

The COVID crisis made us realize the inadequacy of healthcare infrastructure in developing countries like India and globally. This led the health service providers to opt for digital technology for providing health services to patients especially the ones unable to visit the hospitals.

### Technological Progress and Digitalization of Healthcare

- Fear of covid infection reduced physical OPDs and gave a boost to telemedicine.
- The ministry of health and family welfare (MoHFW), NITI Aayog and Board of Governors, Medical Council of India issued the Telemedicine Practice Guidelines in 2020. This regulation democratized provision of health services in the country especially telemedicine.
- It helped bridge the urban-rural healthcare gap by providing super specialty support to cities and rural tier 2 and tier 3 regions.

### Geographical Restrictions

- Due to limited infrastructure and retention of qualified health professional in rural communities, access to timely and quality healthcare is lacking in rural areas. Rural patients have to travel more than an hour for a ten-minute appointment due to geographical restrictions wasting their time, energy and resources.

### Emergence of Digital Healthcare in India

- Interoperability is not seen in the healthcare sector.
- Constraints like security, permission, cost, platform etc. restrict the sharing of electronic health records (EHR) among doctors, hospitals, pharmacies etc. and result in decline of good quality healthcare available to all.
- The review report by the Ministry of Electronics and Information Technology (MeitY) titled “Adoption of Electronic Health Records: A Roadmap for India” highlights that country’s government hospitals and dispensaries have very little ICT infrastructure, with only some major public hospitals having computers and connectivity.
- Israel is a very good example of competent healthcare systems which has invested effectively in its healthcare system with well-connected EHR systems. It has been paperless for last 20 years.
- **National Digital Health Mission (now known as Ayushman Bharat Digital Mission – ABDM):**
  - ✓ Launched in 2020, it is an implementation of National Digital Health Blueprint.
  - ✓ It seeks to create a single repository of medical records of all citizens.
  - ✓ It has been rolled out in six union territories across the country with three key registries – Health ID, Health Professional Registry (HPR), Health Facility Registry (HFR).
- **Comprehensive EHR**
  - ✓ It can be helpful for rural patients as it could soon include data from digital devices that display information about a patient’s health problems and their lifestyle and habits.
  - ✓ These include fitness bands, blood pressure monitors and ingestible tablets to monitor medication response and adherence.
    - Genomic data can also be added to the EHR, including certain drugs that may or may not match the patient’s genome. It can help a doctor know if a specific type of drug will work for a patient without trying different treatments.
    - This can save the time and cost of treatment and shift healthcare from reactive to proactive allowing doctors to address potential problems long before they become a risk.

### Scope of Remote Healthcare in India

- Challenges faced by rural communities in healthcare:
  - ✓ Lack of healthcare expertise.
  - ✓ Access to specialized and trained medical staff.
  - ✓ Difficult to retain trained staff.
  - ✓ Connectivity.
  - ✓ Infrastructure.
- Solutions:
  - ✓ Bring specialized training to existing health professionals.
  - ✓ Ensure promising career and development opportunities for local population.
  - ✓ **Virtual Reality:** To assist healthcare professionals with training and experience through training simulations with a headset that places one in a natural healthcare environment. For example, training in an emergency department (ED) can be very stressful for patients and medical staff, where there is significant pressure of time and patients' lives are at risk.
  - ✓ **Medicine ATMs:** Used in rural areas of Africa, they ensure that patients obtain their medication in a medically safe way, without relying on inaccessible pharmacists, doctors, or other professionals.

### Rise of Remote Healthcare

- Internet of Medical Things (IoMT) is a collection of medical devices and applications that connect to healthcare IT systems through online computer networks. It closely mimics face-to-face consultation and helps the treating physician make appropriate clinical decisions down the line of treatment.
- AI and predictive analytics support many of these IoMT tools and are helpful in preventive medicine and wellness, especially in providing healthcare in neglected areas.
- Integration of tele health with other virtual health solutions and hybrid models of virtual/in-person (physical) care has resulted in the increase of tele health usage 38-fold from pre-COVID baseline and is projected to reach USD 10.6 billion in India by 2025.

### Remote Healthcare for Rural India

- Most Primary Health Centers (PHCs) and Community Health Centers (CHCs) in rural areas lack the necessary equipment and diagnostic expertise. Technology can bridge this gap.
- Innovative startups across the nation are providing healthcare services enabled with the latest and most efficient technologies.
- Atal Innovative Mission (AIM) housed in the NITI Aayog has been setup by Indian Government to promote culture of innovation and entrepreneurship in the country. It supports the establishment of new incubation centres called Atal Incubation Centres (AIC).
- Another startup *Volar Alta* is the one-stop shop for drone-based services and specializes in surveillance, asset inspections and transportation of medical essentials in rural and hard to reach locations using drones, minimizing time, and ensuring safety.

### Conclusion

With the embracement of state of the heart tele health technologies, development of enterprise-wide portfolio, commitment to data transparency, internet connectivity, AI, Machine Learning and blockchain, benefits shall reach the last rung of the ladder. This is bound to consolidate the rural economy into a sustainable model which is an absolute necessity for nations development.

