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(JULY-2019)

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

1. RAMANUJAN MACHINE

Scientists from Technion — Israel Institute of Technology has developed a concept they have named the Ramanujan Machine, after the Indian mathematician.

What is it?

• It is not really a machine but an algorithm, and performs a very unconventional function.

What it does?

• The Ramanujan machine is more of a concept than an actual machine—it exists as a network of computers running algorithms dedicated to finding conjectures about fundamental constants in the form of continued fractions—these are defined as fractions of infinite length where the denominator is a certain quantity plus a fraction, where a latter fraction has a similar denominator, etc.)

• The purpose of the machine is to come up with conjectures (in the form of mathematical formulas) that humans can analyze, and hopefully prove to be true mathematically.

Why Ramanujan?

• The algorithm reflects the way Srinivasa Ramanujan worked during his brief life (1887-1920). With very little formal training, he engaged with the most celebrated mathematicians of the time, particularly during his stay in England (1914-19), where he eventually became a Fellow of the Royal Society and earned a research degree from Cambridge.

• Throughout his life, Ramanujan came up with novel equations and identities —including equations leading to the value of pi — and it was usually left to formally trained mathematicians to prove these.

What's the point?

• Conjectures are a major step in the process of making new discoveries in any branch of science, particularly mathematics. Equations defining the fundamental mathematical constants, including pi, are invariably elegant. New conjectures in mathematics, however, have been scarce and sporadic, the researchers note in their paper, which is currently on a pre-print server. The idea is to enhance and accelerate the process of discovery.

How good is it?

• The paper gives examples for previously unknown equations produced by the algorithm, including for values of the constants pi and e. The Ramanujan Machine proposed these conjecture formulas by matching numerical values, without providing proofs. It has to be remembered, however, that these are infinite series, and a human can only enter a finite number of terms to test the value of the series. The question is, therefore, whether the series will fail after a point. The researchers feel this is unlikely, because they tested hundreds of digits.

• Until proven, it remains a conjecture. By the same token, until proven wrong, a conjecture remains one. It is quite possible that the algorithm will come up with conjectures that may take years to prove.

2. AUTOMATED FACIAL RECOGNITION SYSTEM (AFRS)

On June 28, the National Crime Records Bureau (NCRB) released a Request for Proposal for an

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Automated Facial Recognition System (AFRS) to be used by police officers across the country.

What is automated facial recognition?

• AFRS works by maintaining a large database with photos and videos of peoples' faces. Then, a new image of an unidentified person — often taken from CCTV footage — is compared to the existing database to find a match and identify the person. The artificial intelligence technology used for pattern-finding and matching is called "neural networks".

What does the NCRB request call for?

• The NCRB, which manages crime data for police, would like to use automated facial recognition to identify criminals, missing people, and unidentified dead bodies, as well as for "crime prevention".

•Its Request for Proposal calls for gathering CCTV footage, as well as photos from newspapers, raids, and sketches. • The project is aimed at being compatible with other biometrics such as iris and fingerprints.

• It will be a mobile and web application hosted in NCRB's Data Centre in Delhi, but used by all police stations in the country. "Automated Facial Recognition System can play a very vital role in improving outcomes in the area of Criminal identification and verification by facilitating easy recording, analysis, retrieval and sharing of Information between different organisations."

How will the new database fit in what already exists?

• NCRB has proposed integrating this facial recognition system with multiple existing databases. The most prominent is the NCRB-managed Crime and Criminal Tracking Network & Systems (CCTNS). Facial recognition has been proposed in the CCTNS program since its origin.

• The idea is that integration of fingerprint database, face recognition software and iris scans will massively boost the police department's crime investigation capabilities. It will also help civilian verification when needed. No one will be able to get away with a fake ID.

• It also plans to offer citizen services, such as passport verification, crime reporting, online tracking of case progress, grievance reporting against police officers, and more.

• The new facial recognition system will also be integrated with Integrated Criminal Justice System (ICJS), as well as state-specific systems, the Immigration, Visa and Foreigners Registration & Tracking (IVFRT), and the Koya Paya portal on missing children.

Concerns:

• Cyber experts across the world have cautioned against government abuse of facial recognition technology, as it can be used as tool of control and risks inaccurate results.

• Amid NCRB's controversial step to install an automated facial recognition system, India should take note of the ongoing privacy debate in the US.

• In the absence of data protection law, Indian citizens are more vulnerable to privacy abuses.

• Use of surveillance cameras and facial recognition constrict the rights of particular class of people.

• In the US, the FBI and Department of State operate one of the largest facial recognition systems.

• International organisations have also condemned the Chinese government on its use of surveillance cameras and facial recognition to constrict the rights of Uighurs, a mostly Muslim minority.

• The AFRS is being contemplated at a time when India does not have a data protection law. In the absence of safeguards, law enforcement agencies

will have a high degree of discretion. This can lead to a mission creep. The Personal Data Protection Bill 2018 is yet to come into force, and even if it does, the exceptions contemplated for state agencies are extremely wide.

