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General Studies Paper-3 – S&T – April 2019

1. PROTECTION OF PLANT VARIETIES AND FARMERS' RIGHTS (PPV&FR)

Recently, PepsiCo has sued nine farmers in Gujarat for alleged rights infringement on the grounds that they illegally grew its registered FC-5 potato variety (or FL-2027) used to make Lays chips.

• PepsiCo has invoked Section 64 of the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001 to claim infringement of its rights, as company has patented FC-5 until January 2031 under the Act.

• Farmers groups cite Section 39 of the PPV&FR Act, which specifically says that a farmer is allowed "to save, use, sow, resow, exchange, share or sell his farm produce including seed of a variety protected under this Act" so long as he does not sell "branded seed". About the Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001

• India as a signatory to World Trade Organization in 1994, was obliged under Article 27(3) (b) of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), either to adopt a sui genesis system for plant variety protection or join the Convention of the International Union for the Protection of New Varieties of Plants (UPOV).

o The Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001" was enacted by adopting sui generis system.

• It's the world's only IPR legislation which grants intellectual property rights not only to the plant breeders but also to the farmers by protecting new, extant and farmers' varieties.

• Unlike UPOV, the Act facilitates protection of not only new, but even extant (existing) varieties. That includes those notified under the Seeds Act (1966), farmers' varieties and varieties of common knowledge.

• **Objective**

o To recognize and protect the rights of farmers in respect of their contributions made at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.

o To accelerate agricultural development in the country, protect plant breeders' rights; stimulate investment for research and development both in public & private sector for the development new of plant varieties.

o Facilitate the growth of seed industry in the country, to ensure the availability of high quality seeds and planting material to the farmers.

• The protection period is for 15 years, and 18 years in the case of trees and vines.

• Establishes Plant Varieties Protection Appellate Tribunal (PVPAT): The decisions of the PVPAT can be challenged in High Court. The Tribunal shall dispose of the appeal within one year.

• Protection of Plant Varieties and Farmers' Rights Authority (PPV&FR Authority): Established to implement the provisions of the Act by Department of Agriculture and Cooperation, Ministry of Agriculture. General Functions of the Authority: o Registration of new plant varieties and Maintenance of the National Register of Plant Varieties for registration of new plant varieties, essentially derived varieties (EDV) and extant varieties. o Facilitate development and commercialisation of new varieties through formal linkages with agricultural universities, research institutions and Krishi Vigyan Kendras

o Developing DUS (Distinctiveness, Uniformity and Stability) test guidelines for new plant species: DUS testing is a way of determining whether a newly bred variety differs from existing varieties within the same species (the Distinctness part), whether the characteristics used to establish Distinctness are expressed uniformly (the Uniformity part) and that these characteristics do not change over subsequent generations (the Stability part).

o Maintenance of National Gene Bank to store the seed material including parental lines submitted by the breeders of the registered varieties

o Establish National Gene Fund (2007): It supports and reward farming /tribal/rural communities who are engaged in conservation, improvement and preservation of genetic resources of economic plants and their wild relatives.

o Institute Plant Genome Saviour Community Award, to community of farmers which is engaged in conservation, improvement and preservation of genetic resources of economic plants and their wild relatives, particularly in areas identified as agro-biodiversity hotspots.

About UPOV

• Objective: It's an intergovernmental organization, to provide and promote an effective system of plant variety protection, with the aim of encouraging the development of new varieties of plants, for the benefit of society.

• Protection to Framers: The UPOV Convention provides the basis for members to encourage plant breeding by granting breeders of new plant varieties an intellectual property right: the breeder's right.

Impact of Plant Variety Protection

• increased breeding activities,

• greater availability of improved varieties,

• diversification of types of breeders (private breeders, researchers),

• increased number of foreign new varieties,

• encouraging the development of a new industry competitiveness on foreign markets, and

• improved access to foreign plant varieties and enhanced domestic breeding programs. Difference Between **Patent And PPV&FR Act**

• A patent deals with IPR over devices of Industrial applications whereas PPV & FR Act, 2001 confers IPR to plant breeders who have bred or developed plant varieties.

• A patent is a set of exclusive rights granted by a state (national government) to an inventor or their assignee for a limited period of time in exchange for the public disclosure of an invention. The PPV&FR Act, give rights to farmers, breeders and researches besides giving protection to varieties of all crop species which are notified under the Act. • There is also provision for benefits sharing, compensation to the farmers, recognition and award to the farmers for supporting conservation and sustainable use of plant genetics resource.