The term “environment” comprises all entities, natural or manmade, external to oneself and their inter relationships which provide value now or in the future to humankind. It was introduced in the Constitution of India for the first time in the year 1976 under article 48-A to protect and improve environment and to safeguard country’s forests and wildlife.

### National Environment Policy

Formulated in 2006 by the Ministry of Environment, Forest, and Climate Change. It identifies following objectives:

1. **Conservation of Critical Environmental Resources:** For life support, livelihoods, economic growth, and human well-being.
2. **Intra-generational Equity-Livelihood Security for the Poor:** To ensure equitable access to environmental resources and quality for all sections of society and particularly the poor.
3. **Inter-generational Equity:** To ensure judicious use of environmental resources to meet the needs and aspirations of present and future generations.
4. **Integration of Environmental Concerns in Economic and Social Development:** Through policies, plans, programmes, and projects.
5. **Efficiency in Environmental Resource Use:** To minimize adverse environmental impact.
6. **Environmental Governance:** To apply good governance principles such as transparency, rationality, accountability etc. for managing and regulating use of environmental resources.
7. **Enhancement of Resources for Environmental Conservation:** To ensure higher resource flows comprising finance, technology, traditional knowledge etc. for environmental conservation through mutually beneficial partnership between local communities, public agencies, academic and research communities, investors etc.

### Existing Legislations for Protection and Conservation of Environment

- Environment Protection Act, 1986
- Water (Prevention and Control of Pollution) Act, 1974
- Water Cess Act, 1977
- Air (Prevention and Control of Pollution) Act, 1981
- Indian Forest Act, 1927
- Forest (Conservation) Act, 1980
- Wildlife (Protection) Act, 1972
- Bio-diversity Act, 2002

### LiFE (Lifestyle for Environment)

- Unveiled by Indian Prime Minister at COP 26, Glasgow.
- Aims to promote environment conscious lifestyle.
- Gave the concept of *Panchamrit* for combating climate change:
  - a) India will get its non-fossil energy capacity to 500 gigawatts (GW) by 2030.
  - b) India will meet 50% of its energy requirement from renewable energy by 2030.
  - c) India will reduce the total projected carbon emissions by one billion tonnes from now till 2030.
  - d) India will reduce its carbon intensity by less than 45% by 2030.

e) India will achieve the target of net-zero by 2070.

### Environmental Education

- It helps individuals to adopt green habits for sustainable social development and preserve a cleaner and greener environment for future generations.
- But it needs proper examination of the problem and its source with the help of scientific, educational, innovative and political interventions.
- Strategy for New India @75 by NITI Aayog, 2018 indicates the need to broaden the scope of Massive Open Online Course (MOOCs) and Open and Distance Learning (ODL) and tap their potential to provide access to quality education beyond geographical boundaries. Such MOOCs should be scaled up for environmental education with necessary adaptations in respect of the current environmental issues.
- National Education Policy of India (2020) also covers topics related to environment education.
- Science and Technology has immense potential to strike the economic and ecological balance.
- Satellite Remote Sensing Technology has helped in providing reliable information on various natural resources of a region. For example, forest fire risk areas can be predicted, and early warning of forest fires can be given.
- Off-farm technologies like “bio-briquetting” can help in preventing forest fire hazard as well as loss of biodiversity and generate large-scale energy. For example, it can be used to generate biomass energy from pine needles.

### Technological Interventions by Ministry of Environment, Forest, and Climate Change (MoEF&CC):

- **PARIVESH:**
  - ✓ Stands for *Pro-active and Responsive facilitation by Interactive, Virtuous and Environmental Single window Hub*.
  - ✓ It is a single window integrated environmental management system, developed by Ministry of Environment, Forest and Climate Change (MoEF&CC) through NIC.
  - ✓ It pursues the spirit of Digital India and captures the essence of *minimum government and maximum governance* and has an automated process starting from submitting of application to grant of clearances.
  - ✓ It has resulted in a paradigm shift in environmental clearance process with transparency, accountability, efficiency etc.
- **Decision Support System (DSS):**
  - ✓ A web GIS application developed to provide qualitative and quantitative information w.r.t. forest area and uses different spatial layers for providing forest information like state and district boundaries, tiger corridors etc.
- **Climate Change Knowledge Portal:**
  - ✓ It is a single point information resource which captures sector wise adaptation and mitigation actions being taken by various ministries in one place and provides information to citizens about government initiatives at national and international levels.
- **National Mission on Himalayan Studies:**
  - ✓ It is a Central Sector Grant-in-aid Scheme to address key issues relating to conservation and sustainable management of natural resources in Indian Himalayan region.
  - ✓ It focuses on enhancing livelihoods of local communities in line with National Environment Policy, 2006.

- **Wetlands of India Portal:**

- ✓ It is an initiative to provide a single point access system that synthesizes information dissemination regarding wetland sites of the country, projects, initiatives, and trainings.