Need of the hour:

• The notion that sophisticated technology means greater efficiency needs to be critically analysed. A deliberative approach will benefit Indian law enforcement, as police departments around the world are currently learning that the technology is not as useful in practice as it seems in theory.

• Police departments in London are under pressure to put a complete end to use of facial recognition systems following evidence of discrimination and inefficiency. San Francisco recently implemented a complete ban on police use of facial recognition. India would do well to learn from their mistakes.

3. DNA TECHNOLOGY (USE & APPLICATION) REGULATION BILL

Recently, the DNA Technology (Use and Application) Regulation Bill, 2019 was introduced in the Lok Sabha, which provides for the regulation of use of DNA technology for establishing the identity of certain persons.

Key Provisions of the Bill-

• Use of DNA Data: DNA testing is allowed only in respect of matters listed in the Schedule to the Bill, such as-

o Offences under the Indian Penal Code, 1860.

o for civil matters such as paternity suits.

o for matters related to establishment of individual identity.

• Collection of DNA: the investigating authorities may collect bodily substances of persons.

o Requirement of consent for collection in certain situations-

✓ For arrested persons- Requirement of written consent if the offence carries a punishment of up to seven years. If the offence carries more than seven years of imprisonment or death, consent is not required.

✓ If the person is a victim, or relative of a missing person, or a minor or disabled person, the authorities are required to obtain the written consent of such victim, or relative, or parent or guardian of the minor or disabled person. If consent is not given in these cases, the authorities can approach a Magistrate who may order the taking of bodily substances of such persons.

• DNA Data Bank- A National DNA Databank and regional DNA Databanks will store DNA Profiles from DNA labs in a specified format. It will have various categories of indices such as crime scene index, suspect index etc.

• Removal of DNA profiles:

o The criteria for entry, retention, or removal of the DNA profile will be specified by regulations.

o However, the Bill provides for removal of the DNA profiles of the following persons:

✓ of a suspect if a police report is filed or court order given,

✓ of an undertrial if a court order is given, and

✓ on written request, for persons who are not a suspect, offender or undertrial, from the crime scene or missing persons' index.

• Establishment of DNA Regulatory Board: which will supervise the DNA Data Banks and DNA laboratories.

o The Secretary, Department of Biotechnology, will be the ex officio Chairperson of the Board. The Board will comprise additional members including:

(i) experts in the field of biological sciences, and

(ii) Director General of the National Investigation Agency and the Director of the Central Bureau of Investigation.

o It will advise governments on all issues related to establishing DNA laboratories or Data Banks and grant accreditation to DNA laboratories. Further, the Board is required to ensure that all information relating to DNA profiles with the Data Banks, laboratories, and other persons are kept confidential.

• Penalties for various offences, including disclosure of DNA information or using DNA sample without authorization.

Concerns

• Limited Scope- of the DNA Profile as it shall only be used for the purpose of identification of the person in criminal cases in accordance with the rules of admissibility of evidence for the purpose of prosecution or defence and no other purpose such as medical research. o Does not clearly spell out the consent provisions in sensitive civil matters such as paternity/maternity, assisted reproduction, organ transplants, and cases related to immigration.

• Not fool proof - Although DNA technology is the best method available to carry out identification, it is still probabilistic in nature. There are chances, however remote, that a wrong match is generated, causing unnecessary harassment to an individual.

• Does not cover procedures involved in the commercial use of DNA such as genealogical tests, or medical tests to discover predisposition to disease, or DNA editing.

• Does not state that DNA information related to civil matters will be stored or not in the Data Bank- if DNA information related to civil matters is stored in the data bank, it may violate the fundamental right to privacy as laid down by the Supreme Court.

• Not all DNAs can be matched- the identity of the person as stated above will be stored under various indices. If the person is not an offender, suspect or under-trail, his/her DNA cannot be matched.

• No improvement in conviction rates - Over the last 25 years; most countries have adopted a DNA fingerprinting law and have developed databases for use primarily in criminal investigation, disaster identification and forensic science. However, DNA tests have not led to an improvement in conviction rates in countries where it is already being followed.

Way Forward

• Extensive reskilling of police forces, fire departments etc, will be required to ensure the sanctity of samples to prevent contamination, forgery, mislabelling, and other errors.

• The banks will also need the highest possible levels of cyber security to prevent breaches.

• The legislation or the rules will need regular reviews simply to stay in tune with fast-paced technological changes.

• There are also grave privacy concerns. Given that DNA is the most intrinsic property of any living entity, the need for privacy safeguards and for carefully defined, purpose-based sample collection is necessary.

What is DNA?

• DNA stands for Deoxyribonucleic Acid, a hereditary material in human and almost all the other organisms.

• Most DNA is located in the cell nucleus (called nuclear DNA) but some small amount of DNA can be found in Mitochondria (called mitochondrion DNA).

