



## Cyclone

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# CYCLONE

Cyclones are rapid **inward** air circulation around a **low-pressure** area.

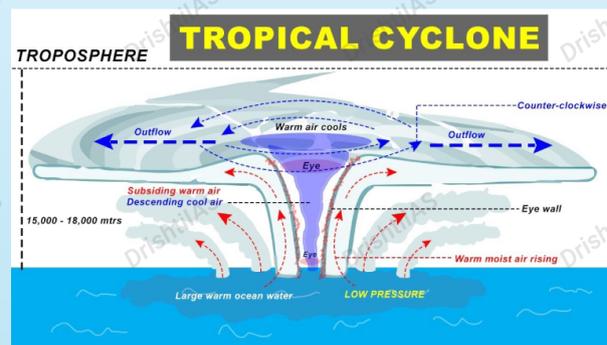


## Cyclone v/s Anticyclone

Pressure System	Pressure Condition at the Center	Pattern of Wind Direction	
		Northern Hemisphere	Southern Hemisphere
Cyclone	Low	Anticlockwise	Clockwise
Anticyclone	High	Clockwise	Anticlockwise

## Classification

- **Tropical Cyclones;** originate between the **Tropics of Capricorn and Cancer**
- **Extra Tropical/ Temperate Cyclones;** originate in the **Polar Regions**



## Conditions for Formation

- Large sea surface with temperature  $>27^{\circ}\text{C}$ .
- Presence of the **Coriolis force**
- Small **variations in the vertical wind speed**
- **A pre-existing weak low- pressure area**
- **Upper divergence** above the sea level system

## Different Names for Tropical Cyclones

- **Typhoons** - Southeast Asia and China
- **Hurricanes** - North Atlantic and eastern Pacific
- **Tornados** - West Africa and southern USA
- **Willy-willies** - Northwest Australia
- **Tropical Cyclones** - Southwest Pacific and Indian Ocean

## Nomenclature

- Nodal Authority - **World Meteorological Organization (WMO)**
- Indian Ocean Region - **Bangladesh, India, Maldives, Myanmar, Oman, Pakistan, Sri Lanka and Thailand** contribute to naming cyclones that occur in this region.

## Cyclones in India

- **Bi-annual Cyclone Season** - March to May and October to December
- Recent Cyclones - **Tauktae, Vayu, Nisarga and Mekanu** (in Arabian Sea) and **Asani, Amphan, Fani, Nivar, Bulbul, Titli, Yaas and Sitrang** (in Bay of Bengal)

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## Cyclone Sitrang

**For Prelims:** Cyclone and its Types

**For Mains:** Cyclone and its formation, Important Geophysical phenomena

### Why in News?

Bangladesh has been devastated by Cyclone Sitrang, which slammed into densely-populated, low-lying areas.

- Named by Thailand, Sitrang is the **first tropical cyclone** of the post-monsoon season of 2022.
- In 2018, Titli was the last October cyclone in the Bay of Bengal.

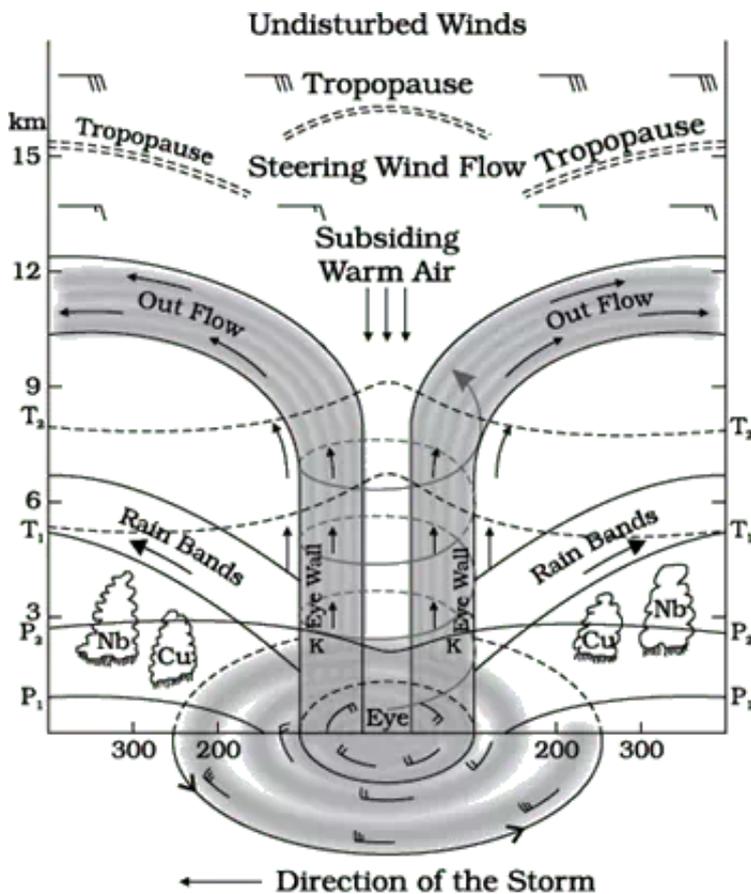
### What are the Tropical Cyclones?

- A **tropical cyclone** is an **intense circular storm that originates over warm tropical oceans** and is characterized by low atmospheric pressure, high winds, and heavy rain.
- A **characteristic feature of tropical cyclones is the eye**, a central region of clear skies, warm temperatures, and low atmospheric pressure.
- Storms of this type are called hurricanes in the North Atlantic and eastern Pacific and typhoons in SouthEast Asia and China. They are called tropical cyclones in the southwest Pacific and Indian Ocean region and Willy-willies in north-western Australia.
- **Storms rotate counterclockwise in the northern hemisphere** and clockwise in the southern hemisphere.
- The conditions favourable for the formation and intensification of tropical storms are:
  - Large sea surface with temperature higher than 27°C.
  - Presence of the **Coriolis force**.
  - Small variations in the vertical wind speed.
  - A pre-existing weak low- pressure area or low-level-cyclonic circulation.
  - Upper divergence above the sea level system.