Rights under the Act

• Breeders' Rights: Breeders will have exclusive rights to produce, sell, market, distribute, import or export the protected variety. Breeder can appoint agent/ licensee and may exercise for civil remedy in case of infringement of rights.

• Researchers' Rights: Researcher can use any of the registered variety under the Act for conducting experiment or research. This includes the use of a variety as an initial source of variety for the purpose of developing another variety but repeated use needs prior permission of the registered breeder.

• Farmers' Rights

o A farmer who has evolved or developed a new variety is entitled for registration and protection in like manner as a breeder of a variety.

o A farmer can save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under the PPV&FR Act, 2001 in

the same manner as he was entitled before the coming into force of this Act provided farmer shall not be entitled to sell branded seed of a variety protected under the PPV&FR Act, 2001. o There is also a provision for compensation to the farmers for non-performance of variety under Section 39 (2) of the Act, 2001; and
o Farmer shall not be liable to pay any fee in any proceeding before the Authority or Registrar or the Tribunal or the High Court under the Act. It will be paid through National Gene Fund.

2. 3-PARENT BABY

Recently, a team of Greek and Spanish doctors has produced a baby from three people using maternal spindle transfer technique (a method of Mitochondrial Replacement Therapy).
Background
• The mitochondria are organelles inside cells that are involved in releasing energy by producing adenosine triphosphate (ATP), the key energy currency that drives metabolism. o Mitochondria are referred to as the powerhouse of the cell.
• In addition to energy production mitochondria also helps to regulate the self-destruction of cells (aptosis), necessary for production of substances such as cholesterol and heme (a component of haemoglobin).
• While most of DNA is found in cell nucleus, some DNA is also found in the mitochondria, it is called mitchochondrial DNA (mtDNA).
• Mitochondria are inherited solely from the mother and this results into cases of babies been born with rare mitochondrial diseases if mother has the faulty mtDNA.
• Certain disorders caused due to mtDNA dysfunction are diabetes, respiratory disorders, Huntington's disease, Parkinson's disease, Alzheimer's disease etc.
• There is currently no cure for mitochondrial diseases.
About "three-parent" babies
• Mitochondrial Replacement therapy (MRT) is a form of In Vitro Fertilization (Assisted Reproductive Technology). • It is used to replace mother's faulty Mitochondrial DNA with healthy Mitochondria from a donor woman during IVF process, thus the name- "three-parent" baby.
• The resulting child is still conceived from two parents and will have nuclear DNA from the woman and her partner, and mitochondrial DNA from the donor.
• The donor's mitochondria contribute just 37 genes to the child, compared with more than 20,000 from the parents. That is a negligible amount and far less than one would gain from a blood transfusion or organ transplant. • No other characteristics in terms of intelligence, eye colour, hair colour, height etc. are changed.
• Advantages: It could prevent severe genetic diseases being passed from mother to offspring and can be used to treat infertility.
• The United Kingdom became the first country in 2015, to have officially approved procedures to create "threeparent" babies.
Issues involved
• Safety Implications: Long term evolutionary implications and unintended consequences on the heredity and future generations are unknown.
• Religious Grounds: Some groups believe that technologies which manipulate or interfere with human eggs and embryos should not be used.
• Social Issues: These techniques being expensive, could benefit certain economically forward social groups only. It can also arise due to the tripaternal aspect, as children formed from these techniques might be subjected to mental agony due to discrimination or it may cause legal complications.
• Ethical Issues: Parents may misuse the technique to get "genetically modified" or "designer" babies.

• Future Health Issues: It could result in children being at higher risk of cancer and pre-matured ageing and would need to be monitored all their lives.

Way Forward

MRT technique should be developed and administered in a regulated environment such that it can be used to prevent fatal diseases while ensuring that it is not misused and only those who need it get access to it.

Process of MRT The Process of Mitochondrial Replacement Therapy can be done by two methods – Pronuclear transfer and Spindle transfer.

Spindle Transfer

• In this method the spindle and associated chromosomes from the normal mitochondria are removed and destroyed and the spindle and related chromosomes form the mother's eggs/abnormal mitochondria are transferred to the emptied donor egg.

• The reconstituted egg is fertilised with sperm from father and the embryo with normal mitochondria and maternal and paternal genomes is transferred to the uterus.