• It is composed of two chains, which coil around each other to form a double helix carrying the genetic instructions used in the growth.
• It is made up of 23 pairs of chromosomes and provides instructions for building an entire organism and the proteins.
• The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). Human DNA consists of about 3 billion bases, and more than 99 percent of those bases are the same in all people.
• An important property of DNA is that it can replicate, or make copies of itself. Each strand of DNA in the double helix can serve as a pattern for duplicating the sequence of bases.

Significance

• It creates a framework for the oversight of law enforcement authorities and the regulation of a rapidly expanding industry that is using and misusing DNA technologies.
• It can almost accurately ascertain the identity of a person, establish biological relationships between individuals etc. Thus, useful in investigations of crime, identification of unidentified bodies, or in determining parentage.
• It will provide accreditation for private laboratories and medical facilities, which have been operating in a legal vacuum

4. CHANDRAYAAN 2

ISRO recently launched Chandrayaan-2 mission.

Background

• Chandrayaan-2, a completely indigenous mission, is India's second lunar exploration mission which the following basic components-
o Orbiter- will observe the lunar surface and relay communication between Earth and Chandrayaan 2's Lander.
o Lander (called Vikram)- designed to execute India's first soft landing on the lunar surface.
o Rover (called Pragyan)- a 6-wheeled, AI-powered vehicle, which will move on the lunar surface and perform on-site chemical analysis.
• Launcher- It was launched by Geosynchronous Satellite Launch Vehicle GSLV MkIII-M1. It is India's most powerful launcher to date, and has been completely designed and fabricated from within the country.
• Some notable features of Chandrayaan 2 Mission-
o 1st space mission to conduct a soft landing on the Moon's south polar region.
o 1st Indian expedition to attempt a soft landing on the lunar surface with homegrown technology.
o 1st Indian mission to explore the lunar terrain with home-grown technology.
o 4th country ever to soft land on the lunar surface after the United States, the U.S.S.R. and China.
• Primary Objective: To demonstrate the ability to soft-land on the lunar surface and operate a robotic rover on the surface. It seeks to
o foster a new age of discovery,
o increase our understanding of space,
o stimulate the advancement of technology,
o promote global alliances,
o inspire a future generation of explorers and scientists.

Scientific Objectives of Chandrayaan 2

• Moon provides the best linkage to Earth's early history.
o It offers an undisturbed historical record of the inner Solar system environment.
o Though there are a few mature models, the origin of Moon still needs further explanations.
o It will conduct detailed topographical studies, comprehensive mineralogical analyses, and a host of other experiments on the lunar surface.

• Evidence for water molecules discovered by Chandrayaan-1, requires further studies on the extent of water molecule distribution on the Moon.

• It will also study new rock types with unique chemical composition.

Why explore the Lunar South Pole?

• The lunar surface area remains in shadow, which is much larger than that at the North Pole. There is a possibility of the presence of water in permanently shadowed areas around it.

• In addition, South Pole region has craters that are cold traps and contain a fossil record of the early Solar System. • Its regolith has traces of hydrogen, ammonia, methane, sodium, mercury and silver- making it an uptapped source of essential resources.

• Its elemental and positional advantages make it a suitable pit stop for future space exploration.

Related News About Chandrayan-1

• Chandrayan-1 was launched by India in October, 2009 using PSLV-C11.

• Primary Objective: To prepare a three-dimensional atlas of both near and far side of the moon and chemical, mineralogical and photo-geological mapping of moon.

• Findings of Chandrayan-1

o Detection of Water – Major finding was the detection of Water (H2O) and Hydroxyl (OH) on the surface of the moon. The data revealed its presence in abundance around the polar region.

o Magma Ocean Hypothesis – It confirmed the Ocean Magma Hypothesis i.e. the moon was once completely in molten state.

o New Spinel-rich Rock – Data from Chandrayaan-1 have led to detection of new spinel-rich rock type on lunar far-side.

o X-Ray signals detected– It detected x-ray signals during weak solar flares thus indicating presence of magnesium, aluminium, silicon and calcium on lunar surface.

5. GAGANYAAN

Recently, Gaganyaan National Advisory Council has been created with members from different institutions and industries.

Background

• An Indian manned mission to space was first mooted in 2004.

• The Gaganyaan programme, an indigenous mission that would take Indian astronauts to space, was announced in 2018.

• Over the years, the Indian Space Research Organisation has developed and tested a number of technologies that are critical to a human space flight. These include a Space Capsule Recovery Experiment (SRE-2007), Crew module Atmospheric Reentry Experiment (CARE-2014), GSLV Mk-III (2014), Reusable Launch Vehicle-Technology Demonstrator (RLV-TD), Crew Escape System and Pad Abort Test. ISRO also recently unveiled a space capsule (crew module) and Space suit prototype.

• ISRO has signed a pact with the Russian firm Glavkosmos to select and train astronauts for the country's Gaganyaan project.

o ISRO will receive assistance from the French space agency CNES, in terms of expertise various fields including space medicine, astronaut health monitoring, radiation protection and life support.