### How do Tropical Cyclones Form?

- The development cycle of tropical cyclones may be divided into three stages:
  - **Formation and Initial Development Stage:**
    - The formation and initial development of a cyclonic storm depends upon the transfer of water vapour and heat from the warm ocean to the overlying air, primarily by evaporation from the sea surface.
    - It encourages formation of massive vertical cumulus clouds due to convection with condensation of rising air above the ocean surface.
  - **Mature Stage:**
    - When a tropical storm intensifies, the air rises in vigorous thunderstorms and tends to spread out horizontally at the tropopause level. Once air spreads out, a positive pressure at high levels is produced, which accelerates the downward motion of air due to convection.

- With the inducement of subsidence, air warms up by compression and a warm 'Eye' (Low pressure centre) is generated. The main physical feature of a mature tropical cyclone in the Indian Ocean is a concentric pattern of highly turbulent giant cumulus thundercloud bands.
- **Modification and Decay:**
  - A tropical cyclone begins to weaken in terms of its central low pressure, internal warmth and extremely high speeds, as soon as its source of warm moist air begins to ebb or is abruptly cut off.



**Fig: Vertical section of the tropical cyclone**

[Infographics](#)

## UPSC Civil Services Examination, Previous Year Questions

### Prelims

**Q. In the South Atlantic and South-Eastern Pacific regions in tropical latitudes, cyclone does not originate. What is the reason? (2015)**

- Sea surface temperatures are low
- Inter-Tropical Convergence Zone seldom occurs
- Coriolis force is too weak
- Absence of land in those regions

**Ans: (b)**

- The most proximate reasons for the lack of cyclones in the South Atlantic and South Eastern Pacific



ocean is the rare occurrence of the Inter-Tropical Convergence Zone (ITCZ) over the region.

- It becomes very difficult or nearly impossible to have genesis of tropical cyclones, unless synoptic vorticity (it is a clockwise or counterclockwise spin in the troposphere) and convergence (i.e., large scale spin and thunderstorm activity) are provided by ITCZ.
- Therefore, option (b) is the correct answer.

**Q. In the context of which of the following do some scientists suggest the use of cirrus cloud thinning technique and the injection of sulphate aerosol into the stratosphere? (2019)**

- (a) Creating the artificial rains in some regions
- (b) Reducing the frequency and intensity of tropical cyclones
- (c) Reducing the adverse effects of solar wind on the Earth
- (d) Reducing the global warming

**Ans: (d)**

- Cirrus cloud thinning is a kind of technology that involves thinning the wispy, elongated cirrus clouds of high altitudes. Cirrus clouds do not reflect a lot of solar radiation back into space, but as these are formed at high altitudes and cold temperatures, these clouds trap long-wave radiation and have a climate impact similar to greenhouse gases. Thinning cirrus clouds would be achieved by injecting ice nuclei (such as dust) into regions where there are cirrus clouds, making the ice crystals bigger and reducing the cirrus optical depth. Thinning the clouds would allow more heat to escape into space and thereby cool the planet.
- Stratospheric Aerosol Injection (SAI) is a technique that would involve spraying large quantities of inorganic particles (e.g. Sulphur dioxide) into the stratosphere to act as a reflective barrier against incoming sunlight, thus helping to reduce the global warming. **Therefore, option (d) is the correct answer.**

**Q. Consider the following statements: (2020)**

1. Jet streams occur in the Northern Hemisphere only.
2. Only some cyclones develop an eye.
3. The temperature inside the eye of a cyclone is nearly 10°C lesser than that of the surroundings.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3 only
- (c) 2 only
- (d) 1 and 3 only

**Ans: (c)**

- Jet Stream is a geostrophic wind blowing horizontally through the upper layers of the troposphere, generally from west to east, at an altitude of 20,000 - 50,000 feet. Jet Streams develop where air masses of different temperatures meet. So, usually surface temperatures determine where the Jet Stream will form. Greater the difference in temperature, faster is the wind velocity inside the jet stream. Jet Streams extend from 20° latitude to the poles in both hemispheres. **Hence, statement 1 is not correct.**
- Cyclones are of two types, tropical cyclone and temperate cyclone. The center of a tropical cyclone is known as the 'eye', where the wind is calm at the center with no rainfall. However, in a temperate cyclone, there is not a single place where winds and rains are inactive, so the eye is not found. **Hence, statement 2 is correct.**

- The warmest temperatures are found in the eye itself, not in the eyewall clouds where the latent heat occurs. The air is saturated only where convective vertical motions pass through flight level. Inside the eye, the temperature is greater than 28°C and the dewpoint is less than 0°C. These warm and dry conditions are typical of the eyes of extremely intense tropical cyclones. **Hence, statement 3 is not correct.**
- **Therefore, option (c) is the correct answer.**

### Mains

**Q. The recent cyclone on the east coast of India was called “Phailin”. How are the tropical cyclones named across the world? Elaborate. (2013)**

**Q. Tropical cyclones are largely confined to the South China Sea, Bay of Bengal and Gulf of Mexico. Why? (2014)**

**Q. Discuss the meaning of colour-coded weather warnings for cyclone prone areas given by India Meteorological Department. (2022)**

Source: [TH](#)

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## People Rights Vs Animal Welfare

**For Prelims:** DPSP, Fundamental Duties, Article 48 A

**For Mains:** Balancing People Rights Vs Animal Welfare

### Why in News?

In view of rising cases of stray dogs menace, the **Supreme Court of India said that a balance has to be maintained** between the safety of people and animal rights.

