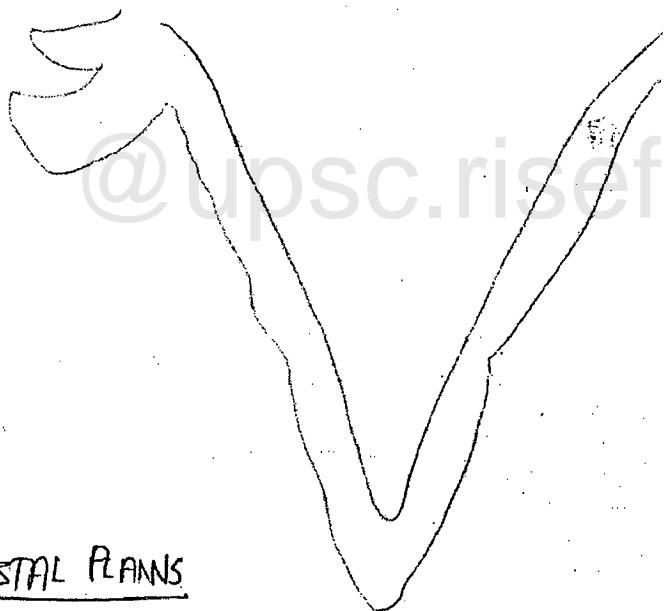
(iii) Telengana Plateau:



COASTAL PLAINS

Heai.

- Runs from Rann of Kutchh to Ganga-Brahmaputra plains
- Formed due to depositional work of River & Sea.



W. COASTAL PLAINS

i) Gujarat Plain

- Rann of Kutchh to Daman.
- Max. width of western coastal plain is 80 km near to mouth of R. Narmada & R. Tapti in Gujarat.

i) Konkan Plain

500 km from Daman to Goa

ii) Kannada Plain

225 km from Goa to Mangalore.

Narrowest part of W. coastal plain.

iii) Malabar Plain

500 km from Mangalore to Kanniyakumari.

2 famous backwaters

* Ashtamudi

* Vembanad.

E. COASTAL PLAIN

i) Utkal plain

400 km long including Mahanadi Delta.

ii) Andhra plain

South of Utkal plain to Pulicat lake

Includes Godavari & Krishna delta.

iii) TN plain

North of Chennai to Kanniyakumari

675 km; including Kaveri delta.

TROPICAL CYCLONE

- Cyclone developed in region lying b/w T. of Cancer & T. of Capricorn.
- The cyclones are not uniform & regular like Temperate cyclone.

Characteristics of Tropical Cyclone:

i) Size:

Diameter range = 80km - 300km

ii) Wind velocity:

Avg = 60 km/hr - 120 km/hr

During Hurricane* = 120 km/hr - 220 km/hr.

iii) Tropical cyclone becomes more vigorous & more with very high velocity over oceans whereas become weak while moving over land area & ultimately die out after reaching the interior part of continent.

iv) Centre of cyclone is characterised by low pressure, Isobars are more/less circular.

v) Unlike temperate cyclone, tropical cyclones are not characterised by temperature variations in diff parts.

vi) Tropical cyclones are not always mobile, sometimes they become stationary over a particular place for a few days & yield heavy RF & cause flood.

TYPES OF TROPICAL CYCLONES (Based on Intensity)

- 1. Tropical Disturbances } WEAK
- 2. Tropical Depressions }
- 3. Tropical Storm } STRONG
- 4. Hurricane }

* HURRICANE → The extensive tropical cyclone surrounded by several closed Isobars.

Pressure diff ↑ within small area.
Hence PGF very strong.



PGF very strong.

USA — Hurricane

CHINA — Typhoon

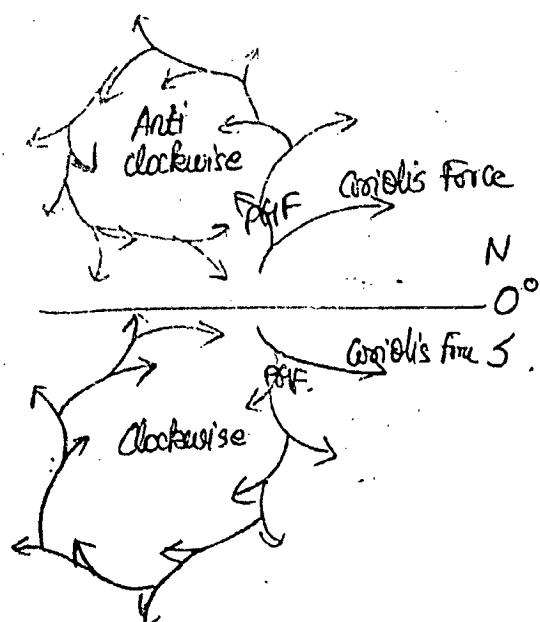
AUSTRALIA — Willy Willy

PHILIPPINES — Baguio

JAPAN — Taiju.

ORIGIN:

- Trop-cyclone is like a heat engine energized by latent heat of condensation.
- They all formed due to the development of low pressure of thermal origin.

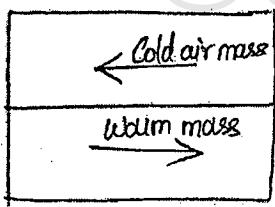


They develop when foll. requirements are fulfilled:

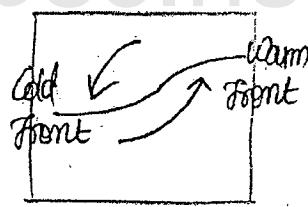
- a) There should be continuous supply of abundant WARM & MOIST AIR.
- b) Trop. cyclone originate over warm oceans having Surface water temperature $> 26^{\circ}\text{C}$ during summer.
(So - No cyclone during winter unlike temperate)
- c) Higher value of Coriolis force is reqd. for Trop. cyclone.
So they are absent from 5°N to 5°S due to min. of.

LIFE CYCLE OF TEMP. CYCLONE.

Stage I: Convergence of two air masses of contrasting physical properties
Stage II: 2 air masses penetrate into the free territory of each other & thus wave like front gets formed.



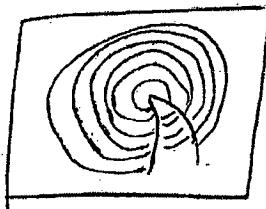
I.



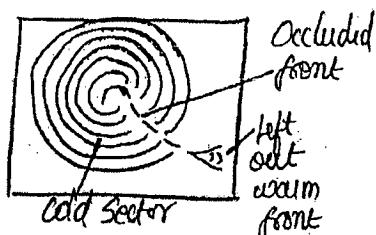
II.



III.



IV.



V

Stage 3: Mature stage when cyclone is developed. Cold sector penetrate into the territory of warm sector & forces warm air to subside.

Stage 4: Warm sector is further narrowed on extent due to the advancement of cold sector in territory of warm sector.

Stage 5: Starts with occlusion of warm front when advancing cold front finally overtakes warm front & an occluded front is formed.

Stage 6: Warm sector completely disappears. Occluded front is eliminated. Ultimately cyclone die out.

Frontal Video

W.Ghats

E.Ghats

W.disturbances

@upsc.risefinity

@upsc.risefinity

@upsc.risefinity