November 2022

Kurukshetra

A JOURNAL ON RURAL DEVELOPMENT

Science and Technology

Editorial

The government has been making efforts to transform the country and empowering people with greater involvement of science and technology. Science, technology and innovations are the constant ways to ensure development and growth in different key areas which are touching the human lives.

The November issue of Kurukshetra is focusing on 'Science and Technology'. The lead article 'Technology and Innovation in Healthcare' talks about the tele-consultation, e-pharmacy, and remote monitoring that have benefited the lives of all stakeholders. Another article 'Smart Water Future' states that since water is an essential but scarce resource, consuming each and every drop of water is necessary in order to ensure the sustainable supply of water in a smart format, we need to focus on two key points - reduction in non-revenue water and wastewater recycling and reuse.

The government's thrust on new digital technologies, innovations and farm mechanization and development in the agricultural sector, has helped not only boost farmers' income but also ensure that the country remains self-sufficient in most of the agricultural commodities. 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. Government has taken various initiatives to give a push to digital agriculture in the country.

No doubt that technology has a pivotal role to play in empowering the people across the country. The article 'Technology Empowering the Masses' mentions that for a developing country like India, the role that science and technology can play in bettering the lives of its citizens. Whether it is agriculture, financial inclusion, education, roads and transport, healthcare or housing, technological interventions can 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, enhancing ease of living and access to various government schemes.

Energy assumes a pivotal position to facilitate the dream of a sustainably developed India. The authors of the article 'Non-conventional Energy Sources' writes that facilitation of balances to non-conventional energy sources holds the key for India's developmental digitations. A revolutionary shift to non-conventional energy sources can bring about transformational opportunities for inclusive economic development. Transition to non-conventional sources of energy is a crucial enabler for sustainable development and climate resilience leading the way towards creation of a more equitable, inclusive and sustainable society.

With this issue of Kurukshetra, we hope that our readers would be able to get valuable information in the field of science and technology especially in the rural context. Happy reading!

Technology and Innovation in Healthcare

Neeraj Sinha
Sanjay Agrawal
Nidhi Sinha

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 is a problem in the country, especially in the hinterland. However, government-led interventions are taking place within rural communities. It is critical that existing and new resources be deployed strategically recognizing the need to improve both the quality of primary-level care and the health of the rural populace. Adopting an integrated approach for addressing both the public health needs and investing in robust information and communications technology infrastructure is the way forward.

The world global pandemic hit the whole world in 2020, and the necessity for robust healthcare management intensified with the COVID crisis. The world could not have imagined a health crisis of such scale or magnitude. We realized the inadequacy of healthcare infrastructure in developing countries like India and globally. Shocking statistics and snapshots were published on patients' travel to the city from hospitals and other healthcare facilities during the COVID infection. This has driven providers to embrace digital technologies to stay in business and continue to provide health services to patients, especially those suffering or are then

Fearing the treatment.

Technological Progress and Digitalization of Healthcare

Care is slowly moving away from healthcare facilities, focusing primarily on patient [illegible] factors, and technology is driving this transformation. Fear of the COVID infection reduces physical OPDs. But this challenge gave virtual counseling enough momentum as a multi-million post. Tele consultation has exploded during the COVID pandemic, as there is a noticeable acceptance among doctors, patients, insurers and others in the wellness ecosystem.

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, enabling medical practitioners to provide healthcare using telemedicine. The regulation democratised the provision of health services, especially telemedicine, in the country.

It has also helped bridge the urban-rural healthcare gap by providing super speciality support to tier-I and tier-2 and tier-3 healthcare. Technology has made life easier for people living in rural and remote areas. The Indian healthcare system has witnessed a paradigm shift in ensuring quality healthcare delivery to citizens in the last decade. Increasingly, the technology has been leveraged for better health and patient care. The application of digital technologies including artificial intelligence (AI), machine learning (ML), data analytics, Internet of Things (IoT), cloud computing, and robotics is increasing in each field of the healthcare system. Although rural communities often have access to local health facilities, many other factors contribute to how they can access healthcare. Some factors include the cost of insurance and specialty services, reliable transportation for essential services, the time needed to attend appointments, and confidence in the quality of services. An integrated approach to healthcare that includes technology adoption is the ideal goal for rural communities.

Geographical Restrictions

India is one of the largest democracies in the world, with around 65 percent of its population residing in rural areas. Yet, access to timely and quality healthcare is lacking. In fact, it is a crisis that no other sector is facing at the moment. Healthcare services in the country lean heavily towards urban areas even though the urban population makes up only about 35 percent of the total populace. Due to limited infrastructure and the retention of qualified health professionals in rural communities, patients often travel long distances to receive specialised treatment in cities. It is common for patients in rural communities to travel more than an hour for a 10-minute appointment, a colossal waste of time, energy and resources for the individuals.

Emergence of Digital Healthcare in India

Interoperability is the ability of systems to be able to communicate with each other and make use of the information obtained through each other without any restrictions. It is common in sectors like banking and finance and is independent of an individual's location. But, such is not the case within the healthcare sector. The Electronic Health Records (EHR) of people are not easily available or communicated within doctors, hospitals, pharmacies, etc. due to constraints like security, permission, cost, and platform to name a few. This results in the decline of good quality healthcare available to all.

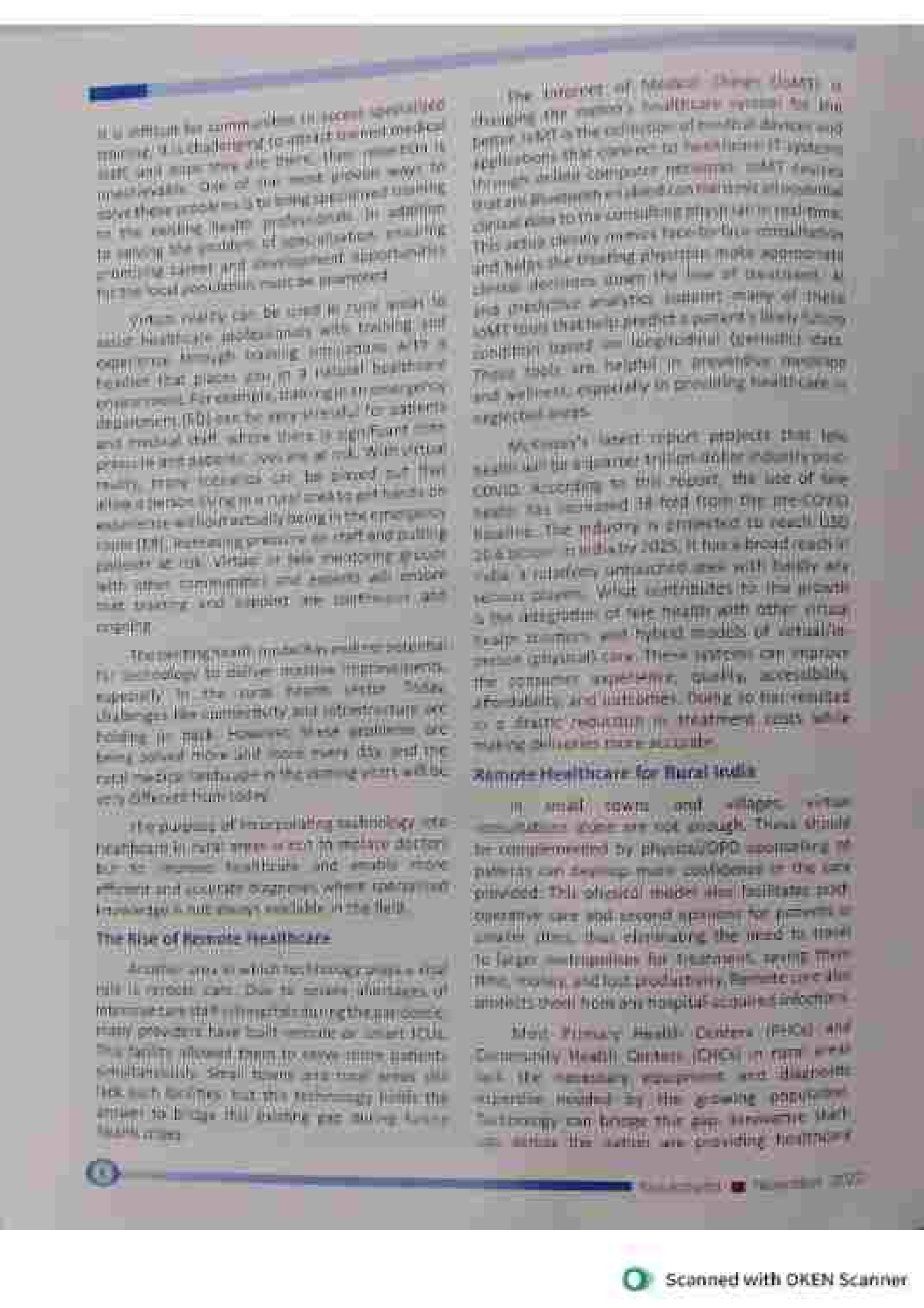
Phones and other modes of communication are insufficient in providing doctors enough information to completely analyse their patients' condition so that the best treatment or advice could be provided to them. Also, the amount of healthcare-related data generated nowadays is humongous (big data). It is thus quite impossible to keep a track of every patient's medical record at all times. In India, a lack of awareness and healthcare digitalisation also adds on to the existing problem. All these ultimately raise the same question of ensuring platform of interoperability in the Indian healthcare system.