Pronuclear Transfer

• In this method, first mother's eggs with abnormal mitochondria and the donated egg with normal mitochondria are fertilised with sperm.

• Then the pronuclei from the normal mitochondria are destroyed and the pronucleus from zygote of the abnormal mitochondria is transferred to the emptied zygote.

• After this procedure the embryo with normal mitochondria and maternal and paternal genome is transferred to the uterus.

3. NIRBHAY MISSILE

India recently successfully test-fired its first Sub-sonic cruise missile, Nirbhay.

• Nirbhay is a long range, all-weather, subsonic cruise missile, with a sharper 'terrain hugging capability'. designed and developed in India by the Defence Research and Development Organisation (DRDO).

• The guidance, control and navigation systems of the missile are configured around the indigenously designed Ring Laser Gyroscope and MEMS based, inertial Navigation System.

• The missile can be launched from multiple platforms and is capable of carrying conventional and nuclear warheads.

• It is a two-stage missile powered by Solid rocket motor booster.

• It is capable of carrying warheads of up to 300kg at a speed of 0.6 to 0.7 Mach (subsonic).

• It has an operational range of 1000 km (long range). Of the six test trials, three were failed and three were successful. No other indigenous missile has been tested at such altitude

• It is the sixth development flight trial with objective to prove the repeatability of boost phase, cruise phase using way point navigation at very low altitudes, along with its sea-skimming capability to cruise at very low altitudes.

• The Nirbhay cruise missile is an Indian version of the American Tomahawk.

4. TECHNICAL TEXTILES

A Seminar was recently organized by Ministry of Water Resources, River Development and Ganga Rejuvenation on "Use of Technical Textiles in Water Resources Works".

What are technical textiles?

• Technical Textiles are defined as Textile material and products manufactured primarily for their Technical performance and functional properties rather than aesthetic and decorative characteristics.

• Technical textiles include textiles for automotive applications, medical textiles (e.g., implants), geotextiles (reinforcement of

embankments), agrotextiles (textiles for crop protection), and protective clothing (e.g., heat and radiation protection for fire fighter clothing, molten metal protection for welders, stab protection and bulletproof vests, and spacesuits).

Significance and potential applications:

• Technical Textiles are being used globally for last several decades. These materials have provided innovative

• engineering solutions for several applications in civil and geotechnical engineering, for infrastructure water resources projects.

• Even while Technical Textiles have been extensively used in developed as well as many developing countries, India has yet to capitalise the technical, economical and environmental benefits on large scale.

• Various parts of India are subjected to floods and environmental degradation. In some of the terrains, the flood management and control can rely on Technical Textiles tubes, containers and bags. Technical Textiles have been found to perform better than concrete as water protection component because of permeability, flexibility and ease of underwater placement.

5. HOW SPACEFLIGHT AFFECTS BODY?

In 2015, astronaut Scott Kelly set off for the International Space Station while his twin, Mark Kelly, remained on Earth. Scott returned in 2016, and both brothers are now retired, but over the one year Scott spent in space, 10 teams of researchers in the US carried out a landmark study on the twins' biological profiles (Scott was sending his samples from space). With the twins sharing the same genetic code, the researchers looked for variances in their bio-markers.

Details of the study:

• The results showed that a long stay in space can cause changes in the human body. These were epigenetic changes — chemical "tweaks" to DNA that can influence gene activity, without affecting the underlying genetic code itself. When epigenetic changes occur at the wrong time or place, the process can turn genes on or off at the wrong time and place. In Scott's case, most of the changes were reversed within months of his return to Earth.

What changed, what did not?

• Telomeres: These are special features at the ends of each DNA strand. Telomeres tend to get shorter as one ages; however, certain factors can affect the rate of this shortening. In Scott's case, the study identified a change in telomere length dynamics during spaceflight and within days of landing.

• Gene expression: Samples taken before, during and after Scott's mission in space revealed some changes in gene expression. These were different from the changes Mark experienced on Earth. Of the changes Scott experienced, most (about 91.3%) reverted to baseline after he returned, while a small subset persisted after six months. Some observed DNA damage is believed to be a result of radiation exposure.

• Gut bacteria: Scott's microbiome during flight was profoundly different from pre-flight. This could be due to the food he consumed in space, although other space-specific environmental factors may have also contributed. When he landed on Earth, Scott's microbiome returned to pre-flight state.