- The court also **suggested that people who feed stray dogs** could be made responsible for vaccinating them and bearing costs if somebody is attacked by the animal.

### What is the Need to maintain a Balance between People Rights and Animal Welfare?

- **To Address the Fundamental Issue:**
  - This **issue raises even more a fundamental issue** regarding rights of wild animals within the society dominated by human beings in general and within the framework of the Constitution of India in particular.
- **Recognition in Hindu Texts:**
  - **Ancient Hindu texts have recognized the rights of animals**, birds and every living creature and regarded every living being as having emerged from the same divine power as humans, thereby deserving due respect, love and affection.
  - India has a culture that promotes tolerance and respect for all life forms. Hindus regard

cows as their sacred animal.

▪ **Punishing Animals is Wrong:**

- During ancient times **some civilizations punished animals for wrongs committed by them**. But with time, the argument relating to Moral agency evolved and it was realized that punishing animals was wrong, since they **lacked the rationality to distinguish right from wrong** and thus punishment would serve no use.
- Thus, **laws evolved and animals (like minors and persons of unsound mind) were held to be bearer of interests** that needed to be safeguarded by the law sans any obligation to perform any corresponding duties.
- The **present legal regime penalizes pet owners** for any damage resulting from the negligent handling of their pet.

## What are the Related Judgements?

▪ **Animal Welfare Board of India v. Nagaraja (2014):**

- In this case, while striking down the practice of Jallikattu (bull-wrestling) and bullock cart racing in the Indian states of Tamil Nadu and Maharashtra, respectively, the **Supreme Court had ruled that the right to dignity and fair treatment** as enshrined in and arising out of **Article 21 of India's Constitution is not confined to human beings alone, but animals as well**.

▪ **Other Judgements:**

- In July 2018 the Uttarakhand High Court and in June 2019, Judge Rajiv Sharma of the Punjab and Haryana High Court observed that **animals have a distinct legal persona with corresponding rights, duties, and liabilities** of a living person and subsequently declared all the citizens throughout their to be persons in loco parentis as the human face for the welfare/protection of animals.
- All citizens of Uttarakhand and Haryana were declared to have legal responsibilities and functions similar to those of a parent vis-à-vis minor children for the welfare and protection of animals within their respective States.

## What is the Constitutional Protection for Animal Rights?

- According to the Indian Constitution, it is everyone's responsibility to care for and preserve the country's natural resources, such as its forests, lakes, rivers, and animals.
  - However, many of these provisions come in the **Directive Principles of State Policy (DPSP)** and **Fundamental Duties** - which cannot be enforced unless there is statutory backing.
- **Article 48 A states** that the State shall endeavour to protect and improve the environment and safeguard the forests and wildlife of the country.
- **Article 51A(g) states** it to be a duty of every citizen of India "to protect and improve the natural environment including forests, lakes, rivers, and wildlife, and to have compassion for living creatures."
- Further, the **State and Concurrent List have been assigned** the following items about animal rights.
- The States are given the authority to "preserve, maintain and improve stock and prevent animal diseases and enforce veterinary training and practice," according to State List Item 14.
- The Concurrent List contains legislation that both the Centre and the States may pass
  - "Prevention of animal cruelty," which is mentioned in item 17.
  - "Protection of wild animals and birds" which is mentioned as item 17B.

## What are the Important Laws in India for the Protection of Animals?

▪ **Indian Penal Code (IPC):**

- The Indian Penal Code (IPC) 1860 is the **official criminal code of India which covers all substantive aspects of criminal law**.
- Section 428 and 429 of the IPC provides for punishment of all acts of cruelty such as killing, poisoning, maiming or rendering useless of animals.

▪ **The Prevention of Cruelty to Animals Act of 1960:**

- The objective of the Act is to **prevent the infliction of unnecessary pain** or suffering on animals and to amend the laws relating to the prevention of cruelty to animals.
- The Act defines "animal" as any living creature other than a human being.
- **Wildlife Protection Act 1972:**
  - The act **aims to safeguard all plants and animal species in the country** to ensure environmental and ecological security.
  - The Act **prohibits the hunting of endangered animals** while providing for the establishment of wildlife sanctuaries, national parks, and zoos.

## Way Forward

- Our legislative provisions and judicial pronouncements make an effective case for animal rights, but no rights can be absolute. Like human rights, regulation of animal rights is a must.
- The need of the hour is **to strike a balance between safeguarding the interests of animals** without compromising on the safety or well-being of humans. Animal abuse has to stop.
- **Humans need to shed their condescending approach** of patronizing other species.
- **Mere intellectual superiority of humankind cannot be allowed to supersede living rights** of another species. Co-existence of all life forms is absolutely essential to prevent an imbalance of our eco-system.

Source: [Livemint](#)

## National Credit Framework

**For Prelims:** National Education Policy, Academic Bank of Credit (ABC), National Credit Framework'

**For Mains:** National Credit Framework (NCrF) and Significance

## Why in News?

- The Ministry of Education recently unveiled a draft '**National Credit Framework**' (NCrF) which aims to bring the entire education system, from school to university, into the academic 'credit' regime and has sought public view.

## What is the National Credit Framework (NCrF)?

- **About:** The new framework is a part of the [National Education Policy](#).
  - According to the framework, an academic year will be defined by the number of hours a student puts in. Credits will be provided to them accordingly at the end of each academic year.
  - The framework has been formulated under the University Grants Commission (Establishment and Operation of Academic Bank of Credits in Higher Education) Regulations, notified in July 2021.
- **Credit System:** The report of the high-level committee on the NCrF, put out in public domain, proposes credit levels from class 5 onward itself - which will be credit level 1, going up to credit level 7 and 8 with post-graduation and a doctorate, respectively.
  - Credit levels will increase by 0.5 for every year of learning.
- **Earning Credit:** The total 'Notional Learning hours in a year' for assignment of Credits will be 1200 hours. A minimum of 40 credits may be earned for 1200 hours of learning every year with 20 credits per semester of six months. Each Credit will come with 30 hours of learning- 30 hours per

credit.