The Ministry of Health & Family Welfare (MoHFW) notified the EHR standards for India in September 2013. Revised EHR standards for India were notified in December 2016. The review report by the Ministry of Electronics and Information Technology (MeitY) titled 'Adoption of Electronic Health Records: A Roadmap for India,' highlighted that the country's government hospitals and dispensaries have very little ICT infrastructure, with only some major public hospitals having computers and connectivity.

To talk about competent healthcare networks, a very worthy example is of Israel. A country that has invested effectively in its healthcare system which has been paperless for the last 20 years. Although the EHR systems of different hospitals are not the same, they are still very well connected.

In India, in the light of the COVID pandemic, the National Digital Health Mission (now known as Ayushman Bharat Digital Mission – ABDM) was launched in 2020, which is the implementation of the

Online Registration System (ORS) is a Digital India initiative aims to provide online access to hospital services for patient, integrated with Ayushman Bharat Health Account.



The Rise of Remote Healthcare

Remote Healthcare for Rural India

services enabled with the latest and most efficient technologies. Many of these start-ups and companies are being supported by the government itself. The Atal Innovation Mission (AIM), housed in the NITI Aayog, has been set up by the Government of India to promote a culture of innovation and entrepreneurship in the country. Under one of its many initiatives, AIM supports the establishment of new incubation centres called Atal Incubation Centres (AICs). AIC LMCP Foundation, Gujarat is one such AIC that has incubated a start-up named Ryaan Analytics Solutions. Ryaan is working on high-tech healthcare AI solutions at scale. It has the vision to bridge the gap between patients and timely medical intervention and to extend diagnostic decision support to healthcare professionals in order to serve patients with efficacy, accuracy, and insights, with innovative technology (TRAP: Treatment Response Assessment and Prediction) in pulmonology and critical care solutions for cancer and pulmonary conditions including COVID-19.

Focusing on the rural parts of the country, Jiffyrx Digital Healthcare has introduced JiffyHealth. The start-up is incubated at AIC Pinnacle Entrepreneurship Forum, Maharashtra, and is aspiring to evolve a robust and scalable healthcare platform, whereby all stakeholders such as patients, doctors, diagnostics, and pharmacies can align to have a seamless yet highly secured flow of health data, so as healthcare delivery can be far more accessible and affordable. They are working towards making healthcare accessible to the bottom of the semi-urban and rural Indian population, endeavouring to contribute to building social capital through quality healthcare delivery. Another such start-up is Valor Alta, incubated at AIC RNTU (AIC Rabindranath Tagore University), Madhya Pradesh. Valor Alta is the one stop shop for drone-based services. They specialise in surveillance, asset inspections, and transportation of medical essentials to rural and hard-to-reach locations using drones, minimising the time, and ensuring safety. Their drones are capable of carrying out internal and external inspections to generate meaningful, actionable insights.

Conclusion

The scope for the digitisation of rural healthcare in the future is massive as we have only just scratched the surface. Once internet connectivity improves, the rural-urban divide can be bridged more effectively. Additionally, our healthcare system need viable platforms that enable doctors and unlicensed medical staff to translate their services telemedically, virtually, and accurately to improve quality of life. We should gradually move from the current provider-centric volume-based model to a patient-centric value-based model. Once a secure Health Information Exchange (HIE) is set up, technological optimisation will be the next logical step to revolutionise healthcare delivery services. Leveraging technologies such as AI, Machine Learning, and Blockchain to advance interoperability in healthcare is an irresistible prospect for the government keeping in view of creating jobs and better employment opportunities.

Telemedicine, e-pharmacy, and remote monitoring have gained the trust of all stakeholders. The private sector's contribution will help meet the goals of universal health coverage and ensure India's progress towards a USD 5 trillion economy with a healthy population. The country still has a long path to dwell on, for bringing its rural areas at par with the urban and also with global standards. With the embracement of state-of-the-art tele health technologies, development of enterprise-wide portfolios, and the commitment to data transparency, 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 the development of the nation. What is expected is a more secure, interoperable healthcare system with the goal of accomplishing better healthcare for Indian citizens, empowering both the urban and rural landscape in the coming years.

References

1. https://www.mohfw.gov.in/pdf/Telemedicine.pdf
2. http://bwhealthcareworld.businessworld.in/article/How-Are-Advances-In-Digital-Technology-Making-Healthcare-Delivery-In-Rural-India-More-Efficient-/20-09-2021-405262/

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Conservation of Natural Resources

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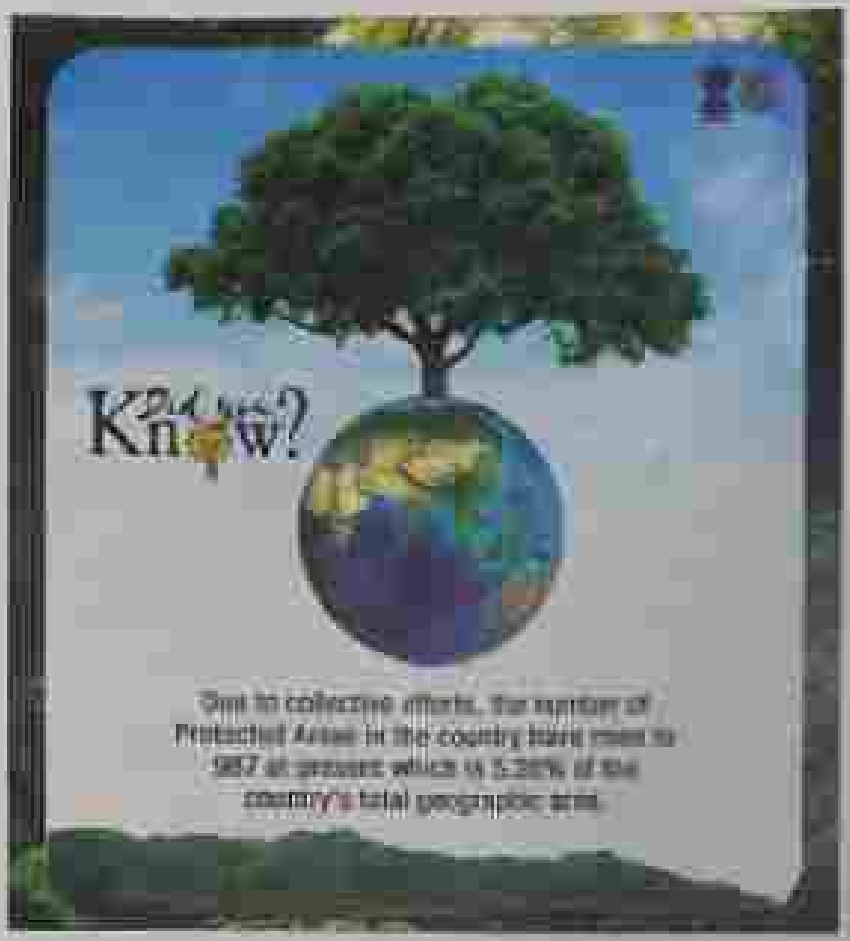
On the occasion of National Science Day (28th February 2022), Hon'ble Prime Minister of India while sharing his thoughts urged families to begin with small efforts to develop scientific temperament among their children. Today when climate conditions are changing, there is a need to inculcate effective environmental education along with the use of technology for environment protection, which will play an important role in sensitizing the people about environmental issues. Environment protection is embraced in our Constitution of India wherein the State's responsibility has been laid down under Article 48-A. Recently, 'Life style for Environment' was unveiled at Conference of Parties (COP) – 26 at Glasgow, which aims to promote environment conscious lifestyle. Science and technology for environment conservation has immense potential to strike the economic and ecological balance. Satellite Remote Sensing technology has emerged as powerful tool in providing reliable information on various natural resources at a glance. Such technologies definitely help and complement government's policies, ensure efficiency and transparency in more sound decision making.