About Gaganyaan Mission

• It is a crewed orbital spacecraft which is expected to carry three people into the space for seven days.

• With this, India could potentially become the fourth country to send a man to space, after the erstwhile USSR, the US and China.

• The total programme is expected to be complete before 2022.

• ISRO also plans two unmanned Gaganyaan flights — by December 2020 and in July 2021 — before undertaking the manned mission by December 2021.

• GSLV Mk III, the three-stage heavy lift launch vehicle, will be used to launch Gaganyaan as it has the necessary payload capability.

• The spacecraft is expected to be placed in a low earth orbit of 300-400 km. Within 16 minutes of taking off, the crew will be in space, where they will remain for five-seven days. The return journey is expected to take 36 minutes.

• Gaganyaan would be smaller in size than the current Russian Soyuz, Chinese Shenzhou, NASA's planned Orion spacecraft

• While formal agreements are not yet in place, ISRO will collaborate with the Indian Air Force and its Institute of Aerospace Medicine, Bengaluru, to train astronauts.

o The astronauts on the human space mission 'Gaganyaan' will mostly be pilots.

How Gaganyaan can prove to be beneficial for India?

• Enhancement of science and technology levels in the country: Gaganyaan will source nearly 60 per cent of its equipment from the Indian private sector hence these are investments will spur technological innovation.

o For example: The programme will provide a unique micro-gravity platform in space for conducting experiments and test bed for future technologies.

• Involvement of multiple agencies : Gaganyaan Programme will establish a broader framework for collaboration between ISRO, academia, industry, national agencies and other scientific organizations.

• Contribution to economy: The programme is expected to give impetus to economic activities within the country in terms of employment generation, human resource development and enhanced industrial capabilities.

About Gaganyaan Advisory Council

• It comprises of multiple senior officials like Secretaries of Department of Space &Department of Science and Technology, Principal Scientific Advisor to PM, Former Chairman of ISRO, Directors of Premier Academic and Research Institutions, Heads of various Indian Industries etc.

• It discusses overall project status of Gaganyaan, covering technical details as well as collaboration with various national stake holders.

• It stresses the need for setting priorities at various National Institutions including Industries to accomplish Gaganyaan.

6. NAVIC

ISRO is in talks with processing chip manufacturers such as Qualcomm to substitute the existing Global Positioning System (GPS) with the Indian version of satellite navigation.

What is NAVIC?

• Navigation with Indian Constellation (NavIC) is an independent regional navigation satellite system designed to provide position information in the Indian region and 1500 km around the Indian mainland.

Services provided:

• IRNSS would provide two types of services, namely Standard Positioning Services available to all users and Restricted Services provided to authorised users.

How many satellites does NAVIC consist of?

• It is a regional system and so its constellation will consist of seven satellites. Three of these will

be geostationary over the Indian Ocean, i.e., they will appear to be stationary in the sky over the region, and four will be geosynchronous – appearing at the same point in the sky at the same time every day. This configuration ensures each satellite is being tracked by at least one of fourteen ground stations at any given point of time, with a high chance of most of them being visible from any point in India.

Why it is necessary to have indigenous global navigation system?

• Having a global navigation system bolsters the ability of a nation to serve as a net security provider, especially through the guarantee of such assurance policies. It can also play a significant role in relief efforts post disasters such as the tsunami in the Indian Ocean region in 2004 and the Pakistan-India earthquake in 2005.

NavIC applications include:

• Terrestrial, Aerial and Marine Navigation.
• Disaster Management.
• Vehicle tracking and fleet management.
• Integration with mobile phones.
• Precise Timing.
• Mapping and Geodetic data capture.
• Terrestrial navigation aid for hikers and travellers.
• Visual and voice navigation for drivers.

7. RUSSIA LAUNCHES SPEKTR-RG

Spektr-RG is a Russian–German high-energy astrophysics space observatory launched recently. It follows on from the Spektr-R satellite telescope launched in 2011.

About Spektr- RG:

• The Spektrum-Röntgen-Gamma mission, also known as Spektr-RG, is a joint project between the Russian space agency, Roscosmos, and the German space agency, DLR.

• Position: Spektr-RG will be placed in a stable orbit in space called a Lagrange point (specifically, L2), where the gravitational forces of two large objects — in this case, the sun and the Earth — balance each other out.

• This location will allow Spektr-RG to perform its observations while using a minimal amount of fuel.

• Objectives: The spacecraft is expected to detect 100,000 galaxy clusters, 3 million supermassive black holes, tens of thousands of star-forming galaxies, the presence of plasma (superheated gas) and many more types of objects. • The observatory includes two X-ray mirror telescopes, called ART-XC and eROSITA.

• A key goal of Spektr-RG will be to investigate the mysterious cosmic components referred to as "dark matter" and "dark energy".

8. THIRTY METER TELESCOPE

Thirty Meter Telescope Set to Begin Construction.