- Notion learning hours in the context of NCeF means time spent not just in classroom teaching, but also in a range of co-curricular and extracurricular activities. The list of such activities includes sports, yoga, performing arts, music, social work, NCC, vocational education, as well as on-the-job training, internships or apprenticeships.
- **Easy Entry and Exit:** The credit transfer mechanism will also **enable a student/ learner to enter and exit the educational ecosystem, both general and vocational**, at any point of time. In such cases due weightage is given to work experience gained or any other training undertaken by the learner.
- **Due Attention to Co-Curricular Activities:** The new credit framework will **not have any hard separation between Curricular and Co-Curricular**, or various discipline and will count in performance on -classroom teaching/learning/laboratory work/class projects; Sports and games, etc.
- **Aadhaar-enabled student registration:** An Aadhaar-enabled student registration will take place. After student registration, an [Academic Bank of Credit \(ABC\)](#) account will be opened. The deposit of degree and credits will take place in those accounts. There will be a knowledge locker along the lines of DigiLocker.
- **Academic Bank of Credit:** The recently introduced [Academic Bank of Credit \(ABC\)](#) for higher education will be expanded to allow for end-to-end management of credits earned from school education onwards and will also include vocational education and trainings, it is envisaged.
- **Significance:**
  - It would work as 'an **umbrella framework for skilling, re-skilling, up-skilling, accreditation & evaluation**' encompassing educational & skilling institutions and workforce.
  - The credits for knowledge acquisition, hands-on training, and positive social outcomes will be a key step for achieving 100% literacy in the next 2-3 years and go towards making India a \$5 trillion economy.

## UPSC Civil Services Examination Previous Year Question

**Q. National Education Policy 2020 is in conformity with the Sustainable Development Goal-4 (2030). It intends to restructure and reorient education system in India. Critically examine the statement. (2020)**

Source: [IE](#)

## Green Crackers

**For Prelims:** Green crackers, SWAS, STAR, SAFAL, PESO

**For Mains:** Significance of Green Crackers

## Why in News?

Recently, a lot of the pollution observed during Diwali can be attributed to the burning of firecrackers or fireworks.

## What are the Green Crackers?

- **Green crackers** are dubbed as '**eco-friendly**' crackers and are known to cause less air and noise pollution as compared to traditional firecrackers.
- These crackers were **first designed by the National Environmental and Engineering Research Institute (NEERI)**, under the aegis of the Council for Scientific and Industrial Research (CSIR) in 2018.
  - NEERI is a constituent of CSIR to conduct research and developmental studies in environmental science and engineering.
- These crackers replace certain hazardous agents in traditional crackers with less polluting substances with the aim to reduce the noise intensity and emissions.
- Most green crackers **do not contain barium nitrate**, which is the most dangerous ingredient in conventional crackers.
- Green crackers **use alternative chemicals such as potassium nitrate and aluminium** instead of magnesium and barium as well as carbon instead of arsenic and other harmful pollutants.
- Regular crackers also produce 160-200 decibels of sound, while that from green crackers are limited to about 100-130 decibels.

## How can one Identify Green crackers?

- Presently, three brands of green crackers are available for purchase:
  - **SWAS - Safe Water Releaser:** These crackers do not use sulphur or potassium nitrate, and thus release water vapour instead of certain key pollutants. It also deploys the use of diluents, and thus is able to control particulate matter (PM) emissions by upto 30%.
  - **STAR - Safe Thermite Cracker:** Just like SWAS, STAR also does not contain sulphur and potassium nitrate, and besides controlling particulate dust emissions, it also has lower sound intensity.
  - **SAFAL - Safe Minimal Aluminium:** It replaces aluminium content with magnesium and thus produces reduced levels of pollutants.
- All three brands of green crackers **can currently only be produced by licensed manufacturers, approved by the CSIR**. Additionally, the **Petroleum and Explosives Safety Organisation (PESO)** is tasked with certifying that the crackers are made without arsenic, mercury, and barium, and are not loud beyond a certain threshold.
- Furthermore, green crackers can be differentiated from conventional crackers in retail stores by a **green logo printed on their boxes**, along with a Quick Response (QR) coding system.

## What is Petroleum and Explosives Safety Organisation?

- PESO is an office under the Department for Promotion of Industry and Internal Trade, **Ministry of Commerce and Industries**.
- It was established in 1898 as a nodal agency for **regulating safety of substances such as explosives, compressed gases and petroleum**.
- Its head office is located in **Nagpur, Maharashtra**.

## What are the Concerns regarding Green Crackers?

- Since green crackers **can only be legally manufactured by firms that have signed agreements with the CSIR**, no small-scale business or cottage business house can manufacture green crackers, which coupled with a ban on traditional fireworks, would leave very many unemployed this time of the year.
- There is a **general lack of awareness amongst both the sellers and the public** on how to identify the right green crackers. In fact, experts have cautioned against purchasing green crackers from street vendors as the items may not be credible.
- It is also revealed that most customers prefer 'traditional' crackers due to a **lack of availability of green crackers**, or due to their higher prices.

## Way Forward

- There should be efforts by the government to increase their production by giving legal sanctions to small manufacturers for the production activities of green crackers. It will help in tackling the problem of scarcity of Green crackers.
- The people should be made aware of the benefits of green crackers and how to recognize their genuineness.