The term "environment" was introduced in the Constitution of India for the first time in the year 1976 and the State's responsibility with regard to environmental protection was laid down under Article 48-A, which reads as "The State shall endeavour to protect and improve the environment and to safeguard the forests and wildlife of the country". Also, article 51-A (g) of Citizens' fundamental duties mentions "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" comprises all entities, natural or manmade, external to oneself, and their inter relationships, which provide value, now or perhaps in the future, to humankind. National Environment Policy, 2006 of India formulated by Ministry of Environment, Forest and Climate Change for the protection and conservation of environment identifies the following seven objectives:

1. **Conservation of Critical Environmental Resources:** To protect and conserve critical ecological systems and resources, and invaluable natural and man-made heritage, which are essential for life support, livelihood, economic growth, and a broad conception of 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 in particular, to ensure that poor communities, which are most dependent on environmental resources for their livelihoods, are assured secure access to these resources.



3. **Inter-generational Equity:** To ensure judicious use of environmental resources to meet the needs and aspirations of the present and future generations.

4. **Integration of Environmental Concern in Economic and Social Development:** To integrate environmental concerns in economic, social programmes and projects for economic and social development.

5. **Efficiency in Environmental Resource Use:** To bring efficient use of environmental resources in the sense of reduction in the use per unit of economic output to minimize adverse environmental impact.

6. **Environmental Governance:** To apply the principles of good governance (transparency, fairness, accountability, reduction in time and cost, participation and regulatory predictability) to the management and regulation of use of environmental resources.

7. **Enhancement of Resources for Environmental Conservation:** To bring higher resource flow, combining finance, technology management skills, traditional knowledge, and social capital, for environmental conservation through mutually beneficial state-private sector partnerships between local communities, public agencies, the academia and research community, investors and multilateral and bilateral development partners.

For the protection and conservation of Environment, several legislations exists namely Environment Protection Act, 1986; Water (Prevention and Control of Pollution) Act, 1974; Water Cess Act, 1977, Air (Prevention and Control of Pollution) Act, 1981. The law in relation to forest and wildlife are Indian Forest Act, 1927, Forest (Conservation) Act, 1980, Wildlife (Protection) Act, 1972 and Biodiversity Act, 2002. Recently under the visionary leadership of Hon'ble Prime Minister of India, LiFE (Lifestyle for Environment) was unveiled at COP 26 at Glasgow, which aims to promote environment conscious lifestyle. And to combat climate change, Panchamrit were given that are: (1) India will get its non-fossil energy capacity to 500 gigawatt (GW) by 2030. (2) India will meet 50 percent of its energy requirements from renewable energy by 2030. (3) India will reduce the total projected carbon emissions by one billion tonnes from now onwards till 2030. (4) By 2030, India will reduce the carbon intensity of its economy by less than 45 percent and (5) By the year 2070, India will achieve the target of Net-Zero.

To enjoy the benefits of quality life, effective environmental education is another important pre-requisite. Moreover, it is an essential component of education at all levels. For

enable the individuals to adopt green habits for sustainable social development and preserve a cleaner and greener environment for our future generations. Understanding and addressing the environmental crisis is not an easy task. In fact it needs proper examination of the problem and its source. Confronting with the environmental glitches needs scientific, educational and political interventions. Innovative solutions are needed to counter environmental degradation and to ensure sustainable development. India has around 23 percent of the population in the 6-17 age group, and to ensure that this young population saves the environment, it is utmost important that they are provided with quality education with respect to environment. Of the 17 Sustainable Development Goals (SDGs), SDG '4' refers to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. And if the percentage [illegible] towards environment protection and conservation of natural resources, then one can imagine the cascading effect it will have for nature's protection. In 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. It is imperative that such MOOCs are scaled up for the environment education with the necessary adaptations in respect of the current environmental issues. Also National Education Policy of India (2020) has climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources, forest and wildlife, and sustainable development and living as some of the thrust areas for environmental education.

Talking about science and technology for environment conservation, it has immense potential to strike the economic and ecological balance. The knowledge of spatial land cover information can help in proper management and monitoring of natural resources. Satellite Remote Sensing technology has emerged as powerful tool in providing reliable information on various natural resources of a region. The changes in land use/land cover can be linked to the human and natural activities. For example, forest fire risk zones can be predicted and accurate mapping of forest fires through risk modelling can be conducted. Available literature also highlights the use of Geographic Information System (GIS) technology in corridor mapping, forest dynamics, forest fragmentation and its relation with the wildlife movement in the [illegible] complexes [illegible] studies conducted by researchers.

Off farm technologies like "bio-briquetting" can also help in preventing forest fire hazard as well as loss of biodiversity. This is a sustainable technology which is efficient, simple, cost-effective and which can generate energy on a local scale (http://gbpihedenvis.nic.in). Biomass energy from pine needles can be generated by using simple technology of biomass briquetting. Under the aegis of G.B. Pant National Institute of Himalayan Environment, Almora (autonomous body of MoEFCC) by manufacturing of bio-briquettes and bio-globules, under its RTC (Rural Technology Complex), one seeks to involve lower and marginalised groups of villagers to provide them with resource utilization training and furthermore livelihood generating capacity.

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

- **PARIVESH:** In pursuance to the spirit of 'Digital India' initiative and capturing the essence of Minimum Government and Maximum Governance, a single-window, integrated environmental management system named PARIVESH (Pro-Active and Responsive facilitation by Interactive, Virtuous and Environmental Single-window Hub) has been developed by the Ministry of Environment, Forest and Climate Change through NIC (www.parivesh.nic.in). Launched on 10 August 2018, it has an automated process starting from submitting of application, preparation of agenda, preparation of minutes to grant of clearances. It facilitates robust and informed decision-making, real time information about the status of application with alerts at each of the stages through SMSs and emails, standardisation of processing and real time monitoring/compliances. There will be single registration and single signing for all types of clearances (Environment, Forest, Wildlife, CRZ). It has paved a way for constituting the Centralised Processing Center in the Ministry and has resulted in a paradigm shift in the environmental clearance process with hallmarks such as transparency, accountability, efficiency, consistency, etc.

- **Decision Support System (DSS):** This is a web GIS application developed to provide quantitative and qualitative 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, Mangrove richness, hydrological layer, etc. available at www.fsigeoportal.gov.in/dss.

- **Climate Change Knowledge Portal:** India's Climate Change Knowledge Portal (https://www.ccindia.nic.in/) is a single point information resource which captures sector-wise adaptation and mitigation actions that are being taken by the various ministries in one place including updated information on their implementation. The knowledge portal will help in disseminating knowledge among citizens about all the major steps the Government is taking at both national and international levels to address climate change issues.

- **National Mission on Himalayan Studies (https://nmhs.org.in):** MoEF&CC attaches highest priority to protect unique but highly fragile Himalayan ecosystem. This portal covers the aspects of National Mission on Himalayan Studies which is a Central Sector Grant-in-aid Scheme through holistic understanding of systems's components and their linkages in addressing the key issues

relating to conservation and sustainable management of natural resources in Indian Himalayan Region. Mission strategy is to focus on enhancing livelihoods of local communities in line with the National Environment Policy 2006 of the Government, with a basic premise that the most secured and effective basis for conservation is to ensure that people dependent on particular resources obtain better livelihoods from the act of conservation than from the degradation of the resources.

- **Wetlands of India portal:** The portal (https://indianwetlands.in/) is an initiative to provide a single point access system that synthesizes information dissemination regarding wetland sites of the country, projects, initiatives and trainings. Wetlands are shallow water-bodies, transitional between terrestrial and aquatic systems, with high biodiversity and productivity. Twelve National Biodiversity Targets, framed by the MoEF&CC in line with the Convention on Biological Diversity's Strategic Plan 2011-2020 also cover wetlands significantly. The portal provides a platform for the people of the country to learn more about wetlands and get involved in their conservation and management.

In the year 2020, Ministry of Science and Technology initiated formulation of fifth draft of National Science, Technology, and Innovation Policy, which aims to bring about profound changes through short-term, medium-term, and long-term mission mode projects by building a nurtured ecosystem that promotes research and innovation on the part of both individuals and organizations. To attract, nurture, strengthen and retain critical human capital through a 'people-centric' science, technology, and innovation ecosystem, has been kept as one of the broader areas of the policy. Transparency to ensure a clean environment for people and future generations through green initiatives based in science that promote sustainability and clean energy, water, air, rivers, forests, parks, and neighbourhoods (https://dst.gov.in). Kishore Vaigyanik Protsahan Yojana, National Science Olympiad Programme, India Innovation Growth Programme and Million Minds Augmenting National Aspirations and Knowledge Awards Programme under the Innovation in Science Pursuit for Inspired Research (INSPIRE) scheme are some of the programmes being conducted by the Department of Science and Technology individually and in cooperation with different organizations to foster a creative thinking towards scientific education. This year on the occasion of National Science Day (28 February 2022), Hon'ble Prime Minister while sharing his thoughts with the people through his monthly radio programme 'Mann Ki Baat', has urged families to begin with small efforts to develop scientific temperament among their children. The application of both science and technology for environment conservation must go hand in hand for the country to achieve the objective of sustainable development. These technologies shall definitely bring and complement government's policies, enhance efficiency, transparency to make sound decision-making.