Background:

• The mega telescope completed its design and development phase in 2009, but legal challenges from Native Hawaiian activists — who treasure Mauna Kea for cultural and religious reasons — have hounded the telescope.

About TMT:

• The Thirty Meter Telescope (TMT) is a proposed astronomical observatory with an extremely large telescope (ELT).

• It is an international project being funded by scientific organisations of Canada, China, India, Japan and USA.

• Planned location: Mauna Kea on the island of Hawaii in the US state of Hawaii.

• The TMT is designed for near-ultraviolet to mid-infrared observations, featuring adaptive optics to assist in correcting image blur.

Potential:

• TMT will enable scientists to study fainter objects far away from us in the Universe, which gives information about early stages of evolution of the Universe.

• It will give us finer details of not-so-far-away objects like undiscovered planets and other objects in the Solar System and planets around other stars.

9. NASA TO LAUNCH DRAGONFLY

NASA plans to launch an unmanned nuclear-powered drone, Dragonfly as early as 2026 to search for life on Saturn's largest moon, Titan.

Key facts:

• Dragonfly aims to search for signs of microbial alien life on Saturn's moon Titan, while navigating its earthlike gravity and aerodynamics in the process.

• The mission will succeed NASA's Cassini probe, which ended its 13-year mission orbiting Saturn in September 2017 by diving into Saturn's atmosphere.

• Dragonfly mission is a part of NASA's New Frontiers program, which includes a series of space exploration missions, which are being conducted with the purpose of researching several of the Solar System bodies, including the dwarf planet Pluto.

• The New Frontiers programme also includes Pluto probe New Horizons, Jupiter probe Juno and OSIRIS-Rex asteroid mission.

• The Dragonfly mission replaces a previously discontinued concept project called Titan Saturn System Mission (TSSM), which required a balloon probe to circumnavigate Titan.

Why study Titan?

• Titan is an analog to the very early Earth, and can provide clues to how life may have arisen on our planet.

• Titan is larger than the planet Mercury and is the second largest moon in our solar system.

• As it orbits Saturn, it is about 886 million miles (1.4 billion kilometers) away from the Sun, about 10 times farther than Earth. Because it is so far from the Sun, its surface temperature is around -290 degrees Fahrenheit (-179 degrees Celsius). Its surface pressure is also 50 percent higher than Earth's.

Objectives of the mission:

• Explore diverse environments from organic dunes to the floor of an impact crater where liquid water and complex organic materials key to life once existed together for possibly tens of thousands of years.

• Study how far prebiotic chemistry may have progressed.

• Investigate the moon's atmospheric and surface properties and its subsurface ocean and liquid reservoirs.

• Search for chemical evidence of past or extant life.

10. PUNCH MISSION

•Context: NASA has selected an US based Indian researcher to lead its PUNCH mission which will image the Sun.

About PUNCH (Polarimeter to Unify the Corona and Heliosphere):

• It is focused on understanding the transition of particles from the Sun's outer corona to the solar wind that fills interplanetary space.

• It will consist of a constellation of four microsatellites that through continuous 3D deep-field imaging, will observe the corona and heliosphere as elements of a single, connected system.

• The mission is expected to be launched in 2022.

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11. LAUNCH-ABORT TEST

• Context: NASA recently carried out a successful test of a launch-abort system for the Orion capsule designed to take U.S. astronauts to the Moon.

About Launch Abort System (LAS):

• It is designed to activate in the event of a rocket malfunction, on the pad or in flight.

• The LAS consists of three different types of solid-fuel rocket motors that will work in synchrony with one another. • In case of a launch-pad or in-flight failure, the abort tower rocket provides 400,000 pounds of thrust, pulling the crew capsule away.

Background:

• The Orion spacecraft is a major component of NASA's newly-named Artemis program, which aims to return U.S. astronauts to the lunar surface in 2024.

12. USE OF ANTIBIOTICS IN ANIMAL FOOD

The health ministry has banned the manufacture, sale and distribution of the antibiotic colistin and its formulations for food producing animals and animal feed supplements.

• It is found that the misuse of colistin in the poultry industry is said to be a major reason for the increase in antibiotic resistance in India.

• The ban has been imposed under provisions of the Drugs and Cosmetics Act, 1940.

• The ban follows recommendations by the Drugs Technical Advisory Board, and the National Antimicrobial Resistance Action Plan committee.

• The government also makes it mandatory for the manufacturers of antibiotic colistin to write clearly on the label that the drug is not to be used in food-producing animals, poultry, aqua farming and animal-feed supplement.

Background

• India is one of the top consumers of agricultural antibiotics worldwide, accounting for 3 percent of global consumption. By 2030, this use is estimated to double.

• Its use has been prohibited in Europe, the United States and China.

Reasons for use of Antibiotics in Animal food

• For the treatment of animals that show clinical signs of an infectious disease.

• As growth promoter to boost the weight of the animals.

• Easy availability of antibiotics.

• Currently, few laws in India govern antibiotic use in food animals, and most pertain only to animal products for export.