Source: [DTE](#)

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## The Lancet Countdown on Health and Climate Change

**For Prelims:** WHO, WMO, Covid-19, Climate Change, Air Pollution, Heat Exposure, COP-27.

**For Mains:** Lancet Countdown on Health and Climate Change, Paris Agreement.

### Why in News?

Recently a report was released titled **Lancet countdown on health and climate change: health at the mercy of fossil fuels**, showing that from 2000-2004 to 2017-2021, **heat-related deaths increased by 55% in India**.

- This report comes ahead of this year's **United Nations climate change conference (COP27)**, to be held in Sharm El Sheikh, Egypt.
- The report represents the **work of 99 experts from 51 institutions**, including the [World Health Organization \(WHO\)](#) and the [World Meteorological Organization \(WMO\)](#).

### What is Lancet Countdown on Health and Climate Change Report?

- The Lancet Countdown on Health and Climate Change, published annually, is an **international, multidisciplinary collaboration, dedicated to monitoring the evolving health profile of climate change**, and providing an independent assessment of the delivery of commitments made by governments worldwide under the [Paris Agreement](#).
- The countries considered in the modelling study represent **50% of the world's population and 70% of the world's emissions** – Brazil, China, Germany, India, Indonesia, Nigeria, South Africa, the UK and the US.
- The Lancet Countdown report was established following the 2015 Lancet Commission on Health and Climate Change.
- It tracks **43 indicators across five key domains**:
  - Climate Change impacts, Exposures and Vulnerability; adaptation, Planning, and resilience for health; mitigation actions and health co-benefits; economics and finance and public and political engagement.

### What are the Findings of the Report?

- **Subsidies Causing Global Problems**:
  - Subsidies to fossil fuel consumption in **many countries are causing global problems, including deterioration of air quality**, decline in food output and increased risk of infectious disease linked to higher carbon emissions.

- In 2021, 80% of the countries reviewed provided some form of fossil fuel subsidy, totaling USD 400 billion.
- In 2019, India spent a net USD 34 billion on fossil fuel subsidies, accounting for 5% of total national health spending.
- **Over 3,30,000 people died in India in 2020** as a result of exposure to **fossil fuel pollutants**.
- **Effects of Rising Temperature on Age Groups:**
  - From 2012-2021, infants under one year old experienced an average of 72 million more person-days of heatwaves per year, compared to 1985-2005.
  - **Adults over the age of 65** in India experienced 301 million more person-days during the same time period.
  - From 2000-2004 to 2017-2021, heat-related deaths **increased by 55% in India**.
- **Impact on GDP:**
  - In 2021, Indians lost **167.2 billion potential labour hours** due to heat exposure with income losses equivalent to about 5.4% of national GDP.
- **Dengue Transmission:**
  - From 1951-1960 to 2012-2021, the number of months suitable for dengue transmission by *Aedes Aegypti* rose by 1.69%, reaching 5.6 months each year.

## What are the Recommendations?

- Improvement in air quality will help to **prevent deaths resulting from exposure** to fossil fuel-derived particulate matter.
- Develop climate solutions that are **proportionate to the scale of the problem**. The climate crisis is endangering not only the health of the planet, but also the health of people everywhere, through toxic air pollution, decreased food security, increased risks of infectious disease outbreaks, extreme heat, drought, floods, etc.
- Therefore, **governments should pay more attention to and invest more resources** in environmental protection.
- Burning of dirty fuels **needs to be minimized as soon as possible** to reduce the accompanying health impacts.

## What are Initiatives taken by India for Controlling Air Pollution?

- [System of Air Quality and Weather Forecasting and Research \(SAFAR\) Portal](#)
- [Air Quality Index](#)
- [Graded Response Action Plan](#) (for Delhi)
- [BS-VI Vehicles](#)
- [Push for Electric Vehicles \(EVs\)](#)
- [New Commission for Air Quality Management](#)
- [Turbo Happy Seeder \(THS\) Machine](#) for reducing stubble burning.
- [National Air Quality Monitoring Programme \(NAMPP\)](#)
- [National Solar Mission](#)
- [National Wind-Solar Hybrid Policy 2018](#)

Source: [TH](#)

## Benefits of Biogas

**For Prelims:** Biogas, Sustainable Development Goals, compressed biogas (CBG), liquefied biogas (LBG),

**For Mains:** Significance of Biogas.

## Why in News?

Countries around the world are turning to [biogas](#) and biomethane to enhance their energy security.

## What is Biogas?

### ▪ About:

- **Biogas**, a renewable fuel produced using the **anaerobic digestion** process from organic feedstock, is primarily composed of methane (50-65%), carbon dioxide (30-40%), hydrogen sulfide (1-2.5%) and a tiny fraction of moisture.
- It contributes to all 17 of the United Nation's [Sustainable Development Goals](#) and can also be converted to produce numerous sustainable transportation fuels.

### ▪ Variants:

- **Compressed Bio Gas (CBG):** The upgraded or high-purity biogas (after removal of unwanted components like carbon dioxide, hydrogen sulphide and moisture) compressed at 250 bar pressure results in a fuel called **compressed biogas (CBG)**. This has properties similar to **compressed natural gas (CNG)** and could be directly used to power CNG engines.
  - **Drawback:** Its existence in the gaseous form, which demands bigger volumes for transportation. Therefore, it is considered more suitable to power small-sized vehicles, though heavy engines have been used for short-distance driving.
- **Liquified Bio Gas (LBG):** If the biogas-derived methane is liquefied by cooling it at -162 degrees Celsius, the fuel thus obtained is **liquefied biogas (LBG)**. It has a higher energy density that lowers storage space requirements.
  - At atmospheric pressure, the energy density of liquid methane is roughly 600 times more than that of gaseous methane and 2.5 times greater than that of methane at 250 bar.
  - **Advantages:** It can become a viable **alternative fuel for heavy-duty road transportation** since it has a comparatively high energy density.
    - It is becoming attractive to the shipping industry in addition to being utilised in heavy-duty vehicles.