**Initiatives by Ministry of Science and Technology:**

- **National Science, Technology, and Innovation Policy, 2020:**

- ✓ Aimed at bringing profound changes through short-term, medium-term, and long-term mission mode projects by building nurtured ecosystem, promoting sustainability and clean energy, water, air, rivers etc.

- **Programs under Innovation in Science Pursuit for Inspired Research (INSPIRE) Scheme:**

- ✓ Kishore Vaigyanik Protsahan Yojana
- ✓ National Science Olympiad Programme
- ✓ India Innovation Growth Programme
- ✓ Million Minds Augmenting National Aspirations and Knowledge Awards.

There is a need to inculcate effective education along with the use of technology for environment protection. This will facilitate people to adopt green social responsibility for environment protection.

### SMART WATER FUTURE

The recent outbreak of COVID-19 pandemic, locust outbursts and persistent issue of climate change have substantiated the fact that the world needs to collaborate and fight the global challenges together in the coming times. One such global challenge is water scarcity where,

- Some 1.1 billion people worldwide lack water access.
- Total of 2.7 billion face water scarcity for at least a month in a year.
- 2 million people mostly children die from diarrheal diseases alone each year.
- 2/3<sup>rd</sup> of the world's population may face water shortage by 2025.

**Issues**

1. **Scarcity:** Incessant urbanization, increasing population and inconsistent climatic trends have resulted in scarcity. Water tables are falling constantly due to population pressure with its quality is diminishing rapidly.
2. **Wastewater Management:** India generates 140 billion cu m (BCM) of wastewater annually and its mismanagement contaminates groundwater leading to various diseases. Lack of liquid waste management, poor sanitation conditions and poor hygiene habits have further contributed to a major portion of the population suffering from water-borne diseases.
3. **Hampered Economic Growth:** As per the UN report on water and jobs, it has been estimated that half of world's workforce i.e., about 1.5 billion people are dependent and employed in one of the eight water and natural resources dependent countries. If India doesn't take the water scarcity problem seriously, it will lose 6% of GDP due to water related disasters by 2030.

**Solutions:**

1. The situation of Global crisis needs to be resolved with local know how and available resources while leveraging technological solutions.
2. Environmental technologies combined with an intelligent, systematic approach to water management can help ensure a sustainable water supply.

3. Use of technology and innovations in scarcity and safety, efficiency, utility operations, monitoring, treatment, and data analytics related to water sector.

### Smart Water Future

- It means management and distribution of water whilst maintaining its quality.
- It focuses on two key points for sustainable supply of water in smart format-
  - a) **Reduction in Non-Revenue Water:**
    - ✓ According to International Water Association (IWA), non-revenue water means all physical and commercial losses due to theft, pipe burst, reservoir overflows, unmetered and ill-metered water bill along with unbilled authorized consumption.
    - ✓ It results in huge distribution losses to Indian utilities.
    - ✓ 40-70% of distributed water is lost on account of leakages, unauthorized connections, billing, and collection inefficiencies.
    - ✓ Four basic leakage management activities undertaken by water utilities to resolve distribution losses-
      - Pressure management
      - Active leakage control by Realtime monitoring of water supply infrastructure using GIS tools, installing smart devices and telemetry.
      - Speed and quality of repairs and pipe asset management
      - Maintenance and renewal.
  - b) **Encouraging Wastewater Recycling and Reuse:**
    - ✓ India generates approximately 61,948 MLD of sewage against the treatment capacity of 23,277 MLD i.e., generating only 37% of wastewater.
    - ✓ Thus, there is a need for reusing, recycling, and treating wastewater in the system. Several technologies can be used for this purpose depending on the purpose of recycled water.
    - ✓ Advanced Green Techniques (AGTs) are being used these days. They are environment friendly, relatively inexpensive, and efficient. Example- Bioreactor.
- **Other Smart Solutions**
  - a) **Implementation of Internet of Things (IoT):** It requires data of water to be transmitted over a longer distance, wirelessly and uninterrupted to a central dashboard to analyze and monitor the water system.
  - b) **Sensors, Remote Sensing, Geographic Information Systems (GIS) Technologies and Visualization Tools:** Used for managing water resources at the service area, watershed, and regional scales.
  - c) **Remote Sensing/Imaging Technologies:** To provide data for mapping water resources, measuring water fluxes and utility asset management. It can be used for incidences of heavy storm water flow, conservation practices etc.
  - d) **New and Existing Sensors:** To provide near real-time data on water quality, flows, pressures, and water levels among other parameters. They can be used to aid daily operations by optimizing resource use, detecting, diagnosing events like pipe bursts, water discoloration events, sewer collapses/blockages etc.
  - e) **Smart Meters:** To provide a clear picture of water consumption and convey data to both consumer and utility, allowing for improved water management.
  - f) **Artificial Intelligence:** For strategic and cost-effective operation of utilities, including better planning and execution of projects, better tracking and understanding of resource loss in real-time, more efficient collection and distribution networks etc.

