

WORLD'S FIRST 3D-PRINTED ROCKET ENGINE

Why in news? AgniKul Cosmos, a start-up incubated at IIT Madras, has launched the world's first single-piece 3D printed rocket engine, designed and built indigenously in the country. With assistance from ISRO, the startup successfully carried out a sub-orbital test-flight of its home-built rocket — Agnibaan — from Sriharikota.

3D printing

- 3D printing, also known as **additive manufacturing**, is a process of creating three-dimensional objects from digital models by adding material layer by layer.
- It is an additive process, in which layers of a material like plastic, composites or bio-materials are built up to construct objects that range in shape, size, rigidity and colour.
- This process allows for more efficient and customized production compared to traditional subtractive manufacturing methods.

Agnibaan SOrTeD (Sub-Orbital Technology Demonstrator)

- Agnikul Cosmos has test-fired its rocket named Agnibaan SOrTeD (Suborbital Tech Demonstrator).
 - A sub-orbital launch is a spaceflight that reaches outer space but doesn't complete an orbit around the Earth.
 - The spacecraft's trajectory intersects the Earth's atmosphere or surface, so it doesn't become an artificial satellite or reach escape velocity.
- This was the fifth attempt by Agnikul to launch the Agnibaan SOrTeD since March 22.
- With this, AgniKul becomes the second private company to launch a rocket after India's first privately developed rocket, from the company Skyroot, flew in 2022.
- **Features**
 - Agnibaan is a customizable, **two-stage launch vehicle** that can carry a payload of up to 300 kg into orbit of about 700 km.

- The rocket uses a **semi-cryogenic engine**, a technology that is yet to be demonstrated by the ISRO in any of its rockets.
 - A semi-cryogenic engine is a type of rocket engine that uses a combination of liquid and gaseous propellants.
 - It operates at temperatures higher than cryogenic engines but lower than traditional liquid rocket engines.
 - They use refined kerosene instead of liquid hydrogen, which is lighter and can be stored at normal temperatures.
 - Kerosene also takes up less space, allowing for more propellant to be carried in the engine's fuel compartment.
 - When combined with liquid oxygen, kerosene provides a higher thrust for the rocket.
- The test flight aims to:
 - demonstrate the in-house and homegrown technologies, gather crucial flight data, and
- It can access both low and high-inclination orbits and is completely mobile — designed for accessing more than 10 launch ports
- **Agnibaan – a series of many firsts**
 - Agnibaan has become the world's first 3D printed engine.
 - It became the first semi-cryogenic engine-powered rocket launch.
 - It also became India's first rocket launch from a private launchpad.
 - Agnibaan is powered by the only rocket engine in the country that uses both gas and liquid fuel (liquid oxygen/kerosene).
- **Significance**
 - Typically, engine parts are manufactured separately and assembled later.
 - Using the 3D-printed manufacturing process is likely to lower the launch cost and cut down the vehicle assembly time.
 - It will help in offering affordable launch services to small satellites.

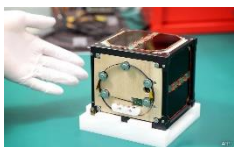
WHAT IS RED FLAG 24 EXERCISE?



An Indian Air Force (IAF) contingent recently arrived at the Eielson Air Force Base in Alaska to participate in the prestigious multi-national exercise, Red Flag 24.

- It is a two-week **advanced aerial combat training exercise** aimed at integrating aircrew in a multinational environment.
- It is designed to replicate a realistic and challenging environment, bringing together aircrew and equipment from different nations and services.
- Approximately **3100 service members are expected to fly**, maintain, and support more than 100 aircraft during the exercise.
- The IAF deployed Rafale fighter jets for the Red Flag 24 exercise.
- The exercises can be adapted to integrate various forces into a **realistic threat environment using** the more than 77,000 square miles of airspace in the Joint Pacific Alaska Range Complex, which is the largest combat training range in the world.
- Since its **inception in 1975, Red Flag exercises** are designed to create a comprehensive learning environment by simulating realistic combat scenarios.
 - There are **two distinct Red Flag exercise locations: Nellis Air Force Base in Nevada and Eielson Air Force Base in Alaska.**
 - The Nevada exercise is organized by the United States Air Force Warfare Center (USAFWC), while the Alaska exercise is managed by the Pacific Air Forces (PACAF), the air component command of the United States' Indo-Pacific Command (USINDOPACOM).

LIGNOSAT



In a world-first, Japanese researchers have built a tiny wooden satellite named LignoSat that will be launched into space in September.

- LignoSat”, a fusion of “**ligno**” (the Latin word for wood) and “satellite”.