It is rightly said by environmentalist and green activist Dr. Anil P. Joshi (Padma Bhushan and Padma Shri) that true capital of a nation is its natural resources, and future demands balance between economy and ecology. Through science and technology, environment conservation can be achieved in holistic manner with the convenience of citizens in accessing information. Further, environmental attitude is directly linked with the level of knowledge regarding environmental issues possessed by an individual. Today when climatic conditions are changing, there is a need to inculcate effective education along with the use of technology for environment protection, which will play an important role in sensitizing the people about environmental issues. This will also facilitate people to adopt green social responsibility for the protection of environment.

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Smart Water Future

Dr. Satyavir Singh Parmar

Water is an essential but scarce resource and therefore conserving and managing each and every drop of water is vital. Since this management involves decisions related to billions of lives and the vast quantities of invigorating resource, usage of technology can be a correct path towards redemption. Technology and innovations can indeed play an essential part in quality and safety, efficiency, utility operations, monitoring, treatment and data analysis related to the water sector and lead India to the path of a smart water future.

The last few years in the history of mankind are text book examples of chaos caused, including dismal, chaos, drama, and hope. One thing which preceding years have taught us is that the world is a global village where the countries are having similar opportunities and have same challenges to deal with. The recent outbreak of COVID-19 pandemic, an outburst of locusts, and the persistent issue of climate change have substantiated the fact that the world needs to collaborate and fight the global challenges in times ahead. One of such global challenges is water scarcity where:

- Some 1.1 billion people worldwide lack access to water, and
- A total of 2.7 billion find water scarce for at least one month of the year.
- Two million people, mostly children, die each year from diarrheal diseases alone.
- By 2025, two-thirds of the world's population may face water shortages (in millions as usual scenario).

The existence and sustenance of mankind depend on water, safe potable water primarily for drinking and other domestic purposes. However, for millions of people in India and worldwide, water is a cause of constant worry in a country as water tables are constantly falling and water quality rapidly diminishing. Due to the increasing population, the per capita annual availability of water in India, which was 1816 cubic meters (cu m) in 2001, got reduced to 1544 cu m in 2011 which will reduce to 1140 cu m in the year 2050. Any situation of availability of less than 1000 cu m per capita is considered by international agencies as scarcity. By 2030, the country's water demand is projected to be twice the available supply and if business as usual continues, it may imply severe water scarcity for hundreds of millions of people.

Another aspect of water that needs to be addressed urgently is the management of wastewater. The per person disease burden due to unsafe water and sanitation was 40 times higher in India than in China and 12 times higher than in Sri Lanka in 2016. With a country generating 140 Billion Cubic Metre (BCM) of wastewater annually, mismanagement of wastewater which also contaminates groundwater, lack of liquid waste management, poor sanitation conditions, and poor hygiene habits has contributed

Smart Water Future

Smart Water would mean the management and distribution of water while maintaining its quality in order to ensure the sustainable supply of water in a smart house. We need to focus on two key areas- reduction in non-revenue water and managing wastewater recycling and reuse.

Under water supply management this due to leakage, which can be considered as a threat to water-scarce economies of the world. Building, non-metallic water, intermittent supply

while initiating physical losses. For the second step of leakage management i.e. active leakage control, it is required to introduce some level of technological intervention. Real-time monitoring of water supply infrastructure by using GIS tools, installing smart devices and telemetry, offer utilities the scope to take timely action in repairing the leakages and finding out the illegal connections easily, thereby saving millions of liters of water along with time and energy.

Since water is an essential but scarce resource, conserving each and every drop of water is necessary. Degradation of natural resources due to rising pollution makes it even more important to devise a circular path of water by using and reusing water in the system. Besides drinking water, there are innumerable non-potable uses of water in a domestic household which can be taken care of by treated wastewater. Wastewater can be treated at centralized or decentralized levels depending upon the level of readiness, amount of waste water generated and funds available in the system. Currently, India generates approximately 61,948 MLD of sewage against the treatment capacity of 23,277 MLD i.e. 37 percent of wastewater generated only (CPCB, 2015). Moreover, even the installed sewage treatment plants either do not run at maximum capacity or do not comply with standards prescribed. Hence, there is an urgent need to promote and push economy to inculcate the habit of reusing, recycling and treating wastewater in the system.

There are a number of technologies that can be used for the above purpose. Depending upon the purpose of recycled water, the effluent filtration technology is decided. Besides this, advanced green techniques (AGTs) are also in rage nowadays. They are environment friendly, relatively inexpensive and efficient. The most common and advanced AGT used for wastewater treatment is hydroponics.

Apart from reducing non-revenue water and encouraging wastewater recycling and reuse, there are a number of smart solutions which India can undertake to move towards smart water future. Some of them are:

1. Implementation of Internet of Things (IoT) technology. This technology will enable the data of the water to be transmitted over a longer distance, wirelessly and uninterrupted to a central dashboard to analyse and monitor the water system.
2. Sensors, remote sensing, geographic information systems (GIS) technologies, and visualisation tools are some key elements to managing water resources at the service area, watershed, and regional scale.
3. Remote sensing/imaging technologies such as satellites and drones, can be used separately or together, to provide data for mapping water resources, measuring water flows, and utility asset management. Data from such technologies can better prepare water resource managers and utilities for incidences of heavy storm water flow, indicate when conservation practices should be enacted during periods of droughts, and ensure all treated water is delivered to customers. In addition, satellite data can be used to provide water quality data (e.g., turbidity, algal blooms, etc.) and hydrological forecasts, which, when used in conjunction with in situ measurements, allow utility operators to prepare for and react to water quality issues and other challenges.
4. New and existing sensors, both fixed and mobile can be used to provide near real-time data on water quality, flows, pressures and water levels, among other parameters. Sensors can be dispersed throughout systems to aid daily operations, by optimizing resource use, detecting, diagnosing, and proactively preventing disruptive events such as pipe bursts, water discoloration events, sewer collapse/blockages, etc. It can also provide useful information for preventative maintenance and improved longer-term planning for water utilities.
5. 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, allowing for improved water management.
6. 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 use in real time, more efficient collection and distribution

remotely, and maintain revenue capture and customer satisfaction.

5 Augmented Reality and Virtual Reality (AR) are two technologies poised to [illegible] digital water. AR and VR technology has the potential to support decision-making in the field by providing holographic representations of pipes, valves, and other assets, and offering immersive, scenario-based training for employees.

6 Blockchain applications have the potential for direct, secure transactions between resource providers and consumers, water utility, and other players in the water sector.

7 Use of Satellite imagery/ GISAs in reservoir operation, flood forecasting, and inundation mapping can help to mitigate floods and save thousands of lives.

Good Practices

India is already on the way ahead in adopting various water modernization technologies. For example, World Bank-funded Karnataka Urban Water Sector Improvement Project (KUWASIP) has reduced NRW from 50 percent to 7 percent and increased the hours of supply from 2 h every few days to 24 h water supply.

Jamshedpur Utilities and Services Company (JUSCO), Jamshedpur has introduced NRW management, and since then the level of NRW decreased from 36 percent to 10 percent with continuous water supply from 7 hour per day.

In one of the unique initiatives, the Andhra Pradesh government has launched the Andhra Pradesh Water Resources Information and Management System (APWRIMS) which is a Smart Water Solution platform targeting the overarching objective of sustainable water management in Andhra Pradesh. The APWRIMS collects data from 1,254 piezometers on a real-time basis across all the 13 districts of the state and correlates the information with all 15,00,000+ bore wells used for agriculture purposes in the state. Soil moisture data is also collected from 900+ locations across the state. The platform has data related to 100+ reservoirs, 40000+ Minor Irrigation tanks, 13 lacs agriculture.

Technology also plays an important role in tackling water-related disasters like floods and it is very heartening to see that we as a nation have developed the way to it. The Central Water Commission is collaborating with M/s Google Inc. 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 Artificial Intelligence and Machine Learning. The system started functioning in 2018 when inundation alerts were provided for Patna Gandhi ghat forecast stations. In a similar initiative, Odisha is the first state in the country that has implemented an Early Warning Dissemination System (EWDS) which aims at establishing a foolproof communication system to address the existing gap of disseminating disaster warning from the State, District and Block levels to communities. The Government of Kerala has also entrusted the Kerala State IT Mission (KSITM) to set up an ICT Platform comprising of web based backend and a mobile app-based field survey application to document the flood related damage caused to houses and commercial establishments in affected districts. Recently, students from IIT Madras have developed an AI-enabled drone that can help authorities provide vital information on people trapped in disaster-hit areas. All these examples show that innovations in flood forecasting and management can lead the way for timely actions and minimize the losses from the flood.

