BYJU'S EXAM PREP | **IAS**
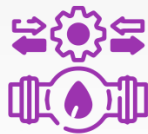
GIST OF
KURUKSHETRA

November 2022

Science and Technology

| Technology and Innovation in Healthcare | Conservation of Natural Resources | Smart Water Future | Technology - Empowering the Masses | Non-conventional Energy Sources |

Outstanding performance by BYJU'S students in IAS 2021

Congratulations to our toppers

03 Ranks in Top 10	**12** Ranks in Top 25	**25** Ranks in Top 50

RANK 01 Shruti Sharma

RANK 5 Utkarsh Dwivedi

RANK 6 Yaksh Chaudhary

RANK 12 Yasharth Shekhar

RANK 13 Priyamvada Mhaddalkar

RANK 14 Abhinav Jain

RANK 15 Challapalle Yaswanthkumarreddy

RANK 16 Anshu Priya

RANK 19 Diksha Joshi

RANK 20 Arpit Chauhan

RANK 21 Dilip Kainikkara

RANK 25 Shruti Rajiakshmi

RANK 29 Bhavishya

RANK 31 Avinash V

RANK 33 Jaspinder Singh

RANK 35 Kartikeya Jaiswal

RANK 37 V Sanjana Simha

RANK 40 Kushal Jain

RANK 44 Anjali Shrotriya

RANK 47 Naman Kumar Singla

RANK 50 Abhijit Ray

Incredible results since 2013

CSE 2020

18 Ranks in top 50 | **22 Ranks** in top 100 | **165 Ranks** in the final list

Rank 2 — Jagrati Awasthi
Rank 8 — Kartik Jivani
Rank 13 — Gaurav Budania
Rank 14 — Karishma Nair
Rank 17 — Sarthak Agarwal

CSE 2019

13 Ranks in top 50 | **22 Ranks** in top 100 | **165 Ranks** in the final list

Rank 3 — Pratibha Verma
Rank 6 — Vishakha Yadav
Rank 8 — Abhishek Saraf
Rank 10 — Sanjita Mohanpatra
Rank 11 — Nupur Goel

CSE 2018 Results

11 Ranks in Top 50 | **28 Ranks** in Top 100 | **183 Ranks** in the Final List

Rank 11 — Pujya Priyadarshni
Rank 16 — Dhodmise Trupti Ankush
Rank 21 — Rahul Jain
Rank 24 — Anuraj Jain

CSE 2017

5 Ranks in top 50 | **34 Ranks** in top 100 | **236 Ranks** in the final list

Rank 3 — Sachin Gupta
Rank 6 — Koya Sree Harsha
Rank 8 — Anubhav Singh
Rank 9 — Soumya Sharma
Rank 10 — Abhishek Surana

CSE 2016

8 Ranks in top 50 | **18 Ranks** in top 100 | **215 Ranks** in the final list

Rank 2 — Anmol Sher Singh Bedi
Rank 5 — Abhilash Mishra
Rank 12 — Tejaswi Rana
Rank 30 — Prabhash Kumar
Rank 32 — Avdhesh Meena

CSE 2015

5 Ranks in top 50 | **14 Ranks** in top 100 | **162 Ranks** in the final list

Rank 20 — Vipin Garg
Rank 24 — Khumanthem Diana Devi
Rank 25 — Chandra Mohan Garg
Rank 27 — Pulkit Garg
Rank 47 — Anshul Agarwal

CSE 2014

6 Ranks in top 50 | **12 Ranks** in top 100 | **83 Ranks** in the final list

Rank 4 — Vandana Rao
Rank 5 — Suharsha Bhagat
Rank 16 — Ananya Das
Rank 23 — Anil Dhameliya
Rank 28 — Kushaal Yadav
Rank 39 — Vivekanand T.S

CSE 2013

5 Ranks in top 50 | **62 Ranks** in the final list

Rank 9 — Divyanshu Jha
Rank 12 — Neha Jain
Rank 23 — Prabhav joshi
Rank 40 — Gaurang Rathi
Rank 46 — Udita Singh

BYJU'S EXAM PREP | IAS

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Mentor Support: You will be assigned a mentor who will guide you throughout your preparation process.

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Stay safe and Keep Learning!

Team BYJU'S

Gist of Kurukshetra November 2022 Issue: Science And Technology

Kurukshetra Magazine is a vital source of study material for the UPSC IAS exam. It is a monthly magazine that gives information about important government schemes and programmes in various sectors. Kurukshetra is an authentic source of information for the UPSC Exam. Here, we provide the **Gist of Kurukshetra**, exclusively for the IAS Exam.

Chapter 1: Technology and Innovation in Healthcare

Background

- The global pandemic affected the whole world in 2020, and the necessity for robust medicare management was intensified due to the COVID crisis.
- The pandemic also helped to realise the inadequacy of healthcare infrastructure in developing countries like India and globally.
- The vulnerabilities highlighted during the pandemic have led to the adoption of digital technologies to continue to provide key healthcare services to patients, especially those who could not visit the healthcare facilities physically for treatment.

Technological Progress and Digitalisation of Healthcare

- Healthcare is slowly shifting away from healthcare facilities, focusing primarily on patient (home) facilities as the fear of the COVID infection reduced physical OPDs and technology is driving this transition.
- Virtual counselling through telemedicine has received a much-needed boost as teleconsultation has multiplied during the COVID pandemic.
- In 2020, the Ministry of Health and Family Welfare (MoHFW), NITI Aayog, and the Board of Governors (BoG) Medical Council of India (MCI) issued the Telemedicine Practice Guidelines. This regulation has helped to democratise the provision of health services.
  - It has also helped bridge the urban-rural healthcare gap
- The Indian healthcare system has experienced a paradigm shift in ensuring quality healthcare delivery to citizens in the last 10 years as technology has now been leveraged for better reach and patient care.
- The application of digital technologies such as artificial intelligence (AI), machine learning (ML), data analytics, Internet of Things (IoT), cloud computing, and robotics is increasing in every facet of the healthcare system.

Emergence of Digital Healthcare in India

- Interoperability is the ability of systems to communicate with each other and make use of the information obtained through each other without any restrictions.
  - However, the Electronic Health Records (EHR) of people are not easily available to doctors, hospitals, pharmacies, etc. due to issues like security, permission, and cost which has affected the quality of healthcare available.
- In this context, the MoHFW notified the EHR standards for India in September 2013 and revised EHR Standards for India were notified in December 2016.

- ○ Further, the review report by the Ministry of Electronics and Information Technology (MeitY) named "Adoption of Electronic Health Records: A Roadmap for India" highlights that the country's public healthcare facilities have very little ICT infrastructure such as computers and connectivity.
- In the wake of the COVID pandemic, the **National Digital Health Mission (NDHM)** (Ayushman Bharat Digital Mission) was launched in 2020, which is the implementation of the **National Digital Health Blueprint** prepared by the MoHFW with an objective to create a framework for the National Health Stack proposed in 2018 by the NITI Aayog.
  - ○ NDHM aims to create a single repository of medical records of all citizens.
  - ○ Under the mission, every Indian will get a unique Health ID which will contain information about every test, disease, medicine, and associated reports.
- A comprehensive EHR would be beneficial to rural patients, as it could soon include data from digital devices that display information about the patient's health problems and could include information about their lifestyle and habits.