- g) **Augmented Reality and Virtual Reality (AR and VR):** Support decision-making in the field by providing holographic representation of pipes, cables, and other assets.
- h) **Blockchain Applications:** Have the potential for direct, secure transactions between resource providers and consumers, peers, utility, and other players in water sector.
- i) **Satellite/Drones/GIS/AI:** Used for reservoir operation, flood forecasting and inundation mapping. It can help mitigate floods and save thousands of lives.

#### Good Practices:

- India is already way ahead in adopting water sector related technologies.
- World Bank-funded Karnataka Urban Water Sector Improvement Project (KUWASIP) has reduced NRW from 50% to 7% and increased the hours of supply from 2h every few days to 24 h water supply.
- Central water commission in collaboration with Google will provide inundation alerts based on Flood Forecast available in Common Alerting Protocol (CAP) platform using high quality digital Terrain Models available with Google using Artificial Intelligence and Machine Learning.
- Odisha is the first state in the country to implement an Early Warning Dissemination System (EWDS) to address the existing gap of disseminating warning from State, District and Block Levels to communities.

Technology is just a way to mitigate the losses from disasters. If we want to fight back against the challenges of water scarcity and looming water disasters, we must change the habit of taking nature for granted and work as a single unit to make our planet green and blue again.

### **TECHNOLOGY- EMPOWERING THE MASSES**

Technological interventions don't only boost productivity, provide better service levels and efficiency but also help ensure that the benefits reach the bottom of the pyramid, ensuring ease of living and access to various government schemes. The rapid adoption of digital technology in the last few years has laid the framework for making delivery of government schemes easier and more efficient. For example:

#### India Stack and Aadhaar

- Development of India Stack- a unified software platform brought India's 1.4 billion population into the digital age. It is centered around Aadhaar which has enabled ease of living through seamless delivery of subsidies, benefits, and other services under various state welfare schemes.
- It aimed to unlock the economic primitives of identity, data, and payments at population scale and helped promote financial and social inclusion.

#### Direct Benefit Transfer (DBT)

- This programme has substantially reduced leakages and associated delays owing to the flow of fund in a multi hierarchy of administrative offices till it reaches the end beneficiary.
- It has become the accepted way of delivering with over 450 schemes like PM-KISAN, Public Distribution Systems (PDS), Mahatma Gandhi National Employment Guarantee Scheme (MGNREGS) etc.

#### Digital Platforms for E-Governance

- The National Informatics Centre (NIC) under Ministry of Information Technology endeavors to cater to ICT needs at all levels of governance including central, state, districts, judiciary, and legislative layer.
- NIC successfully manages programmes like Swachh Bharat Mission, My-Gov, e-Hospital, e-Courts etc.

### Unified Payments Interface

- Developed by National Payments Corporation of India (NPCI).
- It was rolled out in 2017 and today accounts for 16% of total retail payments with more than 30 million UPI QR codes registered by merchants.
- It has helped India morph from a country largely dependent on cash for everyday transactions to a significantly less cash economy and has allowed users to safely transfer money on a real-time basis and across multiple bank accounts without revealing bank account details to other parties.
- Other digital payment options such as Bharat Bill Payment System (BBPS), BHIM Aadhaar, Aadhaar Enabled Payment System (AEPS) and \*99# service all developed within India are propelling rapid adoption of digital payments.

### Smart Cities Mission (SCM)

- Launched in 2015, SCM identified 100 cities across the country for higher economic growth and better quality of life. Whether it is solid waste management, lower air and water pollution levels, better space utilization, beautification of cities etc. application of smart solutions enables these cities to use technology to improve infrastructure and services.
- Like Integrated Command and Control Centre (ICCC), it is the nerve center in each smart city that monitors all activities from a technology enabled and responsive central location. During COVID pandemic, these were converted into COVID-19 war rooms and were used for monitoring of hospital beds especially oxygen, ventilator and ICU bed availability, continuous follow-up of cases was made possible through solutions deployed in these ICCCs.

### **NON-CONVENTIONAL ENERGY SOURCES**

With erratic monsoons and frequent droughts, global warming is no longer a threat but a reality. Conventional energy sources like burning of fossil fuels including coal is its largest contributor. This global climate change phenomenon led to the formation of United Nations Framework Convention on Climate Change (UNFCCC); an international environmental treaty signed in 1992 to combat the excessive greenhouse emissions. *Kyoto Protocol* and Paris agreement are also steps in this direction. But, despite all these efforts, carbon dioxide emissions are alarming and calls for a shift towards non-conventional sources of energy. India is also gradually transitioning from conventional to non-conventional sources essential for its sustainable and holistic development like-

#### **a) Solar Energy**

- India's need for solar energy has resulted in Production Linked Incentive (PLI) Scheme for manufacturing of solar Photo-Voltaic (PV) modules with an outlay of Rs. 24,000 crores. This scheme supports setting up of integrated manufacturing units of high efficiency solar PV modules.
- India recently achieved 5<sup>th</sup> rank globally in solar power deployment surpassing Italy.