In the era of robotics, satellites, and the digital world, one cannot shy away from the concept of not only life-changing but also life-saving technologies. Technologies give us the leverage to perform tasks that were unimaginable to our past generations. But, the important point to take over here is that technology alone cannot combat the disasters created by our species. They are just a way to mitigate the losses from these catastrophes. If we want to fight back against the challenges of water scarcity and looming water disasters, we have to change ourselves. We have to change our habit to take nature for granted and work as a single unit to make our planet again a giant green and blue beautiful sphere of life.

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Technology- Empowering the Masses

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Policies and programmes of the government not only outline the blueprint for economic development of the country but also ensure that the fruits of economic development reach the weaker sections of the population. The key to success of any legislation and schemes run by the government is implementation, continuous monitoring and audit. While over the years many programmes for economic and social upliftment of the weaker sections of the population, especially for those living in rural and remote areas, have been rolled out, lack of transparency, high implementation costs and pilferage would mean that only a minor percentage of the total benefits or legislation would reach the people they are meant for. For instance, the Public Distribution System has been historically skewed down by

diversion of medicines to the open market, brain drain in rural areas and corruption at the last mile. Again, the public healthcare system has been affected by non-transparency, little or no accountability and bureaucratic failures, particularly in the poor states. Lack of awareness about their rights and difficulty in accessing healthcare benefits are another concerns in the attempt of rural and poor people to optimally utilise the government healthcare system.

In the last few decades, technology has been the proverbial catalyst, turning the tide in favour of citizens and their ability to access government schemes. The rapid adoption of digital technology in the past few years has laid the framework for making delivery of government schemes easier and more efficient, ensuring that they reach the beneficiaries in the shortest possible time in a manner convenient to both the dispenser and the receiver of these welfare schemes. Let us look at the some of the major developments spearheaded by technological advancements.

India Stack and Aadhaar

The foundation of India's digital revolution was laid by the development of India Stack – the unified software platform which brought India's 1.4 billion-plus population into the digital age. Defined as a set of open APIs and digital public goods, it aimed to unlock the economic primitives of identity, data, and payments at population scale. Adoption of India Stack by billions of individuals and businesses has helped promote financial and social inclusion and positioned the country for the Internet Age. The bedrock of India Stack is a set of digital identity products centred around Aadhaar, the country's national identity programme. More than 1.31 bn (95 percent) Indians today possess an Aadhaar number, making access to various government and non-government services easier for the ordinary citizen. Aadhaar has enabled ease of living for the citizens, especially the most marginalised and deprived class through seamless delivery of subsidies, benefits, and other services under various state welfare schemes. Aadhaar has also been the foundation of multiple building blocks. More than 17 transactional stacks have been launched over time for digital identity, payments, data empowerment and user ecosystems.

Direct Benefit Transfer

It was the Aadhaar identification programme that ensured the success of the Direct Benefit Transfer system. Direct Benefit Transfer or DBT has travelled a long path since its early initiation by the government of India in 2013 to change the mechanism of transferring cash subsidies and benefits. The programme was aimed at transfer of subsidies and cash benefits directly to citizens through their Aadhaar seeded bank accounts with a hope that crediting subsidies into the bank accounts would substantially reduce leakages, and associated delays owing to the flow of funds in a multi hierarchy of administrative offices till it reaches the end beneficiary. Central Plan Scheme Monitoring System (CPSMS), the earlier avatar of the Public Financial Management System (PFMS), of the Office of Controller General of Accounts, was chosen to act as the common platform for routing of the Direct Benefit Transfer. CPSMS was used for the preparation of beneficiary list, digitally signing the same and processing of payments in the bank accounts of the beneficiary using the Aadhaar Payment Bridge of NPCI. Today, DBT has emerged as a high priority focus area of the government, in reforming government delivery system by re-engineering the existing process in a variety of welfare schemes for simpler and faster flow of information/funds, ensuring accurate targeting of the beneficiaries, de-duplication and reduction of fraud. DBT has become the accepted way of delivering government schemes with the delivery of over 300 schemes including the Public Distribution System (PDS), PM-KISAN, Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), National Social Assistance Program (NSAP), Prime Minister's Matru Vandana Yojana (PMMVY), National Rural Livelihood Mission (NRLM), National Health Mission (NHM), scholarship schemes of various ministries through the National Scholarship Portal (NSP), PM AWAS, LPG-PAHAL, and many more to more than 900 million people through this mode. In addition, states like Uttar Pradesh, Bihar, Madhya Pradesh, Tripura, Maharashtra, Jammu and Kashmir, Andhra Pradesh have also leveraged the DBT platform of PFMS to deliver the benefits of their respective welfare schemes to the people. The total Direct Benefit Transfer (Cumulative) since inception stands at Rs. 25,03,045 crore with estimated gain of Rs 2,22,000 crore up to March 2021. All thanks to Aadhaar and PFMS!

TABLE 1: Direct Benefit Transfer: Making Welfare Schemes Efficient

	FY 2022-23	FY 2021-22	FY 2020-21	FY 2019-20
Total Direct Benefit Transfer (Rs crore)	2,35,228	6,30,264	5,52,527	3,81,632
Total No. of Transactions	212 cr	715 cr	623 cr	438 cr
No. of Schemes	318	307	319	
Ministries covered	53	53	53	

Source: https://dbtbharat.gov.in/

Digital Platforms for E-Governance

Presently, the National Informatics Centre (NIC) under the Ministry of Electronics and Information Technology is playing an instrumental role in executing key IT projects, in close collaboration with Central and State Governments, making the last mile delivery of government services to the citizens a reality through a variety of digital solutions. NIC, as the technology partner of the government of India, endeavours to cater to ICT needs at all levels of government including central, state, districts, judiciary, and legislative [illegible]. A large number of Government initiatives such as Swachh Bharat Mission, MyGov, e-Hospital, fertiliser distribution, e-Courts, e-Transport etc. have been completely managed using digital platforms developed by NIC. NIC offers a wide range of services which includes multi gigabit nationwide network NICNET, NKN, National Data Centres, National Cloud, pan-India VC infrastructure, Command and Control Centre, multi-layered GIS based platform, Domain Registration and Webcast. This plays a significant role in delivering citizen-centric e-Services. It has also developed several digital platforms for the socio-economic development of the country with 'One Nation One Platform' initiative to empower citizens digitally.

Unified Payments Interface

The Unified Payments Interface (UPI), developed by the National Payments Corporation of India (NPCI), has emerged as a game changer in the payments space. Rolled out in 2016, this indigenous disruptive technology today accounts for 75 percent of total retail payments, with more than 30 million UPI QR codes registered by merchants. The number of UPI transactions in August this year stood at 10.58 billion, up from 9.96 billion (996 crore) in July 2023. The value of UPI transactions in FY 2022-23 was Rs 84.15 lakh crore. Rupay credit card transactions [illegible] and credit cards combined. In August 2023 alone, digital payment transactions value through UPI stood at Rs. 15.77 lakh crore, indicating how UPI has become the ubiquitous payments alternative for a majority of citizens, especially for those making payments of small denominations. Whether it is the vegetable vendor, the e-rickshaw driver or the petty shopkeeper, the UPI is clearly becoming the default payment option.

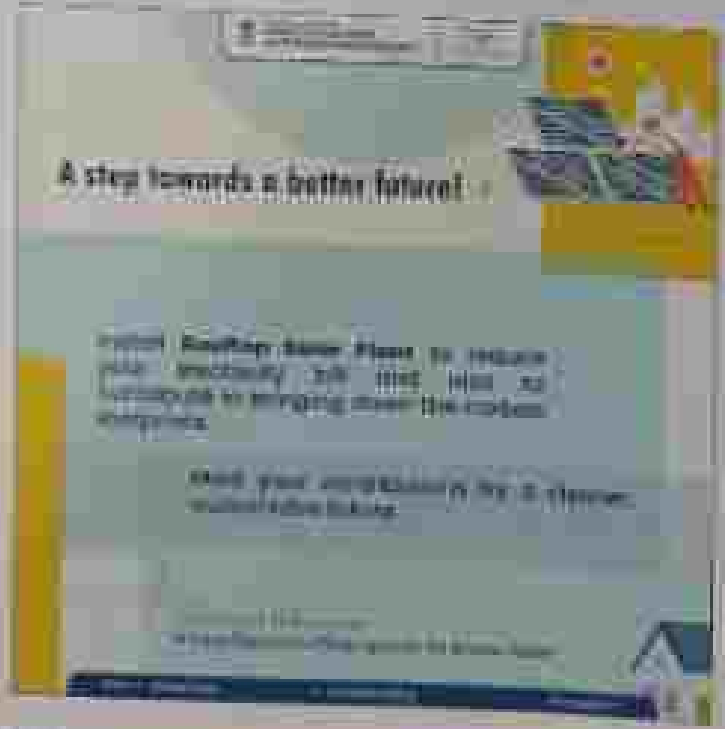
In particular, UPI system has helped India move from a country largely dependent on cash for everyday transactions to a significantly less cash economy. UPI has allowed users to safely transfer money on a real-time basis and across multiple bank accounts without revealing the details of one's bank account to other parties. In the case of the weaker sections, rural females and migrant workers, it is the easiest way to transfer money today. Today, several countries across the world are trying to emulate the success of UPI. Already, UPI has gained acceptance in Singapore (March, 2020), Bhutan (July, 2021) and recently with partners in UAE and Nepal (February, 2023).