Scope of Remote Healthcare in India

- India is a country with around 65% of the population residing in rural areas. However, access to timely and quality healthcare is lacking.
- One of the significant challenges faced by rural communities is the lack of healthcare expertise. The most proven way to solve these challenges is to bring specialised training to the existing health professionals.
- Virtual reality can be used in rural areas to assist healthcare professionals with training and experience through training simulations with a headset that places you in a natural healthcare environment.
- Virtual and tele-mentoring groups with experts will ensure that training and support are continuous and ongoing.
- The existing health model has endless potential for inducing massive improvements, especially in the rural health sector and revolutionalising the rural medical landscape.
- Also, it is to be noted that the purpose of incorporating technology into healthcare in rural areas is not to replace doctors but to improve the efficiency of healthcare systems.

The Rise of Digital Healthcare Facilities in India

- The Internet of Medical Things (IoMT) is changing the nation's healthcare systems for the better. IoMT is the collection of medical devices and applications that connect to healthcare IT systems through online computer networks.
  - ○ IoMT devices that are Bluetooth enabled can transmit all essential clinical data to the consulting physician in real-time thereby mimicking face-to-face consultation.
- McKinsey's latest report projects that telehealth will become a quarter-trillion-dollar industry post-COVID.

- According to the report, the use of tele-health has increased 38-fold from the pre-COVID baseline.
  - The industry is projected to reach USD 10.6 billion in India by 2025.
  - Further, it has a broad reach in India's relatively untouched area.
- The Atal Innovation Mission (AIM) under the NITI Aayog has been promoting innovation and entrepreneurship in the country. AIM supports the establishment of new incubation centres called Atal Incubation Centres (AIC), many start-ups and companies working on healthcare related services and equipment are being supported by these AICs.

Conclusion

- An effective healthcare system of a nation is determined by its ability to deliver high-quality and efficient care that is affordable and accessible for all.
- Access to quality healthcare has been a traditional problem in the country, especially in the hinterlands. However, government-led innovations are taking place at a rapid pace in rural communities.
- As teleconsultation, e-pharmacy, and remote monitoring have gained the trust of all stakeholders, more efforts have to be initiated to leverage other advanced technologies such as AI, ML, and Blockchain to enhance interoperability in healthcare as they also help create jobs and employment opportunities.
- Adopting an integrated approach for addressing both the public's health needs and investing in robust information and communications technology infrastructure is the way forward.

Chapter 2: Conservation of Natural Resources

Introduction

- The term "environment" was introduced in the Constitution of India for the first time in the year 1976 through the 42nd Constitutional Amendment.
- The State's responsibility with regard to environmental protection was laid down under **Article 48-A** of the Constitution which says that the State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country.
- Further, **Article 51-A (g)** which deals with the fundamental duties mentions that "it shall be the duty of every citizen of India to protect and improve the natural environment including forests, lakes, rivers and wildlife and to have compassion for living creatures".
- The "Environment" in its definition encompasses all entities, natural or manmade, external to oneself, and their inter relationships, which provide value, now or perhaps in the future, to humankind.

Objectives of National Environment Policy 2006

The National Environment Policy 2006 of India formulated by the [Ministry of Environment, Forest and Climate Change (MoEFCC)](link) for the protection and conservation of environment identifies the following seven objectives:

- **Conservation of Critical Environmental Resources:** To protect and conserve critical ecological systems which are essential for life support, livelihoods and economic growth.
- **Intra-generational Equity-Livelihood Security for the Poor:** To ensure equitable access to environmental resources for all sections of society, in particular, to poorer communities that are most dependent on environmental resources.
- **Inter-generational Equity:** To ensure judicious use of environmental resources to meet the needs and aspirations of the present and future generations.
- **Integration of Environmental Concerns in Economic and Social Development:** To integrate environmental concerns into policies, programmes, and projects for economic and social development.
- **Efficiency in Environmental Resource Use:** To ensure efficient use of environmental resources in the sense of reduction in their use per unit of economic output, to minimise adverse environmental impact.
- **Environmental Governance:** To apply the principles of good governance to the management and regulation of the use of environmental resources.
- **Enhancement of Resources for Environmental Conservation:** To ensure higher resource flows, technology, traditional knowledge, and social capital, for environmental conservation through mutually beneficial multi-stakeholder partnerships.

Environment related interventions by the government

- For the protection and conservation of the environment, several legislations have been passed by the government namely: the [Environment Protection Act, 1986](link); Water (Prevention and Control of Pollution) Act, 1974; Water Cess Act, 1977; Air (Prevention and Control of Pollution) Act, 1981.
- Laws passed with respect to forests and biodiversity include: Wild Life (Protection) Act, 1972; Indian Forest Act, 1927; Forest (Conservation) Act, 1980; and Biodiversity Act, 2002.
- Recently the Government of India also unveiled [LiFE](link) (Lifestyle for Environment) initiative which aims to promote environment conscious lifestyle.
- To combat climate change, **Panchamrit** (five goals) were announced at the [UN Climate Change Conference of the Parties (COP26)](link) held in Glasgow.
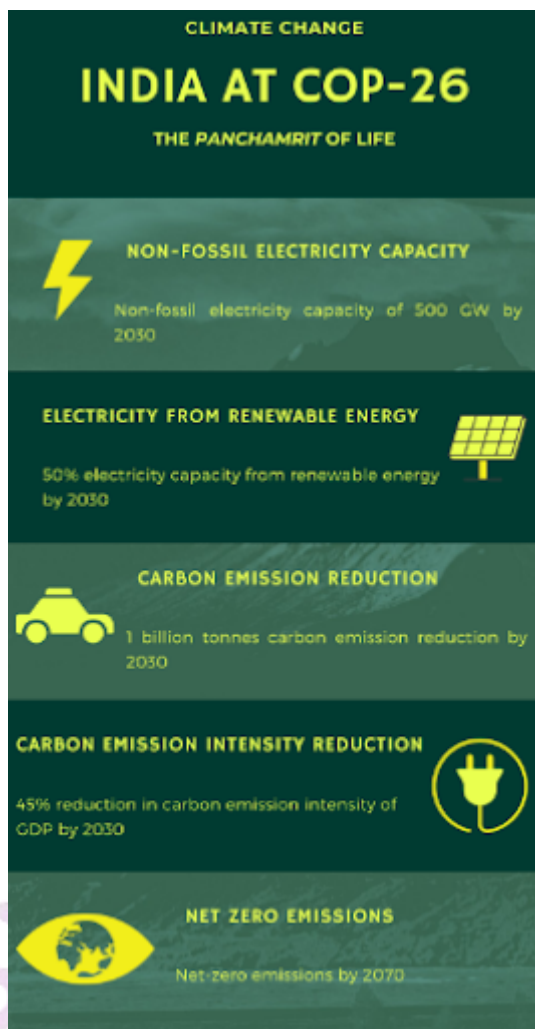
Image Source: InsPIRE

Technological Interventions by MoEFCC

- **PARIVESH**: In line with the spirit of "Digital India", a single-window integrated environmental management system named PARIVESH (Proactive and Responsive facilitation by Interactive, Virtuous and Environmental Single window Hub) was launched by the MoEFCC in August 2018.
  - It has an automated process starting from submitting of application, preparation of agenda, preparation of minutes to grant of clearances.
  - It facilitates sound and informed decision-making, realtime information about the status of application.
- **Decision Support System (DSS):** DSS is a web GIS application developed to provide qualitative and quantitative information with respect to forest area.