• Arteries: The inside of an artery wall can narrow due to plaque buildup. Researchers found indications of inflammation and carotid artery wall thickening in Scott during and immediately after his mission, but no such changes were observed in Mark. Researchers have not yet established whether this adaptation is reversible.

Some of the findings were encouraging for researchers:

• Vaccination: Scott received three flu vaccines — on Earth, in space, and back on Earth — each a

year apart. This study found that his body reacted appropriately to the vaccine.

• Cognition: With few exceptions, Scott's cognitive performance (such as mental alertness, spatial orientation, recognition of emotions) remained largely unchanged during his time in space, and relative to Mark on the ground.

6. GSLV PROGRAMME

The Union Cabinet has approved the ongoing Phase 4 of the Geosynchronous Satellite Launch Vehicle (GSLV) programme.

• The total fund requirement for the GSLV Continuation Programme is Rs 2729.13 crores including the cost of five GSLV vehicles, essential facility augmentation, programme management and launch campaign.

The programme and its significance:

•The GSLV Programme – Phase 4 will enable the launch of 2 tonne class of satellites for Geo-imaging, Navigation, Data Relay Communication and Space Sciences into the Geosynchronous Transfer Orbit (GTO).

• Under the GSLV Continuation Programme, five GSLV flights have been planned during the period 2021-2024.

• The GSLV Continuation Programme – Phase 4 will meet the launch requirement of satellites for providing critical Satellite Navigation Services and Data Relay Communication for supporting the Indian Human spaceflight programme 'Gaganyaan' and the next interplanetary mission to Mars.

Overall significance:

• It will help sustain the self-reliance in the launching of similar satellites for national requirements including next generation navigation satellites, data relay communication satellites and interplanetary missions.

What is Geosynchronous Satellite Launch Vehicle (GSLV)?

• GSLV is a 49 m tall three stage vehicle with the first stage comprising a solid booster with four liquid strap-on motors, each weighing 40 ton. The second stage is a liquid engine and the third stage is the indigenously built Cryogenic Upper Stage (CUS) which uses 15 ton of cryogenic propellants such as Liquid Hydrogen (LH2) as fuel and Liquid Oxygen (LOX) as Oxidiser.

• With the recent successful launch of GSLV-F11 on December 19, 2018, GSLV has successfully placed 10 national satellites.

7. NASA'S KEPLER SPACE TELESCOPE & TESS

NASA's Transiting Exoplanet Survey Satellite, TESS, has discovered its first Earth-sized exoplanet. The planet, named HD 21749c, is the smallest world outside our solar system that TESS has identified yet. • The new planet orbits the star HD 21749 — a very nearby star, just 52 light years from Earth. The star also hosts a second planet — HD 21749b — a warm "sub-Neptune" with a longer, 36-day orbit.

Background:

• While this is the first Earth-sized planet discovered by TESS, other Earth-sized exoplanets have been discovered in the past, mainly by NASA's Kepler Space Telescope, a since-retired telescope that monitored more than 530,000 stars.

• In the end, the Kepler mission detected 2,662 planets, many of which were Earth-sized, and a handful of those were deemed to be within their star's habitable zone — where a balance of conditions could be suitable for hosting life.

About Kepler Mission:

• Launched in 2009, the Kepler mission is specifically designed to survey our region of the Milky Way galaxy to discover hundreds of Earth-sized and smaller planets in or near the habitable zone and determine the fraction of the hundreds

of billions of stars in our galaxy that might have such planets.

About TESS mission:

• The Transiting Exoplanet Survey Satellite (TESS) is a NASA mission that will look for planets orbiting the brightest stars in Earth's sky. It was led by the Massachusetts Institute of Technology with seed funding from Google.

• Mission: The mission will monitor at least 200,000 stars for signs of exoplanets, ranging from Earth-sized rocky worlds to huge gas giant planets. TESS, however, will focus on stars that are 30 to 100 times brighter than those Kepler examined. This will help astronomers better understand the structure of solar systems outside of our Earth, and provide insights into how our own solar system formed.

• Orbit: TESS will occupy a never-before-used orbit high above Earth. The elliptical orbit, called P/2, is exactly half of the moon's orbital period; this means that TESS will orbit Earth every 13.7 days.

• How it works?