### ▪ Applications:

- Biogas can be converted to produce numerous sustainable transportation fuels.
- In addition to being used directly as fuel, biomethane can also be **transformed into other fuels such as hydrogen and methanol**. The primary method for producing hydrogen encourages the reforming of light hydrocarbons, particularly methane, which makes up a significant portion of biogas.
- Gasification is performed by limiting the amount of oxygen and steam present in the reaction and heating the bio-methane to high temperatures (usually over 600°C).
  - **Syngas**, a mixture of hydrogen and carbon monoxide, is created as a result of this process. The hydrogen produced after the removal of carbon monoxide could be used in fuel cells to generate power.
  - Methanol can also be generated from syngas. **Methanol** is an effective fuel; it emits less particulate matter and nitrogen oxide (NOx) than gasoline. It can be used also as a transportation fuel by blending or entirely replacing gasoline. It's more affordable than LNG.

## What is the Indian Scenario regarding Biogas and Methanol?

- CBG is the only transportation fuel from biogas for which commercialisation efforts have been made.
- Currently, LBG, hydrogen and methanol are not produced from biogas in India. The main reasons

are:

- Unavailability of biogas in bulk for such derivatives,
  - Absence of infrastructure to generate and market these fuels,
  - Deficiency of modified automobile engines as well as the lack of effective. Research and development push to improve process economics.
- **Government Initiatives:** The Indian government has been encouraging private businesses to set up CBG plants and provide CBG to oil marketing companies for sale as automotive and industrial fuels under the [Sustainable Alternative Towards Affordable Transportation \(SATAT\) scheme](#) launched in 2018.
- Further, the Indian government and **Niti Aayog** have outlined roadmaps to hasten our transition towards green fuels and promote LNG, hydrogen and methanol.

Source: [DTE](#)

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## Ethiopia

**For Prelims:** Horn of Africa, Middle East, Red Sea, East Africa Community

**For Mains:** Conflict in Ethiopia and way Forward, Indian-Ethiopia Relations.

### Why in News?

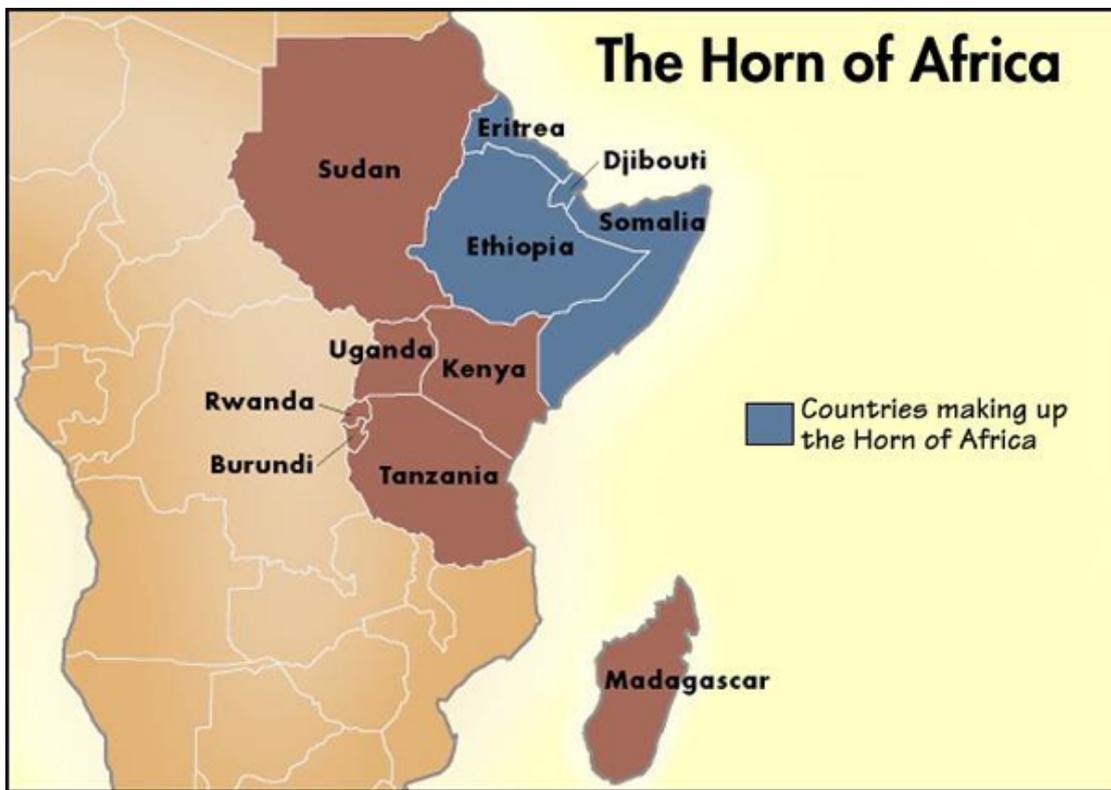
An **Ethiopian government team and Tigray forces** are going to have peace talks in South Africa.

### What Paved to the Peace Talks?

- The spectrum of political, economic, and security problems that confronted Ethiopia and Eritrea paved the way for a **strategy that essentially incorporated reconciliation and democratisation**, social and economic development, and, importantly, ties with the western world.
- This is the first formal Peace talks between the two led by the [African Union](#) and is happening at a time when Ethiopian forces and allies have made some gains in Ethiopia's northern Tigray region.
  - Tigray was a prominent force in the **country's ruling coalition until Ethiopia's current leader** and Nobel Peace laureate (2019) Abiy Ahmed became the Prime Minister in 2018.