Steps to be taken to prevent its misuse

• Track use of antibiotic: Track rates of veterinary antibiotic use, resistance, and residues through a nationwide surveillance and monitoring system

• Alternatives to antibiotics: Subsidies and alternatives to antibiotics are necessary to offer incentives for farmers to decrease antibiotic use without causing economic harm.

• Promote antibiotic-free meat: Veterinarians, farmers, and consumers should be educated on appropriate use of antibiotics and the benefits of antibiotic-free meat.

• Laws to reduce antibiotic use: Appropriate laws and regulation should be framed, along with the enforcement of current laws, to reduce antibiotic use in India.

About Colistin

• Colistin or polymyxin E is an old antibiotic first introduced in 1952.

• The drug has been used for treating infections caused by Gram-negative bacilli, which are responsible for various diseases such as plague, cholera and typhoid.

• However, it was revealed that colistin has side effects of nephrotoxicity and neurotoxicity, prompting to restrict the use of the drug and replace it with other antibiotics which were considered safer at that time

• According to the World Health Organisation (WHO), Colistin is a "reserve" antibiotic, which means it is supposed to be considered a "last-resort" option in treatment and used only in the most severe circumstances, when all other alternatives have failed.

13. INNOVATION ECOSYSTEM

Recently, India has improved its ranking in the global innovation index by five places to 52nd in 2019 from 57th position last year.

Background

• Innovation has been defined as commercially successful exploitation of new technologies, ideas or methods by introduction of new products or processes or by improvement of the existing ones.

• The Global Innovation Index (GII) has been developed by the World Intellectual Property Organization (WIPO) together with top business universities like Cornell University, INSEAD etc.

o It measures the innovative capacity and outputs of 129 economies, using 80 indicators ranging from standard measurements such as research and development investments and patent and trademark filings, to mobile-phone app creation and high-tech net exports.

o This year, India is hosting the launch of the 2019 edition of the GII. o This year's GII theme "Creating Healthy Lives: The Future of Medical Innovation" is important and relevant for India because we would need a strong focus on medical innovation towards the goal of bringing healthcare and its delivery to all Indians.

• India has consistently worked on developing its intellectual property system to provide an enabling environment for innovation to flourish at all levels, including grassroots and frugal innovation.

Steps taken towards Innovation ecosystem

• Various schemes- such as Ramanujan Fellowship Scheme, the Innovation in Science Pursuit for Inspired Research (INSPIRE) Faculty scheme and the Ramalingaswami Re-entry Fellowship, Visiting Advanced Joint Research Faculty Scheme (VAJRA), Knowledge Involvement in Research Advancement through Nurturing (KIRAN) etc.

• ATAL Innovation Mission (AIM)- to act as a platform to promote a network of world-class Innovation hubs and Grand Challenges for India.

o Self-Employment and Talent Utilisation (SETU)- will be a Techno-Financial, Incubation and Facilitation Programme to support all aspects of start-up businesses, and other self-employment activities, particularly in technology-driven areas.

o Various Innovation Challenges- such as for Indian Railways, for Digital India Challenge 2.0, Grand Innovation Challenge by NITI Aayog, Smart India Hackathon etc.

• The India Innovation Growth Programme (IIGP) 2.0 is a unique tripartite initiative of the Department of Science and Technology (DST), Government of India, Lockheed Martin and Tata Trusts which enables innovators and entrepreneurs through the stages of ideation, innovation and acceleration, to develop technology-based solutions for tomorrow.

• Innovate India is a unique platform to display, promote and recognize innovations happening across the nation. It has been launched in collaboration with AIM-NITI Aayog and MyGov. Citizens from all parts of the country are eligible to share the innovation on the platform.

• The Confederation of Indian Industry (CII) has been orchestrating initiatives towards creating and fostering innovation among the Indian industry and encouraging entrepreneurial ventures.

• India is also currently engaged in opening WIPO-supported Technology and Innovation Support Centers (TISCs) in the country, which will help local innovators and creators research and market their products.

• In collaboration with WIPO, the first India Innovation Index, focusing on ranking Indian States was released in 2018.

Challenges faced by Innovation ecosystem

• Indian innovations are invariably incremental and not disruptive- They are often 'first to India' and not 'first to the world'. They copy the 'current best practice' but don't create the 'next' practice.

• Lack of Scalability- to create competitive marketable products with speed, scale and sustainability.

• Quality of the STEM talent pool- the gross enrollment ratio at the tertiary education level in India is a low 26% meaning, a vast reserve of potential research talent is lost.

• Comparison with other countries- Even though India is within touching distance of breaking into the top-50 innovator countries in the world, it is still quite far from a China, which filed, for instance, 53,345 patent applications with the WIPO in 2018 versus India's 2,013.

• Skewed results- India is an odd juxtaposition of stellar successes like the Chandrayaan and digital payments and a large number of unemployable engineering graduates and institutes that have virtually no autonomy. Moreover, while our top-rung universities and institutes (IITs Delhi & Mumbai, IISc) do well regionally, they have consistently remained out of the global top-100.