#### **b) Wind Energy**

- India has the fourth highest wind installed capacity in the world with 39.25 GW.
- As per government assessment, India's gross wind power potential is 302 GW at 100 m and 695.50 GW at 120 m above ground level.

#### **c) Tidal Energy**

- It is yet to take up a full-fledged form. Its relatively high cost and limited site availability with sufficiently high tidal ranges or flow velocities poses constraints on its total availability.

#### **d) Geothermal Energy**

- It is generated from heat derived from sub-surface of earth.
- Gradual decline of radio-active particles in earth's core generates geo-thermal energy.

**e) Hydropower**

- One of the oldest and largest renewable energy sources.

**f) Biomass Energy**

- According to Ministry of New and Renewable Energy (MNRE), in India, 32% of primary energy use is still derived from biomass and 70% of population depends on bio-mass fuel to cater to their daily needs.

**g) Fuel Cell**

- Its end-product is water, making it a clean and sustainable energy source.

**Significance of Non-conventional Energy Sources**

- Ensures attainment of 3 E's- *Energy Security, Economic Development and Environmental Sustainability*.
- Reduces air pollution.
- Better public health outcomes.
- Brings down the cost of energy supply and fetch economic gains.
- Enhanced delivery of affordable clean energy accessible to all.
- Aids Indian economy to delink itself from volatile international oil prices.
- Ease out subsidy burden of government spent on conventional energy sources like kerosene.
- More employment and entrepreneurship opportunities.
- Increased exports of wind electric generators, bio-mass gasifiers, solar energy systems etc.
- Support other developing nations by making best use of non-conventional energy sources.

**Governmental Interventions to Foster Renewable Energy Sources**

- Total of 152.90 GW renewable energy capacity projects have been installed by the government out of which- 50.78 GW is solar power, 40.13 GW wind power, 10.63 GW bio-power, 4.84 GW small hydro power and 46.52 GW large hydro power.
- India is committed to achieving 500 GW of non-fossil fuel-based energy capacity by 2030.
- Government efforts are aligned with making substantial progress in achieving Sustainable Development Goal 7 which calls for “affordable, reliable, sustainable and modern energy for all” by 2030.
- Recent governmental interventions:
  - ✓ **Permitting FDI:** Up to 100% foreign direct investment (FDI) is permitted under automatic route for renewable energy projects including offshore wind energy projects.
  - ✓ **Setting-up Ultra-Mega Renewable Energy:** To provide land and transmission to energy developers on plug and play basis.
  - ✓ **Waiving of Inter-State Transmission System (ISTS) Charges:** For inter-state sale of solar and wind power for projects commissioned by 30<sup>th</sup> June 2025.
  - ✓ **Laying new transmission lines:** For evacuation of renewable power under Green Energy corridor scheme.
  - ✓ **PM-KUSUM:** Pradhan Mantri Urja Suraksha Evam Utthaan Mahabhiyan aims for de-dieselization of farm sector along with providing energy security and increased income to farmers. It has three components:
    - Creation of 10,000 MW of Decentralized Ground mounted grid connected solar power plants.
    - Solarization of 15 lakh grid connected agriculture pumps.

- Installation of 20 lakh agriculture pumps powered by solar energy.
- ✓ **Rooftop Solar Phase-II:** 4000 MW rooftop solar (RTS) capacity addition is targeted through Central Financial Assistance (CFA) in residential sector including for households in rural areas.
- ✓ **National Hydrogen Mission:** Aims at making India, a green hydrogen hub aiding it to fulfill its target of production of five million tonnes of green hydrogen by 2030 along with allied development of renewable energy capacity. India's first hydrogen fuel cell bus was launched in August 2022.
- ✓ **National Offshore Wind Energy Policy:** Notified by Government of India in 2015 for development of offshore wind power in country. There are also Offshore Wind Power Assessment Studies and Survey guidelines to enable private sectors to carry out offshore wind resource assessment.
- ✓ **National Wind Solar Hybrid Policy:** Adopted in 2018 by MNRE. It aims at providing framework for promotion of large grid connected wind-solar PV hybrid projects for efficient and optimal use of transmission infrastructure.
- ✓ **Other Schemes:**
  - Promotion of Biomass-based cogeneration in sugar mills and other industries.
  - Programme on Energy from Urban, Industrial and Agricultural Wastes/ Residues
  - Biogas Power (Off-grid) generation and Thermal application programme (BPGTP)
  - "Panchamrit" announced at COP 26, Glasgow which lays emphasis on non-conventional energy sources.

### Challenges in Transition to Non-Conventional Energy Sources:

- **Enabling Infrastructure and Conducive Ecosystem:** Required for facilitating a smooth transition to renewable energy.
- **Expanding Power Infrastructure:** To permit increased use of diverse energy sources and ensuring system flexibility.
- **Need for Massive Investment:** Ensuring viable financing mechanism to raise long term funds at low interest rates is a formidable challenge. Green finance is marred by issues like long gestation gaps, increased capital costs, potential risk factors associated etc.
- **Disproportionate Investment:** in renewable sector. For example, despite its growth potential, wind energy sector attracts relatively fewer international investments as compared to solar energy sector.
- **Low Credit Worthiness:** It should be ensured that investments in conventional energy sources do not crowd out renewable energy investments.
- **Poor Financial Strength:** Some distribution companies are unable to make timely payments to renewable energy developers. This affects the viability of renewable energy sector and slows down its development.
- **Job and Revenue Loss:** As a result of switching from fossil fuels. To address this issue, strategic planning is required for raising necessary finance and upskilling of human resources.