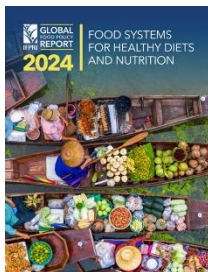
- It is developed by collaborative research and development by a team comprising members from **Kyoto University and Sumitomo Forestry Co.**
- **Objective:** Their objective is to **leverage the eco-friendliness** and cost-effectiveness of wood in space exploration.
- It is constructed from **magnolia wood**, chosen for its durability and adaptability.

Why wood is used?

- Wooden satellites are viewed as **more environmentally friendly** upon reentering the Earth's atmosphere at the conclusion of their mission. Unlike metal satellites, which pose air pollution risks due to the generation of metal particles during reentry, wooden satellites mitigate these concerns.
- It will first be sent to the **International Space Station (ISS)** aboard a SpaceX rocket from the Kennedy Space Center.
- Once it reaches the ISS, it will be released from the Japanese experiment module to test its durability and strength.
- Researchers will receive data from the satellite to monitor its performance, including signs of strain and its ability to withstand **extreme temperature changes**.

GLOBAL FOOD POLICY REPORT 2024

It mentions that at **least 38 per cent** of the Indian **population ate unhealthy foods**, while only 28 per cent ate all five recommended food groups, which include at least one starchy staple food, one vegetable, one fruit, one pulse, nut or seed and one animal-source food.



- The consumption of such **calorie-dense and nutrient-poor foods** was not only high but was also **increasing**, while the consumption of vegetables and other micronutrient-rich foods was low.
- In India and other South Asian countries, **consumption of processed foods** is on the **rise**. After cereals and milk, snacks and prepared foods accounted for the majority of Indian food budgets.

- In India, the proportion of the population **suffering from malnutrition increased** from 15.4% in 2011 to 16.6% by 2021.
- Similarly, the **share of packaged** (highly processed and calorie-dense) foods in household food budgets **nearly doubled** during this period, to 12 per cent from 6.5 per cent.
- In the South Asian region, the report highlighted that micronutrient-rich foods were expensive, whereas cereals, fats and oils, sugar, and sugary and salty snacks were relatively inexpensive.

Key facts about the International Food Policy Research Institute (IFPRI)

- It was established in 1975 and provides **research-based policy solutions** to sustainably reduce poverty and end hunger and malnutrition in developing countries.
- It is a research centre of CGIAR, which is the world's largest agricultural innovation network.
- Its research focuses on five strategic research areas:
 - Fostering Climate-Resilient and **Sustainable Food Supply**
 - Promoting Healthy Diets and Nutrition for All
 - Building Inclusive and Efficient Markets, Trade Systems and Food Industry
 - Transforming **Agricultural and Rural Economies**
 - Strengthening Institutions and Governance
- **Headquarters:** Washington, D.C

TOBACCO EPIDEMIC IN INDIA

- Tobacco is a major cause of preventable disease and death worldwide. It harms both users and those who grow it.
- With around 26 crore users, India has the second highest number of tobacco users after China.
- **Impact on health and environment**

- The health of over 60 lakh workers in the tobacco industry is also at risk due to skin absorption of tobacco.
- Tobacco farming harms the environment by depleting soil nutrients and causing deforestation.
- Processing tobacco requires a lot of wood, and its production generates a significant amount of waste.
 - Up to 5.4 kg of wood is required to process 1 kg of tobacco.
- **Financial burden**
 - **In 2017-2018, the health impacts of tobacco cost India over ₹1.7 lakh crore, far exceeding the ₹48,000 crore health budget for that year.**
 - **Additionally, cleaning up tobacco waste costs around ₹6,367 crore annually, not including the costs of soil erosion and deforestation.**

Awareness, Legislative Provisions and Initiatives Taken by the Government with respect to Tobacco:

- **Framework Convention on Tobacco Control (FCTC)**
 - Launched in 2005, the FCTC aims to reduce tobacco usage worldwide by helping countries develop demand and supply reduction strategies.
 - India is one of the 168 signatories of the WHO's FCTC programme.
- **COTPA Act, 2003**
 - COTPA stands for Cigarettes and Other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply, and Distribution).
 - It has 33 sections governing the production, advertisement, distribution, and consumption of tobacco.
- **National Tobacco Control Programme (NTCP)**
 - India also launched the National Tobacco Control Program (NTCP) in 2007.
 - NTCP is designed to improve the implementation of COTPA and FCTC, improve awareness about the harms of tobacco use, and help people quit it.

- Apart from these interventions, **tobacco taxation** — a globally accepted method to effectively control tobacco use — is also applied in India.