Way Forward

• Innovation is a key driver for sustenance and prosperity of start-ups, conglomerates, governments by helping them improve their service delivery and performance. It also contributes to the long-term development of an economy.

• India needs to boost its innovation ecosystem by intertwining among various stakeholders like the government, industry, academia and society to transform India as an attractive innovation destination.

• There is a need to link National Labs to Universities to improve the synergy between universities and research institutes. It would fill the gaps of faculty support and young talents and ensure deep commitment to excellence.

• Government can also partner with private sector to create new R&D funding opportunities such as 50:50 partnerships with Science and Engineering Research Board (SERB) for industry relevant research under
Ucchtar Avishkar Yojana (UAY).

• Furthermore, academics who believe in not just 'publish or perish', but 'patent, publish and prosper' should form a crucial cog in the machine of this ecosystem. Scientists, who have the passion to become 'technopreneurs' and passionate innovation leaders need to come up for the scalability of these innovations.

14. ARTIFICIAL INTELLIGENCE IN AGRICULTURE

Government inked pact with IBM India for undertaking a pilot study to utilise Artificial Intelligence (AI) and weather technology solutions in agriculture.

• The pilot study will be conducted for the Kharif crop season 2019 in three districts - Bhopal,

Rajkot and Nanded - in Madhya Pradesh, Gujarat and Maharashtra, respectively.

• IBM will give solution in the field of agriculture through AI and weather technology at village level/ farm level to provide weather forecast and soil moisture information on pro bono basis to help farmers for taking decisions regarding water and crop management for better production and productivity.

Artificial intelligence in Agriculture

• It is estimated that AI and connected farm services can impact 70 million Indian farmers by 2020, thereby adding US$ 9 billion to farmer incomes.

• In 2017, the global AI in agriculture market size was US$ 240 million, and is expected to reach US$ 1.1 billion by 2025.

• Major factors driving the growth of the AI in agriculture market include: o the growing demand for agricultural production owing to the increasing population o rising adoption of information management systems and new advanced technologies for improving crop productivity o increasing crop productivity by implementing deep learning techniques o growing initiatives by worldwide governments supporting the adoption of modern agricultural techniques.

Challenges in AI Adoption in Agriculture

• Lack of Trained professionals in agriculture: Only around 4% of Indian AI professionals are trained in emerging technologies such as deep learning.

• Costly for Small farmers: AI in agriculture can prove to be extremely expensive and smaller-scale farmers might not have access to that kind of funding.

• Lack of infrastructure in agriculture: Farms have historically lacked the information technology infrastructure and data warehousing systems to develop and implement AI applications.

• Lack of awareness: There still exists a lack of familiarity with high tech machine learning solutions in farms across most parts of the world.

• Decrease in employment: A deficiency in farming jobs and farm workers has already started and will worsen with the increasing advancement and availability of these technologies.

• Issues in getting temporal data: In case of vast agricultural land, though spatial data can be gathered easily, temporal data (data that represents a state in time, such as the land-use patterns) is hard to get.

o For example, most of the cropspecific data can be obtained only once in a year when the crops are growing. Since the data infrastructure takes time to mature, it requires a significant amount of time to build a robust machine learning model.

• Data related issues: Lack of standards, perceived poor transparency around data use and ownership, and the difficulty of gathering and sharing data has lead to a situation where AI algorithm developers in Agriculture are still starved for data.

Way forward

• Strong data infrastructure: The data infrastructure on the farm will need to become more robust before large scale agricultural AI deployment can be successful.

• Increase digital literacy: Initiatives to increase digital literacy in rural landscape can help farmers understand and adopt these technologies.

• Open source platform: An open source platform would make the solutions more affordable, resulting in rapid adoption and higher penetration among the farmers.

• Incentives to farmers: Government needs to step in by giving incentives to farm to adopt AI and

making it more affordable and attractive for farmers.

• Increase in R&D: Initiatives CoE in AI should be increased to improve more research in the field of AI.

• Collaboration between stakeholders: Industry, Government and all other stakeholders need to come together for viable solutions to agriculture.

Steps taken for AI

• Center of Excellence in Artificial Intelligence (CoE in AI) by National Informatics Centre (NIC) which is a platform for innovative new solutions in AI space, a gateway to test and develop solutions for projects undertaken by NIC at central and state level.

• A Statement of Intent has been signed between NITI Ayog and IBM to develop Precision Agriculture using Artificial Intelligence (AI) in Aspirational Districts.

• Government has begun the use of Artificial Intelligence on pilot basis for crop cutting and yield estimation under scheme Pradhan Mantri Fasal Bima Yoajana.

• Microsoft India is using AI sensors to make farming and healthcare smart.

About Artificial Intelligence

• It refers to the ability of machines to perform cognitive tasks like thinking, perceiving, learning, problem solving and decision making and execute tasks in real time situations without constant supervision.