### Way Forward

Facilitation of transition to non-conventional energy sources will ensure energy security and disaster resilience, generate employment, and improve health outcomes. Incentivizing non-renewable energy sources via fiscal tools and incentives can further provide a push to this transition. As it is a crucial enabler for sustainable development and climate resilience paving its way towards creation of a more equitable, inclusive, and sustainable society.

Globally, governments and organizations are focusing on promoting gender equality and women empowerment to untap the potential of women as the precious human capital. The first steps date back to the UN Conference on Women in Mexico to mark 1975 as International Women's Year followed by 4<sup>th</sup> U.N. World Conference on women held at Beijing in 1995. It 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 (1995-2000's)

- First Science and Technology Policy in India (Scientific Policy Resolution, 1958) acknowledged women's role in science and technology.
- Decision making bodies within science and technology sphere lacked any women leaders or administrators as they were subjected to gender biases and had restricted career advancement opportunities.
- First focused move on women empowerment in this field was when Dr. M S Swaminathan initiated a chapter on "Science and Technology for Women" in the Sixth Five Year Plan (1980-85) prepared by Dr. Manju Sharma, the first woman president of National Academy of Sciences, India (NASI).

### Winds of Change – The 21<sup>st</sup> Century for Women in S&T

- The year 2001 was declared as the year of empowerment of women by then Prime Minister Mr. Atal Bihari Vajpayee.
- In the new millennium, the Indian Science and Technology leadership focused on women enabling policies and initiated implementation of programmes to increase participation of women in STEM (Science, Technology, Engineering and Mathematics) disciplines.
- The Science and Technology Policy 2003 emphasized on promoting women empowerment in all science and technology activities and ensured their full and equal participation. It identified following goals:
  - ✓ Capacity building
  - ✓ Promoting gender neutral workspaces
  - ✓ Providing access to women in science and technology
  - ✓ Increasing number of girls in science and providing ways to overcome challenges of issues like "leaky pipeline" at tertiary and mid-career level.

### Government Initiatives

- **National Task Force for Women in Science**
  - ✓ Identified issues like-
    - Less female students in science than the ideal fraction of 50%.
    - Least number of women in engineering discipline.
    - Recruitment policies and family responsibilities leading to *leaky pipeline* with women drastically decreasing from post-doctoral level to regular faculty/scientist positions.
  - ✓ Took initiatives like:
    - Book on achievements of prominent women scientists proposed to be brought out by Dr. C S Lakshmi (SPARROW, Mumbai).
    - National conference showcasing women achievements organized on women's day in 2008.
  - ✓ Recommended:

- Recruitment of deserving women scientist's institutions, selection or hiring committees to include women scientists.
  - Committee members to avoid asking questions with inherent gender bias and age relaxation for exceptional female scientists.
  - Training, mentorship programs and schemes for career advancement and re-entry.
  - Summer or winter science camps to promote scientific temper among school girls.
  - Women friendly workplaces with availability of creches, campus housing and safeguarding policies against sexual harassment at work were proposed.
  - New policies like focus on maternity leave, setup of gender units in state S&T councils, establishing women's universities in areas with low number of women in science etc.
- **KIRAN (Knowledge Involvement in Research Advancement through Nurturing)**

It is a division reconceptualised at DST in 2014 to cover all women's exclusive schemes to bring gender parity in S&T and provide a framework for gender mainstreaming.
  - **Women Scientist Scheme (WOS):**
    - ✓ It provides opportunities to women researchers who have taken a break in career due to family responsibilities, relocation etc. for pursuing research in basic or applied sciences in frontier areas of science and technology.
  - **CURIE Programme (2008-09):**
    - ✓ "Consolidation of University Research for Innovation and Excellence in Women Universities", this programme supported 9 women's universities across India for enhancing their R&D infrastructure.
  - **Mobility Scheme**
    - ✓ Offers contractual research award towards conducting independent research in any location and enables 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 for career development of employed/unemployed women researchers of up to 45 years of age by providing extramural research grant support.

#### Role of National Science Academies

- The Indian Academy of Sciences(IASc) formed a panel for women in science in 2005 and came out with a collection of life journeys of Indian women scientists.
- NASI under its mandate of science and society launched a pan India programme on technological empowerment of women during the year 2012-13 that included a series of workshops themed on issues related to urban and rural women such as health, nutrition , agriculture , animal husbandry etc.
- The 3 science academies together established a committee that reports to the President and council on the status of women empowerment in science as well as the role of women scientists in bringing technology to the rural women to uplift them from drudgery.
- They have generated awareness on scientific careers for women and young girls, created mentoring opportunities via workshops and generated nationwide survey data on the status of women in science.