It will use transit method to detect exoplanets. It watches distant stars for small dips in brightness, which can indicate that planet has passed in front of them. Repeated dips will indicate planet passing in front of its star. This data has to be validated by repeated observations and verified by scientists.

8. NASA'S CASSINI SPACECRAFT

Data from NASA's Cassini-Huygens spacecraft reveal new information about the lakes on Titan, Saturn's largest moon.

• The small liquid lakes in Titan's northern hemisphere are more than 100 meters deep, perched atop plateaus and filled with methane. They also appear to be seasonal. And the bodies of liquid on one side of the northern hemisphere are completely different than those on the other side.

About Cassini Mission:

• Launched in 1997, the Cassini mission — a cooperation between NASA, the European Space Agency and the Italian Space Agency — has sent back thousands of stunning images and made numerous discoveries about the ringed planet and its moons.

• The spacecraft was launched on October 15, 1997. This was the first landing ever accomplished in the outer Solar System.

• Cassini–Huygens is an unmanned spacecraft sent to the planet Saturn.

• Cassini is the fourth space probe to visit Saturn and the first to enter orbit.

• Its design includes a Saturn orbiter and a lander for the moon Titan. The lander, called Huygens, landed on Titan in 2005.

Objectives of the mission:

• Determine the three-dimensional structure and dynamic behavior of the rings of Saturn.

• Determine the composition of the satellite surfaces and the geological history of each object.

• Determine the nature and origin of the dark material on Iapetus's leading hemisphere.

• Measure the three-dimensional structure and dynamic behavior of the magnetosphere.

• Study the dynamic behavior of Saturn's atmosphere at cloud level.

• Study the time variability of Titan's clouds and hazes.

• Characterize Titan's surface on a regional scale.

9. ANTARES ROCKET

Antares rocket built by Northrop Grumman recently lifted off from NASA's Wallops Flight Facility on Virginia's Eastern Shore carrying the Cygnus Cargo Spacecraft to the International Space Station.

• The mission is called NG-11. It is the eleventh cargo flight for NASA by Northrop Grummanand will be the company's longest one to date.

• The NG-11 mission is also the final cargo mission for NASA by Northrop Grumman under the agency's Commercial Resupply Services 1 program. To mark the occasion, Northrop Grumman named the NG-11 Cygnus the S.S. Roger Chaffee in honor of NASA astronaut Roger Chaffee, who was killed in the Apollo 1 fire alongside crewmates Gus Grissom and Ed White, Jr.

Mice aboard:

• The mice aboard Cygnus are at the core of one such study, which aims to test the effectiveness of an antitetanus vaccine.

• The rodents are split into two groups of 20; half will receive the vaccine in space and the other 20 will not receive the vaccine. Scientists will study the mice to see how the animals responded to the vaccine once they are back on Earth.

Other experiments:

• Other wild science experiments on Cygnus include testing out two robotic systems; Seeker, which is designed to hunt for air leaks on the Space Station, and Astrobee, which aims to help the station's staff with tasks such as inventory and maintenance.

• There's gear to build pristine ZBLAN fiber-optic cables in space, and a prototype for a novel air scrubber that removes carbon dioxide from the station's atmosphere.

• On the exterior of the Cygnus are small CubeSats that will be deployed after the spacecraft leaves the space station this summer.

• The Antares rocket's upper stage also carried 60 so-called ThinSats (tiny satellites) were built by elementary and high school students; one NASA CubeSat (called SASSI2) was built by students at both universities in Indiana and Illinois.

10. BEPICOLOMBO

Following a series of tests conducted in space over the past five months, the ESA-JAXA BepiColombo mission has successfully completed its near-Earth commissioning phase and is now ready for the operations that will take place during the cruise and, eventually, for its scientific investigations at Mercury.

About BepiColombo:

• BepiColombo is a joint mission between ESA and the Japan Aerospace Exploration Agency (JAXA), executed under ESA leadership.

• The mission comprises two spacecraft: the Mercury Planetary Orbiter (MPO) and the Mercury Magnetospheric Orbiter (MMO). The MPO will study the surface and internal composition of the planet, and the MMO will study Mercury's magnetosphere, that is, the region of space around the planet that is influenced by its magnetic field.

• Need: The scientific interest in going to Mercury lies in the valuable information that such a mission can provide to enhance our understanding of the planet itself as well as the formation of our Solar System; information which cannot be obtained with observations made from Earth.