Since the launch of UPI, India has been facilitating financial inclusion at a CAGR of five percent and since 2018, the country has more than doubled the extent of digitisation of payments, as per the Reserve Bank of India's Digital Payments Index and Financial Inclusion Index. This spectacular growth in UPI transactions, at a CAGR of 160 percent over the last five years, has been the prime mover in the rapid adoption of digital payments in India. This growth has been powered by a confluence of technological developments and progressive government policies and regulations. While UPI has been the prime game changer, other digital payment systems such as Bharat Bill Payment System (BBPS), NETC FASTag, Aadhaar Enabled Payment System (AEPS) and *99# service, all developed within the


Cyber
Awareness
Hackers don't take a holiday!
Consumers should take a few extra steps to stay secure while shopping online
Shop only on legitimate & secure websites
Use a secure password & multi-factor authentication
Beware of fake mobile apps
Stay protected against phishing attacks

[redacted]

Non-conventional Energy Sources


A step towards a better future!

Geothermal Energy

Hydropower

Biomass Energy

Fuel Cell

Significance of Non-conventional Sources of Energy

Environmental Interventions to Foster Renewable Energy Sources

needs and reducing carbon footprint and also generate large direct and indirect employment opportunities.

Some of the recent governmental interventions for facilitating transition to renewable sources of energy are as follows:

- Permitting Foreign Direct Investment (FDI) up to 100 per cent under the automatic route for renewable energy projects, including offshore wind 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 viz. under Green Energy Corridor scheme for evacuation of renewable power.
- 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 ₹34,000 crore from Central Government has aimed to set up additional 30.8 GW of solar capacity. It has 3 components: (i) creation of 10,000 MW of Decentralised Ground mounted grid connected solar power plants, (ii) solarisation of 15 lakh grid connected agriculture pumps, and (iii) installation of 20 lakh standalone 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 residential sector including for households in rural areas.
- National Hydrogen Mission: The Mission aims in making India, a green hydrogen hub, aiding India to fulfil its target of production of five million tonnes of green hydrogen by 2030 along with related development of renewable energy capacity. The Mission proposes a framework for inter alia generating demand for Green Hydrogen in sectors such as petroleum refining and fertiliser production, support for indigenous manufacturing of critical technologies. In tune with the National Hydrogen Mission, recently in August 2022, India's first indigenously developed Hydrogen fuel cell bus developed by KPIT-CSIR was launched.
- National Offshore Wind Energy Policy was notified by Government of India on 2015 for the development of offshore wind power in the country. Post notification, Government through National Institute of Wind Energy has also issued guidelines for Offshore Wind Power Assessment Studies and Surveys. These guidelines are expected to enable private sector to carry out offshore wind resource assessment.
- National wind-solar hybrid policy was released in 2018 by MNRE and it aims at providing a framework for promotion of large grid connected wind-solar PV hybrid projects for optimal and efficient utilization of transmission infrastructure.
- Ministry of New and Renewable Energy (MNRE) has also implemented numerous schemes to foster bio-energy such as Scheme to support 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), New National Biogas and Organic Manure Programme (NNBOMP) etc.

The initiatives of Government in facilitating transition to renewable energy sources has been echoed in the international forums as well. In COP 26 summit held at Glasgow, Hon'ble Prime Minister, depicting India's efforts to cope up with climate change, has announced 'Panchamrit' (five nectar elements) which lays great emphasis on non-conventional energy sources. It includes the following: (i) India will take its non-fossil energy capacity to 500 GW by 2030. (ii) India will meet 50 percent of its energy requirements from renewable energy by 2030. (iii) India will reduce the total

projected carbon emissions by one billion tonnes from now till 2030. Further, by 2030, India aims to reduce the carbon intensity by more than 45 percent. By the year 2070, India aims to achieve the target of Net Zero which effectively means to completely negate the production of greenhouse gases.

Thus, much emphasis has been placed on the development of non-conventional energy sources to fight global warming. Over the years, development of renewable energy in India has received greater momentum. India today ranks 4th in the world in installed renewable energy capacity. India's non-fossil fuel energy has increased by more than 25 percent in the last 7 years and now it has reached 40 percent of our energy mix.

Challenges in Transition to Non-Conventional Energy Sources

The transition to non-conventional energy sources is a transformational step necessitating a system overhaul and hence poses many challenges. Drawing on existing infrastructure and conducive ecosystem for facilitating a smooth transition to renewable energy is a matter of concern. This also includes the challenge of expanding power infrastructure to permit increased use of diverse energy sources and ensuring system flexibility. Massive investment is inevitable for facilitating smooth transition to non-conventional energy sources. Ensuring viable financing mechanism to raise long term funds at low interest rate to facilitate this transition is thus a formidable challenge. International green finance flows to India are gradually increasing but are still relatively low while compared to India's lofty climate goals. The landscape of green finance is marred by issues like long gestation gaps, increased capital cost, potential risk factors, especially, etc. Further, investment in renewable energy sector is disproportionate in nature. For instance, despite its growth potential, wind energy sector attracts relatively fewer international investments as compared to solar energy sector.

Another impediment pertains to escalating the issue of low credit worthiness and resulting lack of investor confidence in the renewable energy sector. Renewable energy sector needs considerable attention and it should be ensured that investments in conventional energy sources does not crowd out renewable energy investments. Leveraging private sector investments to its optimal level to foster the transition to clean energy is also a formidable challenge. The weak financial strength of some of the distribution companies and their resulting inability to make timely payments to renewable energy developers is also a formidable hindrance. It can also affect the viability of renewable energy sector and further slow down its pace of development.

Further, coping up with transition job and revenue loss due to switch from fossil fuels will also be a challenge. Addressing this requires strategic planning for raising necessary finance and upskilling of our human resources.

Way Ahead

Facilitation of transition to non-conventional energy sources holds the key for India's developmental aspirations. A revolutionary shift to non-conventional energy sources can bring about transformational opportunities for sustained economic development. It will also ensure energy security and disaster resilience, apart from generating employment, improving health outcomes, and offering other societal benefits. To facilitate a smooth and sustainable transition to non-conventional sources of energy, mobilisation of green finance needs to be adopted at a faster pace. Sound deployment and optimal utilisation of innovative financial instruments like green bonds, blended funding, infrastructure debt bonds can help in this regard. Further facilitating increased public private partnerships for funding and meeting necessary technological requirements is also needed. This also necessitates a conducive regulatory and institutional setup which is responsive to the dynamic needs of renewable energy sector. The existing government policies in this sector goes a long way in mitigating these challenges.

It is also important to further escalate research and development spending on the domain of clean energy sources, so as to come up with cutting-edge enabling technologies. It will foster innovation, and aid in the creation of energy systems that are resilient to future economic and environmental shocks. Diversifying into renewable sources of energy can boost trade and investment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S&T: Towards Women Empowerment

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Having women leaders at tables of power is crucial to bring a sustained and focused change in lives of both urban and rural women. This article talks about the initiatives of science leaders, women scientists, national science academies and the government for promoting gender equality and empowering women in Science and Technology. The developments explored mainly represent those from the year 2000 onwards.

On the occasion of the Independence Day on 15th August, 2022, Honourable Prime Minister Shri Narendra Modi emphasised that women power is significant for the growth of India as he said, "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 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 the 4th U.N. World Conference on Women held at Beijing in 1995. The objectives of the conference 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 (1950-2000s)

"Science and technology is the most powerful enterprise that drives a nation's development", but ironically women in this field are under represented globally, and India has been no exception. The first Science and Technology policy in India (Scientific Policy Resolution, 1958) acknowledged women's role in science and technology and stated: "To ensure that the creative talent of men and women is encouraged and finds full scope in scientific activity". However, the intent was more in words than in action and women continued to be absent from research and technology spaces for various socio-cultural barriers and economic reasons.