- ○ It uses different spatial layers for providing the information like state and district boundary, tiger reserves, tiger corridors, forest type maps, biological richness, hydrological layer, etc.
- **Climate Change Knowledge Portal:** India's Climate Change Knowledge Portal is a single point information resource that captures sector-wise adaptation and mitigation actions that are being taken by the various ministries in one place
  - ○ The portal helps in disseminating knowledge among citizens about all the major steps the Government is taking at both national and international levels.
- **National Mission on Himalayan Studies:** National Mission on Himalayan Studies is a Central Sector Grant-in-aid Scheme that addresses key issues relating to conservation and sustainable management of natural resources in the Indian Himalayan Region.
  - ○ The key objective is to focus on enhancing livelihoods of local communities in line with the National Environment Policy, 2006.
- **Wetlands of India portal:** This portal is an initiative to provide a single point access system that synthesises information dissemination regarding wetland sites of India.
  - ○ The portal provides a platform for the people of the country to learn more about wetlands and get involved in their conservation and management.

Conclusion

- Environmentalist and green activist Dr. Anil P. Joshi has rightly stated that the true capital of a nation lies in its natural resources, and future demands balance between economy and ecology.
- Through science and technology, environment conservation can be achieved in a holistic manner as environmental attitude is directly linked with the level of knowledge regarding environmental issues.
- As the climatic conditions are changing, there is a need to spread awareness about the use of technology for environment protection as it will play an important role in sensitising people about environmental issues and facilitate people to adopt green social responsibility for the protection of the environment.

Chapter 3: Smart Water Future

Water Scarcity at a Global Scale

- About 1.1 billion people worldwide lack access to water
- Around 2.7 billion find water scarce for at least one month of the year
- Close to two million people, mostly children, die each year from diarrheal diseases alone

- It is estimated that by 2025, two-thirds of the world's population may face water shortages.

Water Scarcity in India

- On account of the increasing population, the per capita annual availability of water in India, which was 1816 cubic meters in 2001 has reduced to 1544 cubic meters in 2011 and is expected to reduce to 1140 cubic meters by the year 2050.
    - According to international agencies, any situation of availability of less than 1000 cubic meters per capita is considered scarcity.
- By 2030, India's water demand is expected to be twice the available supply and if the trend continues, it may imply severe water scarcity for hundreds of millions of people.
- Another key aspect of water that requires immediate attention is the management of wastewater.
    - The country generates 140 Billion Cubic Metre of wastewater annually.
    - The per-person disease burden due to unsafe water and sanitation was found to be 40 times higher in India than in China and 12 times higher than in Sri Lanka in 2016.

Smart Water Future

- Smart Water broadly means the management and distribution of water while maintaining its quality.
- To ensure the sustainable supply of water in a smart format, the focus must be on the reduction of non-revenue water and encouraging wastewater recycling and reuse.
- Under the water supply management, loss due to non-revenue water can be considered a threat to water-scarce economies of the world.
- The International Water Association (IWA) has defined "Non-revenue water" as all physical and commercial losses due to theft, pipe burst, overflow of reservoirs, unmetered and ill-metered water bill along with unbilled authorised consumption.
- According to the World Bank, Indian utilities in 2012 face huge distribution losses due to non-revenue water, it has been estimated that about 40-70% of water distributed, is lost on account of leakages, unauthorised connections, billing and collection inefficiencies. Therefore reducing non-revenue water losses has become important.
- There are four basic leakage management activities that can be undertaken by water utilities to reduce distribution losses, namely:
    - Pressure management
    - Active leakage control
    - Speed and quality of repairs and pipe asset management
    - Maintenance and renewal

Use of Technologies to Facilitate Smart Water Management

- Active leakage control can be achieved by technological interventions such as real-time monitoring of water supply infrastructure, use of geographic information systems (GIS) tools, installing smart devices, and telemetry.
- Implementation of Internet of Things (loT) technology helps transmit data or information about water usage to longer distances through wireless, and uninterrupted means.
- The use of Sensors, remote sensing technologies, and visualisation tools help manage water resources at the service area, watershed, and regional scales.
- Satellites and drones can be used to provide data for mapping water resources, measuring water fluxes, and utility asset management. Data from such technologies can better prepare water resource management policies.
- Mobile phones can be utilised to provide near real-time data on water quality, flows, pressures and water levels, among other parameters. It can also help in spreading useful information on water resources to all the stakeholders.
- Smart meters can be used to record customer water usage that will provide a clear picture of water consumption and convey data to both consumer and utility.
- Artificial Intelligence in water can allow for the strategic and cost-effective operation of utilities, including better planning and execution of projects, better tracking and understanding of resource loss and more efficient collection and distribution networks.
  - Further, the use of AI in reservoir operation, flood forecasting, and inundation mapping can help to mitigate floods and save thousands of lives.
- Augmented Reality and Virtual Reality technologies have the potential to support decision-making in the field by providing holographic representation of pipes, cables and other assets and facilitate immersive scenario-based training.
- Blockchain applications have the potential for direct, secure transactions between resource providers and consumers and other players.

Case studies for the adoption of technologies

- The World Bank-funded Karnataka Urban Water Sector Improvement Project (KUWASIP) has reduced NRW from 50% to 7 % and increased the hours of supply from 2 hours every few days to 24-hour water supply.
- The Central Water Commission is collaborating with Google to provide inundation alerts based on the Flood Forecast available in Common Alerting Protocol (CAP) platform using high-quality digital Terrain Models available with Google using AI and ML.
- The Government of Kerala has also entrusted the Kerala State IT Mission (KSITM) to set up an ICT Platform consisting of Web based backend and a mobile app-based field survey application to document flood related damages.
- Further, students from IIT Madras have developed an AI-enabled drone that can help authorities provide vital information about people trapped in disaster-hit areas.

Chapter 4: Technology - Empowering the Masses

Background

- In recent years, there has been a significant increase in investments in the field of science and technology.
- Due to the efforts of the government, India is currently ranked 40th in the Global Innovation Index 2022 as compared to the 81st rank in 2015.
- At the recently concluded State Science and Technology Ministers Conclave, the Prime Minister of India has called for taking research in science and technology to the local level.
- According to the Prime Minister, the need of the hour is that every state should focus on innovation to create local solutions according to their local problem.