• Challenges: Europe's space scientists have identified the mission as one of the most challenging long-term planetary projects, because Mercury's proximity to the Sun makes it difficult for a spacecraft to reach the planet and to survive in the harsh environment found there.

• Significance: Mercury is a poorly explored planet. So far, only two spacecraft have visited the planet: NASA's Mariner 10, which flew past three times in 1974–5 and returned the first close-up images of the planet, and NASA's MESSENGER spacecraft, which performed three flybys (two in 2008 and one in 2009) before entering orbit around the planet in March 2011. The information obtained when BepiColombo arrives will throw light not only on the composition and history of Mercury, but also on the history and formation of the inner planets in general, including Earth.

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11. EMIRATES MARS MISSION – HOPE PROBE

UAE has started its preparations for the upcoming Mars Mission named- HOPE.

Background:

• In July 2014, the UAE leadership announced the launch of the Emirates Mars Mission project by the President of the UAE. Subsequently, the President issued a decree establishing the UAE Space Agency.

HOPE Probe:

• The probe will be built by an Emirati team of engineers and experts and will be sent on a scientific voyage of discovery to the Red Planet.

• This will mark the Arab world's entry into the era of space exploration and place the UAE among the major scientific countries that have begun programmes to explore Mars.

• The probe will be sent to explore the Red Planet by 2020. Following a journey of several months, the probe is expected to enter the Red Planet's orbit in 2021, coinciding with the 50th anniversary of the formation of the UAE.

Scientific Objectives of the Probe Voyage:

1. The Emirates Mars Mission project will answer scientific questions that have long puzzled scientists. These are questions about the Red Planet, which scientists have not been able to explain before because of the lack of data and information.

2. The project will cover all aspects that have not been previously covered, whether scientific or knowledgebased, and it will work on drawing a clear and comprehensive picture of the Martian climate and the causes of the corrosion of its surface that has made it impossible for water to exist on the planet.

3. The project will also provide insights about the weather on the Red Planet. It will observe weather phenomena such as dust storms and changes in temperature and how the atmosphere interacts with topography, from the highest volcano peaks to ice sheets to the vast deserts and the deepest canyons.

12. CLEAN MEAT

The Department of Biotechnology (DBT) has decided to fund the Centre for Cellular and Molecular Biology (CCMB) and the National Research Centre on Meat for research on cell-based meat.

What is it?

• Cell-based meat, also called clean meat or cultured meat, is nutritionally equivalent to conventional meat, and tastes, smells, looks and feels exactly the same. The only difference is in the way it is produced.

• Rather than raising livestock and slaughtering them for meat, cell-based meat is produced through 'cellular agriculture', with animal cells being cultivated into meat.

Why It's the Future?

• Lab-grown meats beat the old-fashioned kind in two areas: They're better for body and they're better for the environment.

• Clean meats are grown in a sterile environment, meaning that you'll avoid bacteria found in traditional meats.

• The environmental benefits might outweigh your personal benefit, though: As the UN's Food and Agriculture Organization notes, animals raised for food make up 14.5 percent of total carbon emissions across the globe.

• According to one study, replacing livestock with lab-grown meats will cut down on the land needed by 99 percent, and the water needed by 90 percent. Granted, those savings are off-set by the energy needed to power the lab itself, but it's still a net benefit.

• By shifting to lab-grown, you'll save resources that will be increasingly in demand as the world's population continues ticking upwards — by some

estimates, demand for meat and seafood will double by 2050, reaching 1.2 trillion pounds.

13. CENTRE FOR CELLULAR & MOLECULAR BIOLOGY (CCMB)

Scientists at CCMB have discovered a new enzyme which helps in breaking cell walls of bacteria and hence, offers a potential for a new drug delivery route to arrest the anti-bacterial resistance.

• Researchers discovered that by blocking 'scissors enzyme' from functioning, new ways to target microbes could be found, leading to a new wave of antibiotic drug. Other bacteria, too, have the same enzyme working on cell division as the cell wall is fundamental for bacterial growth and division.

Significance:

• The new enzyme offers a potential for a new drug delivery route to arrest the anti-bacterial resistance through existing antibiotic drugs. It opens up fresh ways to target microbes, leading to a new wave of antibiotic drugs. **About Centre for Cellular and Molecular Biology:**

• The Centre for Cellular & Molecular Biology (CCMB) is a premier research organization which conducts high quality basic research and trainings in frontier areas of modern biology, and promote centralized national facilities for new and modern techniques in the interdisciplinary areas of biology.