Challenges Associated with respect to Curbing Tobacco Consumption:

- **Poor Implementation of Existing Measures**
 - Smokeless tobacco products often don't follow the packaging rules set by COTPA, and smuggled tobacco products are poorly regulated.
 - **Fines for breaking these rules are outdated**, with companies only facing a maximum fine of ₹5,000 for their first violation.
- **NTPC's Lack of Effectiveness**
 - A 2018 study reported no significant difference in the reduction of bidi or cigarette consumption between NTCP and non-NTCP districts.
 - Possible reasons for this included insufficient staffing, resource allocation, and utilisation, and lack of effective monitoring mechanisms.
- **Tax Evasion**
 - **Tobacco taxes in India are low and haven't kept up with rising incomes, making tobacco products more affordable over the years.**
 - Tax burden of 51% for cigarettes, 22% for bidis, and 64% for SLTs, much lower than the FCTC's recommendation of at least 75% tax.

Way Ahead:

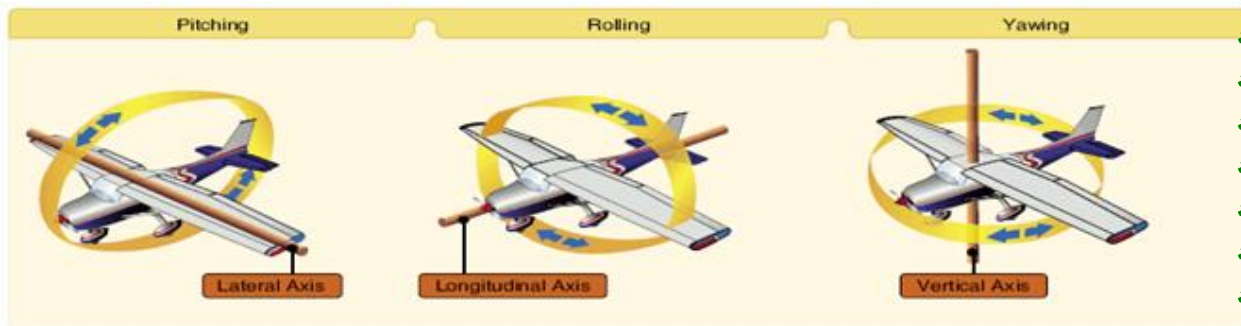
- India has strong laws (COTPA, PECA, NTCP) to control tobacco use and production, but they need stricter enforcement.
- Additionally, **tobacco taxes should be increased to match recommendations, inflation, and economic growth.**
- **The government can also help tobacco farmers switch to other crops, preventing job losses.**
- Studies show that crops like jowar can be more profitable than tobacco.
- Up-to-date data on tobacco use is essential to counter industry tactics and effectively control tobacco. Without this data, efforts to manage tobacco use will fall short.

THE LINK BETWEEN CLIMATE CHANGE AND RISING INCIDENTS OF SEVERE TURBULENCE IN AIRCRAFT

Why in News? After a Singapore Airlines flight from London to Singapore was hit by sudden and severe turbulence over Myanmar, a Qatar Airways flight from Doha to Dublin encountered severe turbulence over Turkey. Though flights around the world experience varying degrees of turbulence on a daily basis, the recent incidents that result in serious injuries are rarer, pointing towards the impact of explosive growth in air traffic and climate change.

What is Flight-Turbulence, its Causes and Types?

- **Meaning of flight-turbulence:**
 - Turbulence is **an irregular motion of the air** resulting from eddies and vertical currents.
 - It may be as insignificant as minor bumps or severe enough to throw an airplane out of control or to cause structural damage.
 - Turbulence is associated with **fronts, wind shear, thunderstorms, etc.**
- **Effects of flight-turbulence:**



- **Causes of flight-turbulence:**
 - **Mechanical turbulence:** It is the result of friction between the air and the ground - irregular terrain and man-made obstacles - that leads to formation of eddies.
 - **Convective or thermal turbulence:** It is caused when hot air from certain ground surfaces rises rapidly while cooler air descends, resulting in convective air

currents. **Frontal turbulence:** It is caused by the friction between two opposing air masses and the lifting of warm air by the sloping frontal surface and is most common close to **thunderstorms**.

- **Wind shear:** It is the change in wind direction/ wind speed (in temperature inversion areas, around jet streams, etc) over a specific horizontal or vertical distance.
 - **Clear air turbulence (CAT)**, which can be sudden and severe and is extremely difficult to forecast or see, may be considered as a type of wind shear turbulence.

Impact of Climate Change on Flight-Turbulence:

- **Findings of the study:** According to some studies, climate change could make turbulence more frequent and severe.
- **How can this be claimed?**
 - Climate change is **strengthening the jet streams** that cause turbulence.
 - A large increase in CAT between 1979 and 2020 in the mid and aircraft cruising altitudes.
 - Over the North Atlantic, severe/ greater CAT durations increased by more than 55% over this period.
- **Future predictions:**
 - The frequency of severe turbulence would increase more than that of light or moderate turbulence.
 - Not only CAT, but also **mountain wave turbulence and near-cloud turbulence** will intensify due to climate change.