The role played by Technology in Empowering the Masses

- For a developing country like India, science and technology play a huge role in bettering the lives of its citizens.
- In India, science and technology have a huge potential to revolutionise agriculture, financial inclusion, education, roads and transport, healthcare and housing sectors.
- Technological interventions not only help boost productivity, better service levels and efficiency but also help ensure that the benefits of modern science reach the bottom of the pyramid, ensuring ease of living and access to various government schemes.
- Technology has been the proverbial catalyst in turning the tide in favour of citizens and their ability to access government schemes.
  - For example, the rapid adoption of digital technology in the last few years has laid the framework for making the delivery of government schemes easier and more efficient.

Key developments spearheaded by Technological Advancements

- **India Stack and [Aadhaar](...):** The foundation of India's digital revolution was laid by the development of India Stack which is a unified software platform that brought over 140 crore-plus population of India's into the digital age.
  - The adoption of India Stack has helped promote financial and social inclusion.
  - The bedrock of India Stack is a set of digital identity products centred around Aadhaar and Aadhaar has also been the foundation of multiple Building Blocks.

- **Direct Benefit Transfer:** Aadhaar identification programme has ensured the success of the Direct Benefit Transfer (DBT) system which was initiated by the government in 2013.
  - The main aim of the programme was the transfer of subsidies and cash benefits directly to citizens through their Aadhaar seeded bank accounts which reduces leakages, and associated delays
  - DBT has emerged as a high priority focus area of the government, in reforming the government delivery system in a variety of welfare schemes for a simpler and faster flow of information/funds.
  - DBT has become the most accepted way of delivering development schemes with the delivery of over 450 schemes such as the Public Distribution System (PDS), PM-KISAN, MGNREGS, Prime Minister's Matru Vandana Yojana (PMMVY), National Rural Livelihood Mission (NRLM), National Health Mission, etc.

TOTAL DIRECT BENEFIT TRANSFER
(FY 2021-22)

₹ 3,60,955 Cr

More details

TOTAL NO. OF TRANSACTIONS
(FY 2021-22)

366 Cr

More details

NO. OF SCHEMES

310

More details

MINISTRIES

54
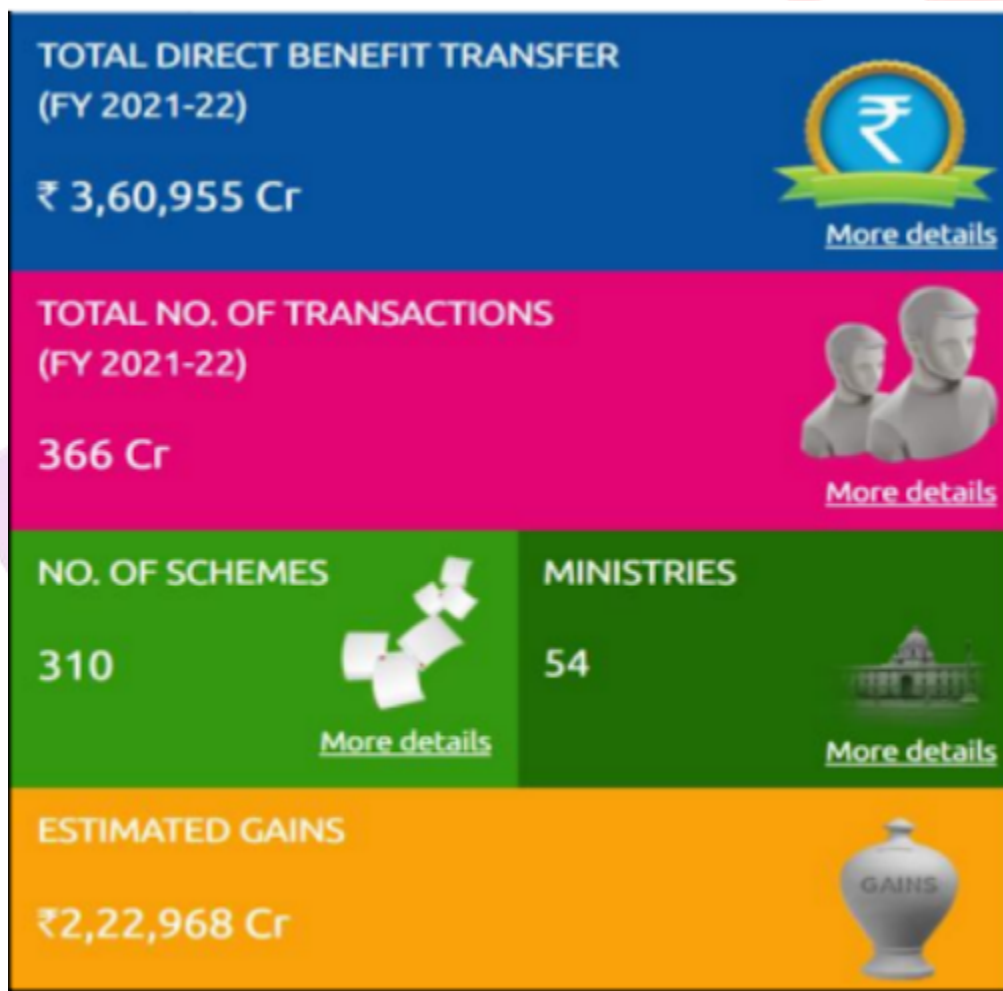
More details

ESTIMATED GAINS

₹2,22,968 Cr

Image Source: PIB

- **Digital Platforms for [e-Governance](#):** The National Informatics Centre (NIC) under the Ministry of Information Technology is playing a huge role in executing key IT projects, in collaboration with Central and State Governments ensuring the last-mile delivery of government services to the citizens through a variety of digital solutions.
  - NIC, as the technology partner of the government of India, aims to cater to ICT needs at all levels of governance and several government initiatives like Swachh Bharat Mission, My-Gov, e-Hospital, fertiliser distribution, e-Courts, e-Transport, etc. have been completely managed using digital platforms developed by NIC.
  - NIC has also developed various digital platforms for the socioeconomic development of the country in line with the vision of "One-Nation One-Platform".
- **[Unified Payments Interface (UPI)](#):** The UPI developed by the National Payments Corporation of India (NPCI), has emerged as a game changer in the payments space.
  - Rolled out in 2017, UPI accounts for about 16% of total retail payments, with over 30 million UPI QR codes registered by merchants.
  - Since the launch of UPI, India has been improving financial inclusion at a CAGR of more than 5%, and since 2018, the country has more than doubled the extent of digitisation of payments.
  - With UPI other digital payment options such as Bharat Bill Payment System (BBPS), BHIM Aadhaar, Aadhaar Enabled Payment System (AePS) and *99# services have also developed.
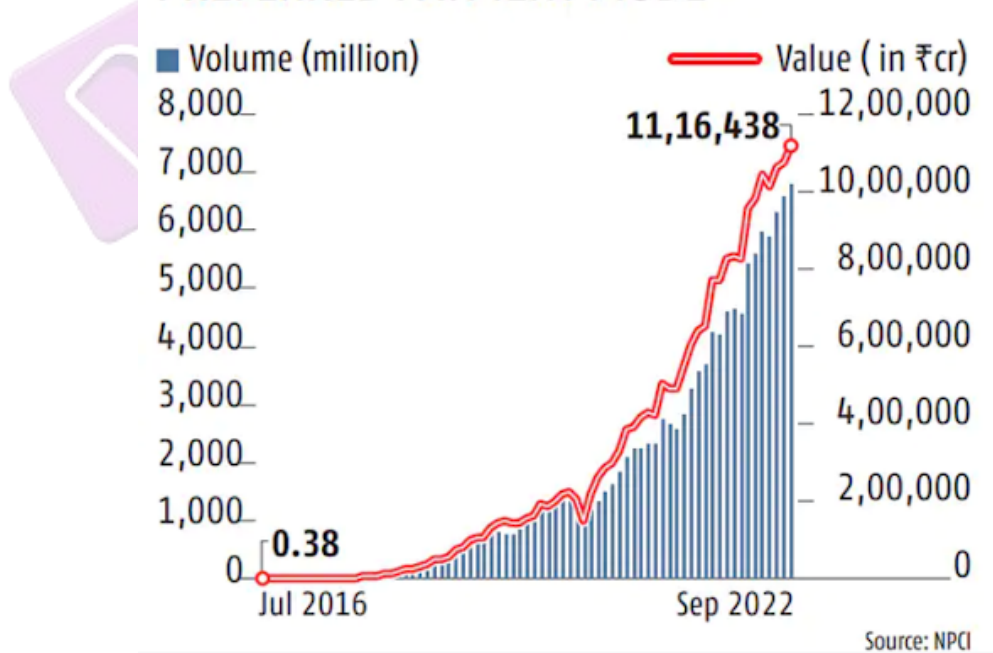