### Where is Ethiopia?

- It is a **landlocked** country located in the Horn of Africa, officially known as the Federal **Democratic Republic of Ethiopia**.
- The country lies completely **within the tropical latitudes and is relatively compact**, with similar **north-south and east-west dimensions**.
- The capital is Addis Ababa.
- Ethiopia is one of the world's oldest countries, its territorial **extent having varied over the millennia of its existence**.
- It is the tenth-largest country in Africa in terms of area.
- Ethiopia is located from Sudan in the southeast, Eritrea to the south, Djibouti and Somalia to the west, Kenya to the north, and South Sudan to the east.
- It is the most **populous landlocked country in the world**.



## What is the Conflict in Ethiopia?

### ▪ Background:

- Ethiopia was an imperial state that gradually weakened with the **emergence of regional and religious rivalries**.
  - Currently Ethiopia has more than 70 ethnic groups. It has Oromo 34.5%, Amhara 26.91%, Somali 6.20%, Tigre 6.07%.
- A major insurgency followed in the 1970s — in Tigray, where the Meles Zenawi-led **Tigray People's Liberation Front (TPLF)**, rebelled against the military government and its policies.
  - It was the backing of the then Soviet Union and allies that propped up both the armed forces and the Mengistu government, but this support began to dissipate in the **1980s, influencing the course of conflicts with the Eritreans and Tigray**.

### ▪ Separation of Eritrea:

- Eritrea, formerly part of Ethiopia, **separated from Ethiopia in 1991** and a majority of Eritrea was in the hands of the Eritrean People's Liberation Front (EPLF), while in Ethiopia it was the TPLF.
- The war between 1998 and 2000 and the border in Eritrea and **Ethiopia remained tense until 2018**.

### ▪ Ethnic Rivalries:

- Abi Ahmed was elected to the post of Prime Minister in **2018 and signed a peace deal to end the border dispute with Eritrea**.
  - After the implementation of this peace agreement, Abi Ahmad was **awarded the 2019 Nobel Peace Prize**.
- But then the conflict started after Ahmed, who belongs to the Oroma community, was accused **by local leaders of the Tigray community** that the community was being harassed by **military officials and bureaucrats**.
  - The original inhabitants of Tigray are considered to be the fighting community of Ethiopia and 60% of senior military positions are **dominated by the Tigray community**.

### ▪ Civil War:

- Along with this, various international agencies have accused **Abi Ahmad of imposing an internet shutdown to curtail press freedom in Ethiopia** and curbing personal rights.

- As a result of Abi Ahmad's policies, the dissatisfaction of the Tigray community increased and **there was a situation of civil war**.
- Missiles were fired by the **Tigray army in the neighboring country of Eritrea, Asmara**, after which the Federal Government of Ethiopia declared an **armed struggle against the Tigray Army (Tigray People's Liberation Front)**.

## What are the Implications of this Conflict?

- **Impact on Neighboring Countries:**
  - Ethiopia is the region of the Horn of Africa which has countries like **Eritrea, Djibouti, and Sudan in addition to Ethiopia**. The launch of missiles at the capital of Eritrea by the Tigray community of Ethiopia also makes **other countries suspicious**.
- **Hydro Project on the Blue Nile:**
  - Tigrayan tensions are also linked to the mega hydroproject on the Blue Nile, the 6,450 MW Grand Ethiopian Renaissance Dam, which will be Africa's largest hydroelectric facility.
  - It is a few hundred kilometres away from the Tigrayan border and upstream and east of the border with Sudan.
  - There is a threat of regional disquiet with Sudan and Egypt which depend on the Nile and fear restrictions to water use.
- **Global Impact:**
  - Global organizations are also affected by this conflict. Recently the President of the World Health Organization has condemned the conflict in Ethiopia.
  - The conflict with Tigray worries the world as it could spill beyond the borders and ignite a crisis in **north-east Africa**.
- **Impact on India:**
  - India considers Africa as an important part of its diplomacy at this time. Various types of welfare programs are being run by India in African countries. Educational work and industrial work are done by Indians in Ethiopia.

## How have been the India-Ethiopia Relations?

- **Ethiopia is one of the largest recipients of long-term concessional credit** from India in Africa.
  - Lines of Credit worth more than USD1 billion have been sanctioned to Ethiopia for sectors such as rural electrification, sugar industry and railways.
- Tele-Education and Tele-Medicine services under the **Pan African e-network Project** was launched in Addis Ababa in July 2007.
  - The Tele-Education project has been replicated by the Ethiopian side and linkages established between the Addis Ababa University and the Indian Institutes of Technology at Delhi and Kanpur.
- Bilateral trade between Ethiopia and India stood at **USD 1.28 billion in 2018-19**, out of which Indian exports to Ethiopia were USD 1.23 billion and imports were USD 55.01 million.
  - There are more than 586 Indian companies in Ethiopia employing more than 55,000 people with licensed investment of over USD 4 billion.
  - About 58.7% of Indian investments are in the manufacturing sector, followed by agriculture (15.6%).
- Indian Mission has been celebrating the **International Day of Yoga** in Addis Ababa. Mission held Gandhi@150 celebrations in Addis Ababa (Oct 2020).

## Way Forward

- Abiy can reach out to regional political leaderships, especially the TPLF, find common ground, and run the country peacefully by restoring the balance between ethnicities and regions and decentralising the federal government.
- The protection of civilian safety and security is essential. The **African Union** can play a role in this.

**Q. Consider the following pairs: (2018)**

	<b>Regions sometimes mentioned in news</b>		<b>Country</b>
1.	Catalonia	—	Spain
2.	Crimea	—	Hungary
3.	Mindanao	—	Philippines
4.	Oromia	—	Nigeria

Which of the pairs given above are correctly matched?