• It was set up initially as a semi-autonomous Centre on April 1, 1977 with the Biochemistry Division of the then Regional Research Laboratory (presently, Indian Institute of Chemical Technology, IICT) Hyderabad.

• It is located in Hyderabad and operates under the aegis of the Council of Scientific and Industrial Research (CSIR). • It is designated as "Center of Excellence" by the Global Molecular and Cell Biology Network, UNESCO.

14. MALARIA VACCINE

Government of Malawi recently launched the world's first malaria vaccine in a landmark pilot programme.

• The country is the first of three in Africa in which the vaccine, known as RTS,S (Trade name: Mosquirix), will be made available to children up to 2 years of age.

• Ghana and Kenya will introduce the vaccine later.

• Financing for the pilot programme has been mobilized through a collaboration among three key global health funding bodies: GAVI, the Vaccine Alliance; the Global Fund to Fight AIDS, Tuberculosis and Malaria; and Unitaid.

RTS,S

• RTS,S/AS01 (RTS,S) is the world's first malaria vaccine shown to provide partial protection against malaria in young children.

• RTS,S aims to trigger the immune system to defend against the first stages of malaria when the Plasmodium falciparum parasite enters the human host's bloodstream through a mosquito bite and infects liver cells.

• The vaccine is designed to prevent the parasite from infecting the liver, where it can mature, multiply, reenter the bloodstream, and infect red blood cells, which can lead to disease symptoms.

• It has been developed by British pharmaceutical company GlaxoSmithKline in partnership with the PATH Malaria Vaccine Initiative (a non profit organisation).

Malaria

• Malaria is a communicable disease caused by Plasmodium parasites that are transmitted to people through the bites of infected female Anopheles mosquitoes.

• It is preventable and curable.

• In 2017, 5 countries accounted for nearly half of all malaria cases worldwide: Nigeria (25%), the Democratic Republic of the Congo (11%), Mozambique (5%), India (4%) and Uganda (4%).

India and Malaria

• As per the World Malaria Report 2017 of World Health Organization (WHO), the estimated malaria cases from India are 87% in South East Asia region.

• The National Framework for Malaria Elimination (NFME) 2016-2030 lays out the vision, mission, broad principles and practices to achieve the target of malaria elimination by 2030 synchronising with the Global Technical Strategy (GTS) for Malaria 2016-2030 of World Health Organisation (WHO).

• The Government has drafted National Strategic Plan for malaria elimination (2017-2022) wherein the country has been stratified based on the malaria burden into four categories – category 0 to category 3 and based on this the intervention of malaria control and prevention are being strengthened. WHO Global Technical Strategy for Malaria 2016-2030

• Adopted by the World Health Assembly in May 2015, it provides a technical framework for all malaria-endemic countries.

• It is intended to guide and support regional and country programmes as they work towards malaria control and elimination.

• The Strategy sets ambitious but achievable global targets, including: o Reducing malaria case incidence by at least 90% by 2030. o Reducing malaria mortality rates by at least 90% by 2030. o Eliminating malaria in at least 35 countries by 2030. o Preventing a resurgence of malaria in all countries that are malaria-free.

The Global Malaria Programme (GMP)

• The WHO Global Malaria Programme (GMP) coordinates WHO's global efforts to control and eliminate malaria by: o setting, communicating and promoting the adoption of evidence-based norms, standards, policies, technical strategies, and guidelines; o keeping independent score of global progress; o developing approaches for capacity building, systems strengthening, and surveillance; and o identifying threats to malaria control and elimination as well as new areas for action. “High burden high impact approach"

• A new country-driven response – “High burden to high impact” – was launched in Mozambique in November 2018. It will be supported by WHO.

• The approach will be driven by the 11 countries that carry the highest burden of the disease (Burkina Faso, Cameroon, Democratic Republic of the Congo, Ghana, India, Mali, Mozambique, Niger, Nigeria, Uganda and United Republic of Tanzania).

Related news

• Recently the Indian Council of Medical Research has launched the 'Malaria Elimination Research Alliance (MERA) India' to prioritise, plan and scale up research to eliminate the disease from India by 2030.

• ‘Malaria Elimination Research Alliance-India (MERA-India)’ is a conglomeration of partners working on malaria control.