Image Source: Business Standard

- **<u>Smart Cities Mission</u>:** One of the most visible examples of the impact of technology in changing the lives of our people is the evolution of our Smart Cities.
    - Launched in 2015, the Smart Cities Mission (SCM) identified 100 cities across the country for higher economic growth and better quality of life for people by enabling local area development and harnessing technology,
    - Application of Smart Solutions enables these cities to use technology to improve solid waste management, lower air and water pollution levels, better space utilisation, beautification of the cities, efficient urban mobility, improved city infrastructure and health facilities for the citizens.
- **Integrated Command and Control Centre (ICCC):** ICCC are said to be the nerve centre in each Smart City.
    - ICCCs monitor all the activities taking place in the city from a technology enabled and responsive, central location and are designed to aggregate the information across multiple applications with the help of sensors deployed.
    - As of March 2022, ICCCs are operationalised in 76 Smart Cities in the country and are playing a key role in ensuring better monitoring and efficiency in areas like traffic management, crowd management, detection of crimes, disaster management, etc.
    - During the COVID pandemic, these ICCCs were converted into COVID-19 war rooms and became the epicenter of coordinated actions amongst various stakeholders for dealing with the pandemic, continuously monitoring hospital beds, oxygen, ventilator and ICU bed availability.

Chapter 5: Non-conventional Energy Sources

Introduction

- Energy occupies a pivotal position to facilitate the dream of a sustainably developed India.
- Sources of energy play a key role in determining the pace of global warming as conventional energy sources such as the burning of fossil fuels is the largest contributor to global climate change as they account for about 75% of the total global greenhouse emissions and about 90% of the total carbon dioxide emissions.
- Apart from adverse ecological implications, excessive reliance on conventional sources of energy will also result in their exhaustion.
- India is gradually transitioning from conventional sources to non-conventional sources of energy for its needs and it is particularly significant as India is one of the fastest growing countries in the world and fifth largest economy

● India holds a strategically important position in the global arena and India's efforts in climate change will pave a direction for the future generation.

Non-conventional Energy sources

● Non-conventional energy sources refer to those renewable sources of energy that are obtained from nature and are replenished at a rate faster than their consumption unlike conventional energy sources such as coal and natural gas.
● These energy sources do not get depleted when used hence they are inexhaustible.
● Further, they are regarded as clean sources of energy as they are less hazardous compared to conventional sources of energy.
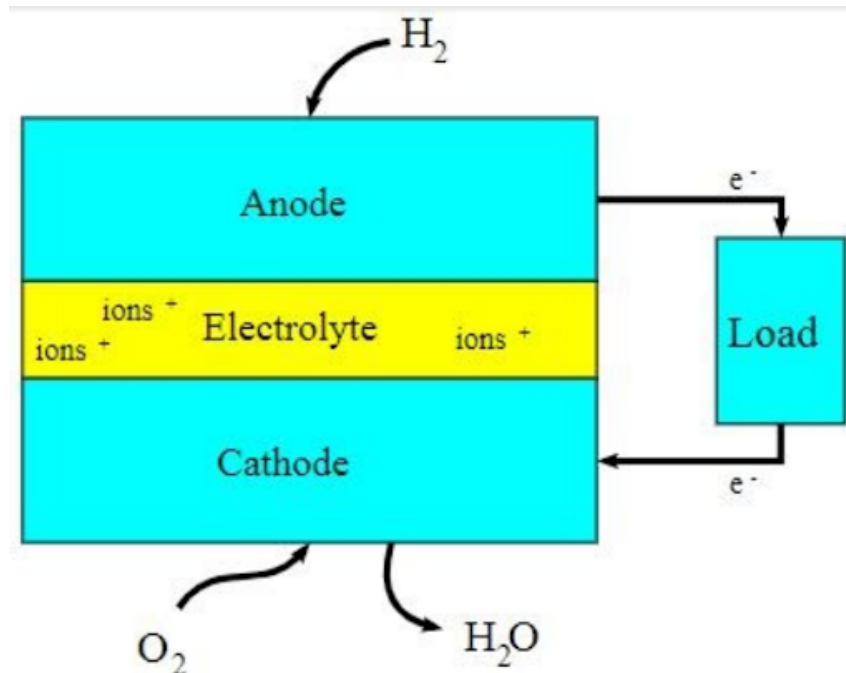
Significance of Non-conventional Energy sources

● Transition to non-conventional sources of clean energy ensures the attainment of three Es in energy policies namely energy security, economic development and environmental sustainability.
● The shift towards non-conventional sources of energy will make this planet a better place to live as they not only help address the issue of climate change and global warming but also contribute to better public health outcomes.
● The shift towards non-conventional sources of energy can help reduce the cost of energy supply and also ensure enhanced delivery of affordable clean energy that is accessible to all.
● The transition to renewable energy sources will aid the Indian economy to delink itself from volatile international oil prices and also ease the burden of subsidies.
● Further, the transition to non-conventional sources of energy leads to more employment and entrepreneurship opportunities and boosts exports.

Popular Non-conventional Energy sources in India

● **Solar Energy:** Solar energy can be harnessed by converting solar energy into electric energy in solar plants.
  ○ India, being a tropical country and its geographical location makes Solar energy a conducive source of energy.
  ○ Solar energy has penetrated the rural belts of the country making and has evolved as one of the key sunrise sectors with a lot of potential.
  ○ The country's need for solar energy has led to the introduction of the Production Linked Incentive (PLI) scheme for manufacturing of solar Photo-Voltaic (PV) modules with an outlay of Rs. 24,000 crores.