From 1960s–1980s, the number of women who rose high to leadership positions could be just

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

INSA Report (2002): A Breakthrough for Women in Science

Initiatives taken by the Government

National Task Force for Women in Science

[redacted]

Recommendations of the Task force

[redacted]

Women Scientist Scheme (WOS)

[redacted]

CURIE Programme (2008-09) – Promoting S&T infrastructure

[redacted]

Mobility Scheme

[redacted]

Role of National Science Academies

Application of S&T for Women's Welfare

employment in the areas of dairy, poultry, sheep and goat farming, aquaculture, floriculture, mushroom cultivation, vermiculture and vermicomposting. Other areas of prior focus on value added products, bee-keeping, bio-fertilizer production, coir and jute products, fruit and vegetable based products, etc.

Women technology parks are centres that are strategically placed in a women farmer's community to facilitate demonstration of methodology by scientists/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 micro-enterprise and pave way towards self-reliance. These centres work in coordination with panchayats and those who provide financial assistance. A national award for 'Women's Development through Application of Science and Technology' has been instituted to honour individuals/institutions who have made significant S&T advancements for women's development at grass root level.

DST also supported setting up a Golden Jubilee Women's biotech park at Siruseri, Kancheepuram District in 2001 as a joint project with the Government of Tamil Nadu with an investment of Rs. 400 lakhs. The Park is an entrepreneurial facility primarily supporting first generation women entrepreneurs and women scientists and provides support towards making small-scale investments to independently take up production of value added products such as herbal cosmetics and essential oil, bio-pesticides, bio-fertilizers, ready to eat snacks etc.

Application of science and technology have also been sought for providing a healthy lifestyle to rural women with special focus on nutritional health, hygiene and sanitation and education and training projects.

Environment conservation is also an issue that hugely impacts lives of rural women, and thus scientists are inspired to undertake environmental sustainability projects with a provision for reaching the impediments by involving the rural women.

Vigyan Jyoti, 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 provides 'hand-holding' and mentoring for girls from their school stage till PhD. A spectrum of activities such as science camps, special lectures, counselling of parents and interaction with women scientists are planned for girls as a part of early exposure to science and related careers. The Navodaya Vidyalaya Samiti (NVS) is the implementation partner of Vigyan Jyoti with 100 JNVs presently acting as 'Vigyan Jyoti Knowledge Centres' to girls from Govt. schools of small cities and rural areas.

Recent Developments

On 28th February 2020, India celebrated National Science Day with 'Women in Science' as the focal theme. Underscoring the fundamental need of guiding principles to institutionalize gender equality across all scientific institutions and enterprises, DST launched GATI (Gender Advancement for Transforming Institutions) in a mission mode program. GATI aims to push higher education institutions, research institutes and universities towards supporting diversity, equity and inclusion (DEI) with a belief that ensuring a diversity in talent will ultimately allow institutions to flourish to their best. The participating pilot institutions are expected to acknowledge and overcome cultural and systemic barriers that impede the academic and professional advancement of women in science. The institutions will be required to create policies, practices, action plans for the intended self-sustainable and accreditation model and will be assessed for a GATI award. Apart from accrediting and recognizing institutions through certification and awards, GATI would mentor, coach and provide training support to institutions to develop global best practices in gender equality.

Attention to women's concerns has revealed the value of cognitive diversity in the scientific process. There are still many 'finds' to be conquered; for example recently Dr. N Kalaiselvi became the first women DG, CSIR and Secretary, DSIR. With the ongoing efforts, the coming years shall hopefully see S&T workspaces where women representation is normalized in all roles starting from entry to reaching higher echelons of leadership and policy making.

(The author is a science education and communication consultant. Views expressed are personal. Email: [illegible]@gmail.com)

Science and Technology in Agriculture

Sandip Das

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

The green revolution initiated in the 1960s was to boost country's foodgrain production thus reducing import dependency through the introduction of irrigation, fertilisers, high yielding varieties of wheat and rice and usage of pesticides and insecticides. Through continuous development of new varieties of rice, wheat, cotton, pulses, oilseeds and other crops in the last five decades, India has emerged as a prominent producer of several commodities. Besides achieving self-sufficiency in foodgrains production, India has emerged as the biggest producer of rice in the world since last decade.

The agriculture and allied sector play a critical role in rural livelihood, employment and national food security. The sector provides the largest source of livelihoods in the country. Proportion of the rural population depending directly or indirectly on agriculture for employment opportunities is more than that of any other sectors. It is estimated that around 55 - 60 percent of its rural households depend primarily on agriculture for their livelihood. According to the agriculture census (2015-16), there are 14.5 crore farmers' families in the country; around 82 percent of farmers belong to small and marginal categories, who own less than one acre of land each.

According to the Economic Survey (2021-22), the agriculture sector in the country has experienced buoyant growth in the past two years. The sector which is the largest employer of workforce, accounted for a sizable 18.8 percent (2021-22) in Gross Value Added (GVA) of the country registering a growth of 3.6 percent in 2020-21 and 3.9 per cent in 2021-22. The survey 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 Committee on Doubling Farmers' Income in its report 2018 has noted the role of digital technology which can play a transformational role in modernizing and improving rural infrastructure as agricultural activities.

Digital technologies are finding increasing use in the agriculture value system and farmers are increasingly becoming more informed as private investments are taken to provide them ready access to technology and information. Government has taken several initiatives to give a push to digital agriculture in the country.

The Government has finalized the conceptual note on India Digital Ecosystem of Agriculture (IDEA) framework which would lay down the architecture for the federated farmers' database. The databases related to the schemes sponsored by the government have been integrated. 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 effectively planning towards increasing the income of farmers in particular and improving the efficiency of the agriculture sector as a whole. Several initiatives have been initiated to boost use of science and technology in Indian agriculture.

Under the national e-Governance plan in Agriculture (NeGP-A), the funds are released to the States and Union Territories for projects involving use of modern technologies such as Artificial Intelligence, Machine Learning, Robotics, Drones, Data Analytics, Block Chain etc.

The sub mission on Agricultural Mechanization being implemented since April, 2014, aims at promoting the unreached by bringing to the small and marginal farmers in the core and giving the benefits of farm mechanization by promoting Custom Hiring Centers (CHCs), creating hubs for hi-tech and high value farm equipments; distribution of various agricultural equipments, creating awareness among stakeholders through demonstration and capacity building activities, and ensuring performance testing and certification at designated testing centers located all over the country.

e-NAM: Online Marketplace

The National Agriculture Market (e-NAM) 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. Digital services are provided to traders, farmers, Farmer Producer Organizations (FPOs), Vendor through various modules of e-NAM platform such as FPO trading module, warehouse based trading module. Under the scheme these reforms are mandatory for States/ Union Territories (UTs) or their respective APMC Acts for integrating their mandi with e-NAM platform - provision for e-trading, single point levy of mandi fee and unified single trading license for the State. States without APMC Act need to provide legally enforceable guidelines and institutional mechanism for implementing e-NAM.

So far, 1200 mandis of 22 States and 3 UTs have been integrated with the e-NAM platform for providing online access to farmers to sell their agricultural produce. More than 1.73 crore farmers and more than 2.25 lakh traders have been registered on e-NAM platform. Trading parameters for 194 agricultural and horticultural commodities such as cereals, pulses, oilseeds, fruits and vegetables, grains, flowers and fibre crops have been provided. FPO trading module has been created whereby FPOs can trade their produce from the collection center/ processing unit bringing the produce to APMC Warehouse based trading modules are provided in e-NAM to facilitate trade from warehouses based on e-NWR. Further, the e-NAM platform is made interoperable with Karnataka e-Market Services Private Limited (KeMS) platform of Government of Karnataka which will facilitate farmers of either the platforms to sell their produce in other platforms thereby increasing their market access.

In July, 2022, the Agriculture Ministry launched the Platform of Aggregation Pool 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. The PoP would increase farmers' digital access to multiple markets, buyers and service providers and bring transparency in farmers transactions with the aim of improving price search mechanism and ensure competitive price realization. So far, 41 service providers from different platforms are covered

under FPO that facilitate various value chain services like trading, quality checks, warehousing, fintech, market information, transportation etc. The platform creates a digital ecosystem for farmers who are benefited from the expertise of different platforms in different segments of the agriculture value chain.

Through e-NAM, GPS based e-NAM Mandi Locator: Farmers / Sellers can locate their nearby e-NAM mandi using GPS based mandi locator feature through e-NAM mobile app. According to an Agriculture Ministry official, this helps the farmers to easily locate and reach the selected mandi and sell their agri-produce. The platform has been integrated with AGMARKNET platform. Farmer can access the prevailing commodity prices & arrival information of e-NAM mandi as well as non e-NAM mandi on e-NAM mobile app prior to even going to the mandi. Currently, the e-NAM portal is available in several languages - Hindi, Bengali, Marathi, Gujarati, Tamil, Telugu, Punjabi, Odiya, Dogri, Malayalam and Kannada and English to facilitate farmers to use e-NAM in the language of their choice.