• It can be deployed to take over a variety of tasks, enable connectivity and enhance productivity.

• The field of artificial intelligence is essentially when machines can do tasks that typically require human intelligence.

• It encompasses machine learning, where machines can learn by experience and acquire skills without human involvement.

Application of AI

• Healthcare: increased access and affordability of quality healthcare,

• Agriculture: enhanced farmers' income, increased farm productivity and reduction of wastage,

• Education: improved access and quality of education,

• Smart Cities and Infrastructure: efficient and connectivity for the burgeoning urban population,

• Smart Mobility and Transportation: smarter and safer modes of transportation and better traffic and congestion problems.

Importance of AI

• AI has the potential to overcome the physical limitations of capital and labour and open up new sources of value and growth.

• AI has the potential to drive growth by enabling

o Intelligent automation i.e. ability to automate complex physical world tasks.

o Innovation diffusion i.e. propelling innovations through the economy.

• Role in social development and inclusive growth: access to quality health facilities, addressing location barriers, providing real-time advisory to farmers and help in increasing productivity, building smart and efficient cities etc. **Challenges with AI**

• Lack of enabling data ecosystems such as access to intelligent data

• Lack of broad based expertise in research and application of AI

• Inadequate availability of AI expertise, manpower and skilling opportunities

• High resource cost and low awareness for adopting AI in business processes

• Large gaps in data collection, preparation, and benchmarking capabilities.

• Unclear privacy, security and ethical regulations

• Unattractive Intellectual Property regime to incentivise research and adoption of AI

• Absence of collaborative effort between various stakeholders.

15. BIOLOGICAL RESEARCH DATA

The Department of Biotechnology has brought a draft document, called the Biological Data Storage, Access and Sharing Policy of India on use and sharing of biological data.

Background

• The draft document is primarily meant to address a long-standing concern among many scientists, that several scientists use government funds to conduct research and collect biological specimens and data such as DNA samples, cell and tissue samples, store these details in databases and often lock them up.

o It blocks access to other researchers and scientists who may be interested in them.

o This leads to duplication of data collection exercises, lost opportunities to access data collected over the years and a wastage of public money. o Sharing of data maximizes the collective utility of data.

• However, there are many issues that must be taken into account in the context of data sharing, the most importantly it must be done in a responsible manner. o Data may induce vulnerability to individuals and to populations. The rights to privacy and confidentiality of individuals and populations must be protected as emphasized in the U.N. Declaration of Human Rights, and no harm must be done to them as a result of data sharing.

• The document provides a framework and principles for sharing of data while protecting the rights of individuals and populations and without causing any harm to them.

Broad Guidelines for Biological Data

• Framework for Data Sharing and Access-

o Access to Data- Data generated from publicly-funded projects should be shared openly for public good, with few restrictions and in a timely manner, safeguarding the ethical issues that may arise out of shared data.

✓ Only under specific circumstances, data generated using public funds may not be provided open access, and may be provided under a managed/controlled access protocol.

✓ Access to data that are of "sensitive" nature may be barred, even if generated using public funds.

o High standards and best practices should be used in generation, management and access to data.

o Data that are valuable in the long-term should be stored in a manner that these remain accessible for a long time.

o Conduct of research- must not be jeopardized by release of data.

o Privileges of Data Generator- there may be a period of moratorium before the data generator releases the data in the public domain.

✓ However, the shared data will always be de-identified.

• Data Release and Timing

o Raw Data- It is produced by the various equipment that are used, e.g. DNA sequencer, Flow cytometer, etc.

✓ It must be shared within one year of its generation, by placement in a suitable database identified by the funding agency of the Government of India.

o Processed Data- It is the data processed from the raw data. It may be shared with others within two years of data-generation o Meta Data- It is the supplementary data as to complement the

understanding of other data. It may include the gender, background etc. It should be released concurrently with other types of data.

o Deposition of Data- in an appropriate database in a National Biological Data Centre, as identified by the Department of Biotechnology. It shall be the responsibility of the data generator

o Withdrawal of Data- requests may be considered and granted provided that the data are identifiable in the database.

• Data User Agreement

o Open Access Data- Most data stripped of all personal identifiers and data that are not subjected to any intellectual property or patent restrictions should be made accessible openly, especially if the data are generated using public funds.

✓ Here the agreement must contain the information regarding the data provider, intellectual property, sharing of data, re-identification of individuals and other legal issues.

o Managed Data- Sometimes, data generated in even in publicly funded projects may not be allowed open access for a variety of reasons. Such data should still be made available to others under managed access.

✓ Here the agreement must contain the purpose of access, competence of researchers requesting data access, users authorized to access the data, duration of data etc.

• Audit-

o For open-access data, there may be a national committee established by a consortium of national funding agencies to monitor access and use.

o For managed-access data, the institution that manages data shall be responsible for data-audit.

o The data-management group shall regularly seek reports from users who have been provided dataaccess.

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