- The scheme is expected to create an additional 10,000 MW capacity of integrated solar PV manufacturing plants and reduce imports of solar PV cells and modules and provide adequate impetus to R&D.
- India has achieved 5th rank globally in solar power deployment by surpassing Italy and the efforts of the Government have led to the increase of solar power capacity by over 11 times.

- **Wind Energy:** The kinetic energy of wind in motion is used to generate wind energy.
  - The expansion of the wind industry in the country has created a strong ecosystem with a manufacturing base of about 10,000 MW per annum.
  - As of 31st March 2021, India with a total installed capacity of 39.25 GW has the 4th highest wind installed capacity in the world.
  - India with its long coastline of around 7,500 km has immense potential in harnessing offshore wind energy.

- **Tidal Energy:** The energy produced from the surge of ocean i.e from the rise and fall of waves is called tidal energy.
  - Tidal energy is yet to take a full fledged form for commercial purposes and is still in the R&D phase.
  - Relatively high cost and limited availability of sites with sufficiently high tidal ranges or flow pose constraints on its total availability.

- **Geo-thermal Energy**: The energy generated from the heat derived from the subsurface of earth is called geo-thermal energy. The gradual decline of radioactive particles in the earth's core generates geo-thermal energy.

- **Hydropower:** Hydropower, or hydel power, is considered one of the oldest and largest sources of renewable energy. It generates electricity by harnessing the flow of water.

- **Biomass Energy:** Biomass energy is generated by living organisms or organisms that lived earlier.
  - Biomass is an organic material and contains stored energy obtained from the sun. Burning of biomass results in the release of chemical energy in biomass in the form of heat.
  - According to the Ministry of New and Renewable Energy (MNRE), about 32% of the total primary energy use in India is still derived from biomass and more than 70% of the country's population depends on biomass fuel.
  - A recent study by MNRE suggests that the present biomass availability in India is around 750 million metric tonnes annually.

- **Fuel Cell:** Fuel cell refers to the source of energy that uses hydrogen and oxygen to generate electric power. Through chemical reactions with oxygen, fuel cells convert hydrogen obtained from diverse sources, into electricity.
  - Water is the only end product of this process, making it a clean and sustainable energy source.

Governmental Interventions to Foster Non-conventional Energy sources

● **Permitting [Foreign Direct Investment (FDI)](#) up to 100% under the automatic route** for renewable energy projects.
● Setting up of **ultra-mega renewable energy Parks** to provide land and transmission to renewable energy developers on a plug and play basis.
● **Waiving of Inter State Transmission System (ISTS) charges** for inter-state sale of solar and wind power for projects to be commissioned by 30th June 2025.
● Laying of new transmission lines and creating new sub-station capacity for evacuation of renewable power under **Green Energy corridor scheme.**
● **Pradhan Mantri Kisan Urja Suraksha Evam Utthaan Mahabhiyan ([PM-KUSUM](#)):** PM-KUSUM aims for de- dieselisation of the farm sector along with providing energy security and increased income to farmers.
    ○ The Scheme with a financial support of over Rs.34,000 crores from the Central Government has aimed to create additional 30.8 GW of solar capacity.
    ○ PM-KUSUM has three key components namely:
        ■ Creation of 10,000 MW of Decentralised Ground mounted grid connected solar power plants
        ■ Solarisation of 15 lakh grid connected agriculture pumps
        ■ Installation of 20 lakh agriculture pumps powered by solar energy
● **Rooftop Solar Phase-II Programme:** Under this Programme 4000 MW rooftop solar (RTS) capacity addition is targeted through Central Financial Assistance (CFA) in the residential sector including for households in rural areas.

- **National Hydrogen Mission:** The mission aims to make India a green hydrogen hub and help India to fulfil its target of production of 5 million tonnes of green hydrogen by 2030.
- **National Offshore Wind Energy Policy**: Notified by the Government of India in 2015 the policy aims to develop offshore wind power in the country.
- **National wind solar hybrid policy:** Adopted in 2018 by MNRE, it aims at providing a framework for promotion of large grid connected wind-solar PV hybrid projects for optimal and efficient utilisation of transmission infrastructure.

Challenges in Transition to Non-Conventional Energy Sources

- Ensuring an enabling infrastructure and conducive ecosystem for facilitating a smooth transition to renewable energy
- The challenges of expanding power infrastructure to permit increased use of diverse energy sources and ensuring system flexibility.
- The need for massive investments for facilitating smooth transition to non-conventional energy sources and ensuring viable financing mechanisms to raise long term funds.
- Lack of investor confidence in the renewable energy sector.
- International green finance flows to India have been relatively low when compared to India's climate goals.
- The ecosystem of green finance is impeded by issues such as long gestation gaps, increased capital cost, potential risk factors associated, etc.
- Further, coping with immediate job and revenue loss due to switching from fossil fuels will also be a challenge.

Way forward

- Addressing key challenges require strategic planning for raising necessary finance and upskilling human resources.
- To facilitate a smooth and sustainable transition to non-conventional sources of energy, mobilisation of green finance needs to be adopted at a faster rate.
- Greater deployment and optimal utilisation of innovative financial instruments like green bonds, crowdfunding, and infrastructure debt bonds play a key role in this regard.
- Facilitating increased public private partnership for funding and meeting necessary technological requirements is also important.
- It is also crucial to further escalate R&D expenditure on the domain of clean energy sources as it will boost innovation, and aid in the creation of resilient energy systems.
- Ensuring greater synergy among all the concerned stakeholders through a participatory approach can further help to fasten the pace of the shift towards renewable sources.

Chapter 6: S&T: Towards Women Empowerment

Background

- On the occasion of Independence Day 2022, the Prime Minister of India emphasised that women power is significant for the growth of India and said that "if we look at Nari Shakti in law, education, science and police, our daughters and mothers are making major contributions to India".
- Globally, governments and organisations are focussing more on promoting gender equality and women empowerment to untap the potential of women as human capital.
- The first steps date back to the **UN Conference on Women** in Mexico to mark 1975 as International Women's year.
- Further, the objectives of the **4th UN World Conference on Women** held in Beijing in 1995 highlighted full gender equality and integrating women in developmental activities by creating opportunities for full participation at diverse workplaces.

Women in Science and Technology in India (1950-2000's)

- Science and technology is the most powerful enterprise that drives a nation's development, but ironically women in this area are under-represented globally
- However, the first Science and Technology Policy in India (Scientific Policy Resolution, 1958) acknowledged women's role in science and technology.
- Between the 1960s- 1980s, the number of women who rose high to leadership positions were minimal as the three national academies of science (INSA, NASI, IASc) had a minuscule number of women scientists as elected members.
  - Also, the coveted Shanti Swarup Bhatnagar prize started in 1958 was awarded to only eight women researchers until the early years of the 21st century.
- Even women who had access to higher education were subjected to gender biases and had restricted career advancement opportunities.
- The first focussed move on women empowerment in science and technology was when Dr. M S Swaminathan initiated a chapter on "Science and Technology for Women" in the Sixth Five Year Plan (1980-85) which was included in the plan document on "Women and Development".
- The chapter was prepared by Dr. Manju Sharma who later became the first woman president of the National Academy of Sciences, India (NASI) and later Secretary, Department of Biotechnology (DBT).