### Application of S&T for Women's Welfare

- "S&T for Women" is a special scheme ruled out by DST in 1981-82 to primarily engage women scientists to foster research and development of technology with a potential to improve the quality of life of rural women.
- Some of the key themes and areas of interventions include- R&D in post-harvest technology such as thrashing, winnowing and milling; developing or improvising tools and equipment used by rural women for easy use and training women on the use of new innovative methods and tools.
- Women Technology Parks are another innovative concept that highlight women empowerment via S&T as they represent a link between rural women workforce and scientists and researchers.
- Vigyan Jyoti, a programme introduced by DST in 2019-20 aims to provide exposure to meritorious young girls in Tier 2 cities and remote and rural areas to pursue a career in STEM.

### Recent Developments

- DST launched GATI (Gender Advancement for Transforming Institutions) to push higher education institutions, research institutes, and universities towards supporting diversity, equity, and inclusion with a belief that attracting diversity in talent will ultimately allow institutions to flourish to their best.

With the ongoing efforts, the coming years shall hopefully see S&T workspaces where women representation is normalised in all roles starting from entry to reaching higher echelons of leadership and policy making.

## SCIENCE AND TECHNOLOGY IN AGRICULTURE

The agriculture and allied sector plays a critical role in rural livelihood, employment and national food security. According to the Economic Survey (2021-22), the agriculture sector has experienced buoyant growth in the past 2 years. It stated that the growth in allied sectors including livestock, dairying, and fisheries has been the major drivers of overall growth in the sector.

### Digital Technologies

- The government has finalised the core concept of India Digital Ecosystem of Agriculture (IDEA) framework which would lay down the architecture for the federated farmers database and would serve as a foundation to build innovative Agri-focused solutions.
- Under the National e-Governance Plan in Agriculture (NeGP-A), funds are released to States and union territories for projects involving use of modern technologies such as artificial intelligence, machine learning, robotics, data analytics etc.
- The sub-mission on Agricultural Mechanization being implemented since April 2014 aims at "reaching the unreached" by bringing to the small and marginal farmers in the core and giving the benefits of farm mechanization by promoting custom hiring centres (CHCs), creating hubs for hi-tech and high value farm-equipment's, distribution of various agricultural equipment etc.

### e-NAM: Online Marketplace

- It is a pan India electronic trading portal which networks the existing Agricultural Produce Market Committee (APMC) mandis to create a unified national market for agricultural commodities.
- Under the scheme, 3 reforms are mandatory for states or union territories in their respective APMC acts for integrating their mandis with e-NAM platform:
  - ✓ Provision for e-trading
  - ✓ Single point levy of market fee

✓ Unified single trading license for the state

- 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

- It's 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 based on their Aadhar card and also check the history of credits to the bank account.
- A database is being created by the Agriculture Ministry for quick identification of eligible farmers for PM KISAN and other schemes and farmers welfare schemes to be launched in the future.

#### AGMARKNET Portal

- Integrated scheme for agricultural marketing schemes (AGMARKNET) which promotes creation of agricultural marketing infrastructure by providing back end subsidy support to state, cooperative and private sector investments.

#### National Mission on Horticulture

- It promotes holistic development of horticulture sector including bamboo and coconut.
- HORTNET project is a web-enabled workflow based system for providing financial assistance under the mission for integrated development of horticulture.

#### Agriculture Infrastructure Fund (AIF)

- Financial assistance is provided digitally in the form of interest subvention and credit guarantee for setting up post-harvest management infrastructure to beneficiaries such as farmers, primary agricultural credit societies, farmers producers organisations, self-help groups (SHGs). It allows convergence with other schemes so that benefits from other Centre or State Government schemes can also be availed along with AIF.

#### 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 such as manure, biofertilizers, green manuring etc.
- It uses 4R approach- Right quantity, Right time, Right mode and Right type of fertiliser for judicious and reduced use of chemical fertilizers.
- Integrated Nutrient Management has been promoted through implementation of Soil Health Cards scheme since 2015 which provides nutrient status of soil along with prescription about balanced and integrated use of inorganic and organic fertilisers.

#### Kisan Suvidha App

Facilitates dissemination of information to farmers covering range of issues like weather forecasting, extreme weather alerts, market price of commodities, information about dealers of fertilizers seeds pesticides etc.

#### Use of Drones in Agriculture

- Department of Agriculture and Farmers Welfare has released standard operating procedures for the use of drones in pesticide and nutrient application.
- In order to make drone technology affordable and available to the farmers and other stakeholders, financial assistance of 100% cost of drone (up to ₹10 lacs per drone) together with a contingent expenditure is provided

under sub-mission to the institutions of Indian Council of Agricultural Research (ICAR), Krishi Vigyan Kendra (KVK), state agricultural universities, state and central government agricultural institutions etc.