PM KISAN Digital Payment

Under the PM KISAN scheme, Rs 6,000 annually in three installments is directly transferred into the bank accounts of the eligible farmers under Direct Benefit Transfer mode. According to agriculture ministry data, since its launch in February 2019, 11 installments have been disbursed under the PM KISAN. More than Rs 2 lakh crore has been transferred to about 11 crore eligible farmers through this scheme. Farmers can do their self-registration through the farmers corner in the portal.

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. 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. The database will have all the information including Aadhaar, bank account of farmers and the land records of farmers will be linked with these records. The land records of the farmers will have to be digitally converted to create the database.

AGMARKNET portal

Integrated Scheme for Agricultural Marketing scheme (AGMARKNET) 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, which 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. It facilitates web-based information flow, of the daily arrivals and prices of commodities in the agricultural produce markets spread across the country.

National Mission on Horticulture

It 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. It is a unique intervention to accomplish e-Governance

in RKM wherein face recognition has been integrated in all the processes of workflow – before application filing, authentication, processing and other payments to the beneficiary's bank account through DBT.

Agriculture Infrastructure Fund

To establish a medium – long term debt finance facility for investment in viable projects for post-harvest management infrastructure and community farming assets through incentives and financial support in order to improve agriculture infrastructure in the country. 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 (PACS), Farmer Producers Organizations (FPOs), Self Help Groups (SHGs), Multi-Purpose Agriculture (MPAC). The fund also allows convergence with other schemes so that benefits from other Central/State government schemes can also be availed along with. The total size of the fund is Rs.1 Lakh crore. All loans upto Rs.2 crore per project under this financing facility have interest subvention of 3% per annum. This subvention is available for a maximum period of 7 years.

National Project on Soil Health and Fertility

The Government has recommended soil test based balanced and integrated nutrient management through conjunctive use of bio-organic and inorganic sources such as manure, fertilizers, green manuring, in-situ crop residue recycling etc., of plant nutrients with 4Rs approach – right quantity, right time, right mode and right type of fertilizer for judicious use of chemical fertilizers and to reduce use of chemical fertilizers. In addition, split application, use of slow releasing fertilizers including neem coated urea and growing leguminous crops are also advocated and use of specific conservation technologies are also advocated. Integrated Nutrient Management has been promoted through implementation of Soil Health Card scheme since 2015.

Soil health card provides nutrient status of the soil along with information about fertilizer and integrated use of inorganic and organic fertilizers to maintain good soil health that results in increase in production. To save soil losses owing to farmers of the country, so as to provide a base to address nutrient deficiencies in fertilization practices. Soil Health Card Portal is available where farmers can Track soil samples.

Kisan Suvidha App

Development of Kisan Suvidha mobile application to facilitate dissemination of information to farmers covering range of crops – weather forecast, attractive weather alert, market price of commodities, information about dealers of fertilizer, seeds, pesticide, seeds etc, plant protection for 32 major crops, agro advisories, soil health card, soil testing labs, cold stores and godowns, veterinary laboratories and diagnostic centres, crop insurance and government schemes. Besides, Kisan Suvidha mobile application provides information about the latest technologies developed by the Indian Agricultural Research Institute. The app provides details about 151 technologies.

Usage of Drones in Agriculture

To promote the use of drones in agriculture, the Department of Agriculture and Farmers welfare has released the Standard Operating Procedures for use of drones for pesticide and nutrient application, which provides concise instructions for effective and safe operations of drones. In order to make drone technology affordable and available to the farmers and other stakeholders of this sector, financial assistance of 100 percent cost of drone (upto Rs. 10 lakh) per drone) together with the contingent expenditure is provided under sub-mission on Agricultural Mechanization to the institutions of Indian Council of Agricultural Research (ICAR), Krishi Vigyan Kendras (KVK), state Agricultural Universities (SAUs), state and other Central Government agriculture institutions, departments and public sector undertakings (PSUs) engaged in agricultural activities for its demonstration on the farmer's fields.

Farmers Producers Organizations (FPOs) are provided grant of 75 percent for purchase of drones for its demonstration on the farmers' fields, in order to provide agricultural services through drone application. Financial assistance of 40 percent of the total cost of drone and AI attachments up to a maximum of Rs. 4.00 lakhs is also provided for drone purchase by the Custom Hiring Centers (CHCs) under

Cooperative Society of farmers, FPOs and Rural entrepreneurs.

ICAR has also compiled more than 100 mobile apps developed by ICAR, State Agricultural Universities and KVKs and uploaded on its website. These mobile apps developed in the areas of crops, horticulture, veterinary, dairy, poultry, fisheries, natural resource management and allied subjects, offer valuable information to the farmers including package of practices, market prices of various commodities, weather related information, advisory services, etc. The Government is providing advisories, services on various crop related matters to the registered farmers through SMSs.

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 (IT) enabled platform for technology transfer among farmers and stakeholders. According to an official note, Indian Council for Agricultural Research (ICAR) during 2021-22 developed and released 109 varieties/hybrids of field crops including 35 varieties with special traits and 54 varieties of horticultural crops for cultivation by ICAR.

The government, during 2020-21 and 2021-22, had allocated funds to the tune of Rs 1755 crore and Rs 2422 crore to the states for introducing new technologies including drones, artificial intelligence, block chain, remote sensing and GIS etc in agriculture. Further, the Government also allocated Rs 1202 crore and Rs 1208 crore in 2020-21 and 2021-22 respectively to ICAR for undertaking Research and Development in Agriculture for developing new technologies, their demonstration at farmer's field and capacity building of farmers for utilization of new technology.

The government has accorded due focus on ensuring livelihood service delivery and facilitating market access to farmers. Adequate emphasis towards reducing transaction costs, potential of FPOs to enhance their bargaining power. Development of infrastructure has also been given due attention to ensure better connection of farmers to the national and international market.

High yielding, weed-tolerant, pest resistant and climate-resilient varieties and technologies in crops, horticulture, animal and fisheries science developed besides precision farming applications for production and post production

agriculture developed by ICAR have played important role in increasing production and productivity, reducing cost of production and enhancing income of the farmers. Adoption of Farming Systems Models developed by ICAR have also enabled farmers to enhance their income and strengthen their economic condition. Besides, State specific strategies for increasing farmers' income provided to States by ICAR, are also helping farmers to increase their incomes.

Collaborative Institutional Thrust on Research

National Agricultural Research System comprising of more than 100 Research Institutions, 63 state agricultural universities, three central agricultural universities and four universities having agriculture faculty besides 82 All India Coordinated Research Projects and Network Projects, each having a large number of coordinating centres across the nation, is amongst the largest and strongest research systems of the world.

Emphasis is given by ICAR to shift research from a commodity-based to farming systems based approach. ICAR has created multidisciplinary research complexes in different regions of the country to address this. A dedicated institute ICAR-Indian Institute of Farming Systems Research (IIFSR), Modipuram, Uttar Pradesh is working on characterizing, creating, studying and refining the farming system models in all the agro-climatic regions. Another institute, ICAR - Mahatma Gandhi Integrated Farming Research Institute has been established to facilitate and promote centralization and dissemination of the technology for integrated farming through network/consortia approach. State-wise, Region Specific Integrated Farming System Models developed by ICAR are demonstrated through the network of research institutes and KVKs all over the country.

ICAR's Roadmap for Food and Nutritional Security

ICAR has developed a clear roadmap for next 10 years harnessing the power of science and innovation for ensuring food and nutritional security of our people, farmers' prosperity and to enhance the natural resource base to promote inclusive growth and sustainable development of the Indian agriculture sector. The focused areas of research and development would include: Genetic enhancement of plants/animals/fish for higher productivity under increased intensity of biotic and abiotic stresses; productivity enhancement through sustainable intensification and mechanization of agriculture and food systems; enhancing value, safety and income through food processing; development of energy efficient technologies and farming practices; education and human resource development & developing and promoting innovations in technology transfer systems.

To ensure that the newer technologies like improved variety seeds of crops, new breeds/ strains of livestock and fish and the improved production and protection technologies reach the farmers and end users in shortest possible time, technologies are demonstrated and disseminated through central and State Government agencies, KVKs and through private sector through licensing.

The government's thrust has been to help farmers accessing latest farm technologies as well as new varieties of seeds to ensure that farmers' income get a boost and sustained in coming years besides ensuring that India remains self-reliant in production of most of the agricultural commodities.

References

1. https://www.pib.gov.in/PressReleasePage.aspx?PRID=1848726
2. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1808312
3. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1843139
4. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1847506
5. https://enam.gov.in/web/dashboard/stakeholder-data
6. http://164.100.24.220/loksabhaquestions/annex/175/AU2145.pdf
7. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1808372

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