Winds of Change — The 21st Century for Women in S&T

- The former Prime Minister Atal Bihari Vajapayee had declared the year 2001 as the "**year of empowerment of women**".

- According to Atal Bihari Vajapayee "developing countries that have made remarkable social progress, have done so mainly through the empowerment of women, which has had enormous impact in terms of literacy, health and economic well-being of families".
- In the 21st century, the Indian Science and Technology leadership has focused on women by enabling policies and implementing programmes to increase the participation of women in STEM (Science, Technology, Engineering and Mathematics) disciplines.
- The **Science and Technology Policy, 2003** emphasised to promote the empowerment of women in all science and technology activities and ensuring their full and equal participation.
- Key scientific and technological empowerment goals which were identified include capacity building, promoting gender neutral workspaces, providing access to information to women in science and technology, increasing the number of girls in science and providing ways to overcome the challenges of the issue of "leaky pipeline" at tertiary and mid-career level.

Initiatives taken by the Government

- **National Task Force for Women in Science:** In 2002, the President of Indian Nation Science Academy (INSA) constituted a committee to examine the status of women in science in India.
  - The recommendations of the INSA report on "Careers of Women in Science" prompted the Scientific Advisory Committee of the Prime Minister to constitute a National Task Force for Women in Science in December 2005 under the Department of Science and Technology (DST).
- **Recommendations of Task Force:** The task force made several recommendations including:
  - Recruitment of deserving women scientists in institutions,
  - Selection committees to include women scientists
  - Refresher training, mentorship programs and schemes
  - Creating women friendly workplaces with availability of creches and safeguarding policies against sexual harassment
  - Promote scientific temperament among school girls
  - New policies with focus on maternity leave
  - Developing avenues to promote entrepreneurship and self-employment
- **Women Scientist Scheme (WOS):** WOS-A provides opportunities to women researchers who have taken a break in a career primarily due to family responsibilities, relocation, etc. for pursuing research in basic or applied areas of science and engineering.
  - WOS-B provides grant support to women scientists for developing S&T solutions for solving grassroots level issues and promoting social benefit.

- ○ WOS-C provides a one-year internship in the domain of [Intellectual Property Rights](#) (IPRs).
- **CURIE Programme (2008-09):** One of the major goals that were identified by the National Task force was to increase the number of women in S&T by providing them access to cutting edge S&T infrastructure and promoting scientific skills training.
  - ○ The DST conceptualised and initiated the Consolidation of University Research for Innovation and Excellence in Women Universities (CURIE) and supported nine women universities across India in enhancing their R&D infrastructure.
  - ○ Currently, the program is expanding its focus to improve STEM education and research in post graduate colleges to provide education to girls in small cities.
- **Mobility Scheme:** the scheme offers a contractual research award towards conducting independent research in any location as women face difficulties in their present job due to relocation (due to marriage, transfers, etc.)
  - ○ This helps women to undertake research during early phases of their career while fulfilling key domestic responsibilities.
- **Biotechnology Career Advancement and Reorientation Programme (BioCARe)**: Launched by DBT in 2011 the programme helps in career development of employed/ unemployed women researchers by providing extramural research grant support.
- **Knowledge Involvement in Research Advancement through Nurturing (KIRAN):** It is a division reconceptualised at DST in 2014 to cover all the women-exclusive schemes to bring gender parity in S&T and provide a framework for gender mainstreaming.
  - ○ It supports Women Scientist Scheme (WOS), CURIE Programme and the Mobility scheme.

Recent Developments

- Vigyan Jyoti is a programme introduced by DST in the year 2019-20 with an aim to provide exposure to meritorious young girls in tier 2 cities and remote and rural areas to pursue a career in STEM.
  - ○ The programme promises hand-holding and mentoring for girls from their school stage till PhD.
- On 28th February 2020, India celebrated National Science Day with "Women in Science" as the focal theme.
- The DST has launched GATI (Gender Advancement for Transforming Institutions) as a mission mode program that aims to push higher education institutions, research institutes and universities towards supporting diversity, equity and inclusion (DEI)
  - ○ Apart from accrediting and recognising institutions through certification and awards, GATI would also mentor, coach and provide training support to institutions to develop global best practices in gender equality.

- Women technology parks are centres that are strategically placed near women farmer communities to facilitate demonstration of methodology by scientist-cum-technologists.
  - The goal is to make rural women develop an attitude that adoption and practice of such transforming technologies will help them build their own enterprises.

Chapter 7: Science and Technology in Agriculture

Introduction

- The agriculture and allied sector play a critical role in rural livelihood, employment and national food security. The sector provides the largest source of livelihood in the country.
- The proportion of the Indian population depending directly or indirectly on agriculture for employment opportunities is more than that of any other sector.
- According to the Economic Survey (2021-22), the agriculture sector in the country has experienced buoyant growth in the last two years. The sector accounted for 18.8% (2021-22) in Gross Value Added (GVA) of the country registering a growth of 3.6% in 2020-21 and 3.9% in 2021-22.
- The Economic Survey also stated that the growth in allied sectors including livestock, dairying and fisheries has been the major driver of overall growth of the sector.

Use of Digital Technologies in Agriculture

- The Committee on Doubling Farmers' Income in its report 2018 has highlighted the role of digital technology, which can play a transformational role in modernising and organising how rural India performs its agricultural activities.
- Digital technologies are finding increasing use in the agricultural value system, and farmers are increasingly becoming more informed, as various measures are taken to provide them ready access to technology and information.
- The Government has finalised the core concept of **India Digital Ecosystem of Agriculture (IDEA) framework** which lays down the architecture for the federated farmers database.
  - The IDEA would serve as a foundation to build innovative agri-focused solutions leveraging emerging technologies to contribute effectively in creating a better ecosystem for agriculture in India.
  - This ecosystem shall help the Government in effective planning towards increasing the income of farmers in particular and improving the efficiency of the agriculture sector as a whole.

- Under the **National e-Governance Plan in Agriculture (NeGP-A),** the funds are released to the States and UTs for projects involving use of modern technologies such as AI, ML, Robotics, Drones, Data Analytics, Block Chain, etc.