### Thrust on Genetic Improvement

- The Indian Council of Agricultural Research (ICAR) during 2021-22 developed and released 309 varieties or hybrids of field crops including 35 varieties which special traits and 94 varieties of horticultural crops for cultivation.
- High yielding, cost saving, disease, pest-resistant and climate-resilient varieties and technologies in crops, horticulture, animal and fisheries science developed by ICAR have played an important role in increasing production, reducing production cost and enhancing farmer income.

### Collaborative Institutional Thrust on Research

- Emphasis is given by ICAR to shift research from a commodity-based to farming systems based approach.

### ICAR's Roadmap for Food and Nutritional Security

- A clear road map has been developed for next 10 years harnessing the power of science and innovation for securing food and nutritional security of our people, farmers prosperity and to enhance the natural resource base to promote inclusive growth and sustainable development of Indian agriculture sector.

Government's thrust has been to help farmers accessing latest farm technologies as well as new varieties of seeds to ensure that farmer's income get a boost and sustain in coming years besides making India self-reliant in agricultural production.

## **TECHNOLOGY AND INNOVATION IN RURAL ECONOMY**

Science and technology can develop in rural communities, a learning and innovations capacity that increases the effectiveness of their efforts to solve problems like employment, recycling waste, better housing, drinking water, sanitation etc and improve their lives. Technological advancements can help rural people make better decisions to achieve the objectives of poverty eradication, food security and sustainable development.

### Five Key Services Related to Science and Technology:

1. **Access to information**
2. **Monitoring the situation of natural resources and environmental impact**
3. **Education and communication technologies**
4. **Networking**
5. **Decision Support Systems**

### Government Initiatives

- Schemes like e-NAM(National Agriculture Market) helps farmers and traders to view all Agriculture Produce Market Committee (APMC) related information at one place.
- For conserving rainwater, the Government of India is investing in mapping all of India's aquifers through National Programme on Aquifer Mapping and Management (NAQUIM) which aims at 3D mapping of aquifers and characterizing them in terms of quantity, quality, spatial and temporal distribution of water level and resources.
- The union budget of 2022 also pushed for an array of digital technologies and drones to propel growth in the farm sector.

## Digitalization

- Digitalization can be a solution in reducing traditional bottlenecks like shrinking markets and low density that have been road blocks in building long term and sustainable rural economies.
- Technological advancement can lower trade expenses allowing rural areas to tap into new markets.
- Cross-border ecommerce or commerce through digital platforms has proven critical in lowering entry barriers for enterprises and SMEs looking to sell in worldwide markets.
- Modern Information and Communication Technology (ICT) has acted as a catalyst in establishing a platform that extends financial goods and services to remote and marginalised regions and individuals and has helped banks reduce their cost, increase customer reachability and efficient management of risk in businesses.
- Various schemes for technology enabled rural developments include:
  - ✓ **Technological Advancement for Rural Areas (TARA):** Provides long term course support to science based voluntary organisations and field institutions in rural and other disadvantaged areas to promote and nurture them as “S&T incubators” and “Active Field Laboratories”.
  - ✓ **e-Shram:** Designed by Ministry of Labour and employment to benefit unorganised workers who are not members of Employees Provident Fund Organization (EPFO) or Employees State Insurance (ESIC).
  - ✓ **Common Service Centers (CSCs):** Serves as the access point for essential public utility services, social welfare programmes, healthcare, finance, education, agriculture services and a variety of business to consumer (B2C) services to citizens living in rural and distant areas of the country.
  - ✓ **Digital India Land Records Modernization Programme (DILRMP):** Aimed at leveraging existing commonalities in land records to develop an appropriate integrated land information management system.
- Online classes during the pandemic were a major catalyst for digital adoption amongst rural population because they forced many new users to explore advanced functionalities.
- Several global tech giants see this space as a new growth opportunity and are investing in innovative solutions for crop health monitoring and yield estimation.
- Innovation in digital payment has enabled faster and easier access to cash particularly in rural areas that have been cash strapped due to lower penetration of ATMs and banking products.
- Small finance banks and non-banking financial companies (NBFCs) are adopting technology to expand their reach and offer credit solutions in rural areas.

## Challenges

- Lack of access to low cost funds results in poor credit history of small farmers, making them incapable of developing business plans. The Agriculture Infrastructure Fund (AIF) launched by the government in August 2020 aims to aid farmer groups and private players to invest in post-harvest management infrastructure and community farming assets.
- Access to reliable real time data has become imperative for credit risk evaluation, weather forecasting, crop management and enabling price transparency for the farmers.
- There is a need to invest in weather stations for ensuring accurate weather forecasting. For this, the Indian government has recruited private companies like Skymet weather and IBM weather companies.
- Building farmer trust is another challenge. For this, an effective collaboration among progressive farmer groups, government extension agencies, traditional large and trusted players is required so that they can readily adopt new and innovative practices.

To sum up, utility of science and technology will be paramount in achieving the aim of rural development as it is the most important and effective tool for ensuring poverty alleviation, food security, life skills and educating the masses but this should also be seen that it is being used in a sustainable manner and only to the extent that it does not interfere with the nature and ecosystem.