• The principal activity of the alliance is to prioritise, plan, conduct, scale up and translate relevant research in a coordinated and combinatorial way in order to have a tangible impact on the population who are at risk of malaria.

• It intends to complement the efforts on national scale while contributing to the broader global agenda.

• It will facilitate trans-institutional coordination and collaboration around a shared research agenda which responds not only to programmatic challenges and addresses gaps in available tools but also proactively contributes to targeted research.

15. NASA DETECTS UNIVERSE’S FIRST MOLECULE

Scientists have detected Helium hydride ion (HeH+), the first molecule to be formed in our universe, for the first time ever.

• Helium hydride, was detected roughly 3,000 light-years from Earth by NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA).

• It was detected in a planetary nebula, NGC 7027. Planetary Nebula is a cloud of dust and gas in outer space formed when a star, at the end of its lifetime, blows off its outer layers as it runs out of fuel to burn.

Details

• Almost 14 billion years ago, after Big Bang when universe cooled down, ionised hydrogen and neutral helium atoms reacted to form HeH+.

• As this process progressed, HeH+ reacted with neutral hydrogen and created molecular hydrogen, marking the beginning of star formation and modern universe.

• Scientists held that the chemistry of the universe began with HeH+. However, the lack of definitive evidence of its existence in interstellar space has been a dilemma for astronomy for a long time, which is now resolved.

Stratospheric Observatory for Infrared Astronomy (SOFIA)

• It is a Boeing 747SP aircraft modified to carry a 106-inch diameter telescope.

• It is a joint project of NASA and the German Aerospace Centre.

16. BLACK HOLE

Recently, the Event Horizon Telescope revealed the first ever photograph of the shadow of a black hole.

About Black Hole

• A black hole is a region of space-time, which exhibits the property of extremely intense gravitational force, which is so strong, that nothing, not even light, can escape it.

• Black holes were predicted by the Einstein's theory of general relativity, which showed that when a massive star dies, it leaves behind a small, dense remnant core.

• If the core's mass is more than about three times the mass of the Sun, the force of gravity overwhelms all other forces and produces a black hole.

• In the center of a black hole is a gravitational singularity, a one-dimensional point which contains a huge mass in an infinitely small space, where density and gravity become infinite and space-time curves infinitely, and the laws of physics as we know them cease to operate.

• Black holes cannot be directly observed because they themselves do not emit or radiate light, or any other electromagnetic waves that can be detected by instruments built by human beings. But the area just outside the boundary of the black hole (Event Horizon), which has vast amounts of gas, clouds and plasma swirling violently, emit all kinds of radiations, including even visible light. Hence, the presence of black holes can be inferred by detecting their effect on other matter nearby them.

• Now, the Event Horizon Telescope has captured the just outside region of a black hole, located 55 million light-years from Earth, at the centre of a galaxy named Messier 87. The image shows a photon (light quantum) can orbit the black hole without falling in. This is called the 'last photon ring'.

Significance

• Observed the unseeable- For centuries, the concept of black hole has only been theorized, without any actual evidence of it. This is a remarkable confirmation of more than a century of theoretical work.

• Capturing the event horizon requires perfection- because the black hole is very small as compared to other celestial bodies and the light has to pass through all sorts of gases and material of the space and the Earth's atmosphere. The telescopes of EHT also have to synchronize in a perfect manner to be able to make simultaneous

recordings of the radiations coming in from the black hole region.

• Better understanding of the universe- Scientists can compare the actual image with computer-simulated images used earlier to ascertain the differences, which could be explained by instrumentation, observation or other errors. This can provide a test for existing theories of the universe, and lead to a better understanding of black holes and the nature of the universe itself.

• Enhances the understanding of gravitational force- which can be useful for the Global Positioning Satellites in order to make them accurate to more than a few metres.

Event Horizon Telescope (EHT)

• A long-standing goal in astrophysics is to directly observe the immediate environment of a black hole. The 'event horizon' is the boundary defining the region of space around a black hole from which nothing can escape.

• The EHT is an international collaboration to continue the progress in achieving this goal, using the technique of Very Long Baseline interferometry (VLBI) at short wavelengths.

• In this technique, a network of 8 groundbased radio telescopes have been linked and exploit the rotation of our planet to form one virtual Earth-size telescope observing at a wavelength of 1.3 mm.

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