Various S&T interventions in the Agriculture Sector

- **e-NAM:** The National Agriculture Market (e-NAM) is a pan-India electronic trading portal that networks the existing Agricultural Produce Market Committee (APMC) mandis to create a unified national market for agricultural commodities.
  - Digital services are provided to traders, farmers, Farmers Producer Organisations (FPOs), mandis through various modules of e-NAM platform
  - So far, 1260 mandis of 22 States and 3 UTs have been integrated with the eNAM platform for providing market access to farmers and over 1.73 crore farmers and 2.26 Lakhs traders have been registered on e-NAM platform.
  - Trading parameters for 193 agricultural and horticultural commodities like cereals, pulses, oilseeds, spices, flowers and fiber crops have been provided.
  - In July 2022, the Agriculture Ministry launched the **Platform of Platforms (PoP)** under e-NAM intended to promote trade and marketing of agricultural produce wherein farmers will be facilitated to sell the produce outside their state borders.
- **PM KISAN Digital Payment:** Under the PM KISAN scheme, Rs. 6,000 is directly transferred into the bank accounts of the eligible farmers under DBT mode annually in three installments.
  - The PM-KISAN mobile app was launched to broaden the reach of the scheme where farmers can view the status of their application, update or carry out corrections of name based on their Aadhaar card and also check the history of credits to their bank accounts.
- **AGMARKNET portal:** Integrated Scheme for Agricultural Marketing schemes to promote creation of agricultural marketing infrastructure by providing backend subsidy support to State, cooperative and private sector investments Services are provided through AGMARKNET portal.
  - AGMARKNET portal is a G2C e-governance portal that caters to the needs of various stakeholders such as farmers, industry, policy makers and academic institutions by providing agricultural marketing related information from a single window.
- **National Mission on Horticulture:** This mission promotes holistic development of the horticulture sector (including bamboo and coconut).
  - HORTNET project is a web enabled work flow-based system for providing financial assistance under the mission for Integrated Development of Horticulture.

- **Agriculture Infrastructure Fund:** This was created to mobilise a medium to long term debt finance facility for investment in viable projects for post-harvest management Infrastructure and community farming assets through incentives and financial support
  - Financial assistance is provided digitally in the form of Interest Subvention and Credit Guarantee for setting up post-harvest management Infrastructure
- **National Project on Soil Health and Fertility:** The Government has recommended soil test based balanced and integrated nutrient management through conjunctive use of both inorganic and organic sources
  - The project recommends a 4Rs approach namely right quantity, right time, right mode and right type of fertiliser for judicious use of chemical fertilisers
  - Further, integrated Nutrient management has been promoted through the implementation of Soil Health Cards scheme since 2015.
- **Kisan Suvidha App:** The development of Kisan Suvidha mobile application aims to facilitate dissemination of information to farmers covering range of issues such as weather forecast, extreme weather alert, market price of commodities, information about dealers of fertiliser, seeds, pesticide, soil testing labs, crop insurance government schemes, etc.
  - Besides, **Pusa Krishi mobile app** provides information about the latest technologies developed by the Indian Agricultural Research Institute.
- **Usage of Drones in Agriculture:** To promote the use of drones in agriculture, the Department of Agriculture and Farmers Welfare has released the SOPs for use of drones in pesticide and nutrient application
  - To make drone technology affordable and available to the farmers and other stakeholders of this sector, financial assistance of 100% cost of drone.
  - Further, contingent expenditure is provided under submission on Agricultural Mechanisation to the institutions such as ICAR, KVKs, State Agricultural Universities (SAUs), and Public sector undertakings (PSUs).
  - FPOs are provided grants of 75% for purchase of drones for its demonstration on the farmers' fields to provide agricultural services through drone application.
- **Thrust on Genetic Improvement:** The government's thrust has been on the use of new technology in agricultural research.
  - The research by ICAR focuses on genetic enhancement of crops, livestock, fish for high yield, quality and climate resilience, conservation of resources and, development of intelligent information technology enabled platform for technology transfer among farmers and stakeholders.
  - According to reports, ICAR during 2021-22 has developed and released about 309 varieties of hybrid field crops including 35 varieties with special traits and 94 varieties of horticultural crops for cultivation.

Conclusion

The government's thrust on new digital technologies innovations and investments in research and development in the agricultural sector has not only helped to boost farmers' income but also ensure that the country remains self-sufficient in most agricultural commodities.

Chapter 8: Technology and Innovation in Rural Economy

Background

- India is a land of villages and more than 69% of India's population lives in villages
- Rural areas have benefited in many ways due to the developments in science, technology and innovations both directly as well as indirectly
- Scientific inputs in agriculture are of direct importance to the rural sector and so are the expansion efforts in telecommunications and roads
- Technology can be used in the rural economy to create gainful employment, recycling wastes, create value-added products, human welfare through better housing, water, sanitation, promotion of non-conventional energy, climate change and decentralised techno economic systems.

Scope of S&T in Rural Economy

- Agricultural Information Systems can provide access to information through platforms.
- Monitoring the situation of natural resources and environmental impact through different information processing tools
- Education and Communication Technologies can play a significant role in generating new approaches to learning and knowledge management
- Networking is another key area where S&T can contribute greatly to facilitate effective communication between people and institutions
- Decision Support Systems (DSS) help in data and information sharing which provide relevant knowledge on inputs for informed decision-making

Key Efforts Undertaken by the Government

- The Government has rolled out schemes for education, financial literacy, agri-tech and skill development that cater to nearly 50 crore people living in rural regions.
- Digital literacy and connectivity have strengthened the labour market and provided a platform to educate and become financially independent.

- In April 2016, the Government of India launched **e-NAM (National Agriculture Market)** online platform for farmers that integrates agricultural markets pan-India with a theme of "one nation-one market".
- Saving and conserving rain water for creating appropriate rainwater harvesting structures has been the key objective of the Government which has been investing in mapping all of India's aquifers.
  - In this context, the **National program on Aquifer Mapping and Management (NAQUIM)** facilitates 3D mapping of the aquifers and characterising them in terms of quantity, quality and spatial and temporal distribution of water level.
- The Union Budget of 2022 has also pushed for an array of digital technologies and drones to propel growth in the farm sector.
- **Technological Advancement for Rural Areas (TARA)**: This scheme under the **Skill Enhancement Education and Development Program (SEED**) is providing long-term core support to science-based voluntary organisations and field institutions in rural to promote and nurture them as "S&T Incubators" and "Active Field Laboratories".
- The country's gram panchayats are linked to **National Optical Fibre Network (NOFN)** with the help of Public Sector Undertaking (PSU) fibres filling the connectivity gap between gram panchayats and blocks.
- **Common Service Centres (CSC):** CSCs are a part of the Digital India mission are serving as the access points for essential public utility services, social welfare programmes, healthcare, finance, education, agriculture and a variety of services to citizens
- **Digital India Land Records Modernization Programme (DILRMP):** DILRMP is a scheme aimed at leveraging existing commonalities in land records to develop an appropriate Integrated Land Information Management System (ILIMS)

Significance of S&T in Rural Economy

- Digitalisation will go a long way in reducing traditional bottlenecks such as shrinking markets and low density that have been roadblocks in building sustainable rural economies and can also create new growth opportunities.
- Technological advancements can help lower trade expenses, allowing rural areas to tap into new markets as the rural goods and services can reach more distant markets at a lesser cost and at a faster pace.
- In rural economies, advanced technology can also help to improve the entrepreneurial business environment.
  - Example: 3D printer technology has the potential to make small-scale production more cost-effective.
- The surge of start-ups attracts new players into the market to offer more technology-based solutions.

Conclusion

- Science and Technology have the potential to develop learning and innovation capacity among rural communities that increases the effectiveness of their efforts to solve problems and improve their lives.
- The technological advancements help empower rural communities as they help the rural population to take informed decisions that help in poverty eradication, ensuring food security and sustainable development in rural areas.
- In order to ensure true socio-economic development of rural households it has become essential to use science and technology to bridge the existing gaps between rural and urban areas.

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