- (a) 1, 2 and 3
- (b) 3 and 4 only
- (c) 1 and 3 only
- (d) 2 and 4 only

**Ans: (c)**

- Catalonia is in Spain. It is an autonomous region in North-east Spain with a distinct history dating back almost 1,000 years. It initiated a referendum for independence from Spain in October 2017 and unilaterally declared independence. Hence, pair 1 is correctly matched.
- Crimea was a Ukrainian territory which was annexed by Russia in 2014. Hence, pair 2 is not correctly matched.
- Mindanao is the second largest island in the Philippines. Hundreds of pro-Islamic State militants seized parts of the predominantly Islamic city of Marawi in Mindanao in May 2017. Hence, pair 3 is correctly matched.
- Oromia region is inhabited primarily by the Oromo ethnic group, the largest ethnic group in Ethiopia. There were clashes between Oromo and Somali ethnic groups in December 2016 following territorial disputes between the two communities in Ethiopia. **Hence, pair 4 is not correctly matched.**
- **Therefore, option (c) is the correct answer.**

Source: [TH](#)

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## Launch Vehicle Mark 3

### Why in News?

Recently, the [Indian Space Research Organisation's \(ISRO\)](#) heaviest rocket **Launch Vehicle Mark 3 (LVM3 or GSLV Mark 3)** has successfully orbited 36 satellites of **U.K.-based OneWeb**.

- OneWeb is a global communications network powered by a constellation of 648 Low Earth Orbit (LEO) satellites.

### What is LVM 3?

- **About:**

- The LVM3-M2 mission is a dedicated commercial mission for a foreign customer OneWeb, through **NewSpace India Limited (NSIL)**, a Central Public Sector Enterprise (CPSE).
  - It is the first multi-satellite mission with 36 OneWeb Satellites to the LEO as the heaviest Payload mass of 5,796 kg. of LVM3 till date.
  - This newest rocket is capable of **launching 4,000-kilogram class of satellites into GTO (Geosynchronous Transfer Orbit)** and 8,000 kgs of payloads into LEO.
  - It is a **three-stage launch vehicle consisting of two solid propellant S200 strap-ons** on its sides and core stage comprising L110 liquid stage and C25 cryogenic stage.
- **Features:**
    - First Commercial Mission of LVM3
    - First launch of LVM3 to LEO
    - First Indian rocket with six-ton payload
    - First NSIL Mission with LVM3
    - First OneWeb Mission with NSIL/Department of Space.
  - **Technical Achievements:**
    - Handling of multiple satellite separation events
    - Increased nominal mission duration
    - Ensuring safe separation distance through C25 (cryo) stage re-orientation & velocity addition
    - Ensuring data availability for entire mission duration
    - Realisation of new payload adaptor and interface ring for the satellites dispenser

## What is OneWeb Constellation?

- OneWeb Constellation operates in a LEO Polar Orbit Satellites are arranged in **12 rings (Orbital planes) with 49 satellites in each plane.**
- The orbital planes are inclined to be near polar (87.9 Deg.)
- The orbital planes are 1200 km above the Earth. Each satellite completes a full trip around the earth every 109 minutes.
- The earth is rotating underneath satellites, so they will always be flying over new locations on the ground.

## What are other Launch Vehicles Developed by ISRO?

- **Satellite Launch Vehicle (SLV):** The first rocket developed by ISRO was simply called SLV, or Satellite Launch Vehicle.
  - It was followed by the Augmented Satellite Launch Vehicle or ASLV.
- **Augmented Satellite Launch Vehicle (ASLV):** SLV and ASLV both could carry small satellites, weighing up to 150 kg, to lower earth orbits.
  - ASLV operated till the early 1990s before PSLV came on the scene.
- **Polar Satellite Launch Vehicle (PSLV):** PSLV's first launch was in 1994, and it has been ISRO's main rocket ever since. Today's PSLV, however, is vastly improved and several times more powerful than the ones used in the 1990s.
  - It is the first Indian launch vehicle to be equipped with liquid stages.
  - PSLV is the most reliable rocket used by ISRO to date, with 52 of its 54 flights being successful.
  - It successfully launched two spacecraft - [Chandrayaan-1 in 2008](#) and [Mars Orbiter Spacecraft in 2013](#) - that later travelled to Moon and Mars respectively.
- **Geosynchronous Satellite Launch Vehicle (GSLV):** GSLV is a much more powerful rocket, meant to carry heavier satellites much deeper into space. To date, GSLV rockets have carried out 18 missions, of which four ended in failure.
  - It can take 10,000 kg of satellites to lower the earth's orbits.
  - The indigenously developed Cryogenic Upper Stage (CUS), forms the third stage of GSLV Mk II.
  - Mk-III versions have made ISRO entirely self-sufficient in launching its satellites.
    - Before this, it used to depend on the European Ariane launch vehicle to take its heavier satellites into space.
    - GSLV Mark-III was used to launch the [Chandrayaan-2 mission](#) to the moon in 2019, which was the first operational flight of the rocket.

- ISRO has renamed the **GSLV Mark-III as Launch Vehicle Mark-III**.
  - A GSLV - for the Geostationary Orbit (GEO) - will continue to be called so. The LVM3 will go everywhere —GEO, Medium Earth orbit (MEO), LEO, and missions to the moon, sun.

## UPSC Civil Services Examination Previous Year Question

**Q. With reference to India's satellite launch vehicles, consider the following statements: (2018)**

1. PSLVs launch the satellites useful for Earth resources monitoring whereas GSLVs are designed mainly to launch communication satellites.
2. Satellites launched by PSLV appear to remain permanently fixed in the same position in the sky, as viewed from a particular location on Earth.
3. GSLV Mk III is a four-staged launch vehicle with the first and third stages using solid rocket motors; and the second and fourth stages using liquid rocket engines.

Which of the statements given above is/are correct?

- (a) 1 only
- (b) 2 and 3
- (c) 1 and 2
- (d) 3 only

**Ans: (a)**

**Source:** [IH](#)

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