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**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 teleconsultation, e-pharmacy, and remote monitoring that have gained the trust 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 increasing wastewater recycling and reuse.

The government's thrust on new digital technologies, innovations and focus on research 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, ensuring ease of living and access to various government services.

Energy occupies 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 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 to sustain economic development. Transition to non-conventional sources of energy is a crucial enabler for sustainable development and climate resilience being its 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 relevant information in the field of science and technology especially in the rural context. Happy reading!

Technology and Innovation in Healthcare

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

The recent global pandemic for the world in 2020, and the lessons for robust medical management attached with the COVID crisis, the world could not have anticipated a health crisis of such scale or magnitude. We realized the inadequacy of healthcare infrastructure in developing countries like India and globally. Wearing surgical and face masks were guidelines as patients tried to stay away from hospitals and other healthcare facilities, leaving 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 unwilling to visit their

facilities for treatment.

Technological Progress and Digitalisation of Healthcare

Over a decade, massive data from diagnostic facilities, flowing primarily in patient (HBM) files, and technology is driving the transition. Fear of the COVID infection led to physical OPD. As the suffering gave virtual counselling through telemedicine a multifaceted boost, the consumer has embraced using the digital platform, as there is a perceived acceptance among doctors, patients, insurers, and others in the health ecosystem.

eSanjeevani OPD
STAY HOME OPD

स्वस्थ भारत

eSanjeevani OPD
registration service under ABDM through QR Code

Allows patients to simply scan a QR code & share details with hospital

Benefits:

- Reduced time
- Reduced human effort in manual record keeping & queries

QR Code

Connect to eSanjeevani OPD through QR Code & scan of QR Code. QR Code will be generated for patient registration & OPD services.

In 2005, the Ministry of Health and Family Welfare (MoHFW), NIT Delhi, and the Board of Governors (BoG) Medical Council of India (MCI) issued the 'Benchmark Practice Guidelines', enabling medical practitioners to provide healthcare using telemedicine. The regulation incorporated the provision of health records, especially for medication, in the country.

It had also helped shape the health-care healthcare gap by providing super-specialty support to cities that could not afford one. A recent technology has made the career for people living in rural and remote areas. The Indian healthcare system has witnessed a paradigm shift by ensuring quality healthcare delivery practices in the last decade. Increasingly, the technology has been leveraged for better rural and urban care. The application of digital technologies, including artificial intelligence (AI), machine learning (ML), data science, Internet of Things (IoT), cloud computing, and robotics is increasing in each level of the healthcare system. Although rural communities often have access to local health centres, many other factors contribute to how they can access healthcare. Some factors include the cost of services and specialty services, service transportation to essential centres, the time needed to attend appointments, and workforce in the quality of services. An integrated approach to healthcare that includes technology adoption is the ideal path for rural communities.

Geographical Restrictions

While one of the biggest differences in the world, with around 65 percent of its population concentrated in cities, let alone telemedicine, healthcare access is still a concern that is often more acute in rural areas. Healthcare services in the country have heavily skewed 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, residents often have long distances to receive specialised treatment. In cities, it is common for citizens to travel considerable to travel more than 100 km for a 30-minute consultation, a common waste of time, energy, and resources for the thousands of ill.

Emergence of Digital Healthcare in India

Interoperability in the health system is the key to communicate with each other and make use of the information obtained through exchange without any restriction. It is common to receive the banking and finance and is independent of an individual's location but such a scenario does not exist in 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 follow a few, the results in the delivery of great quality healthcare available to all.

Pharmacies and other modes of collaboration and integration in providing services through information to completely analyse their primary condition so that the best treatment or advice could be delivered to them. Also, the growth of healthcare-related data generated, wherever it happens (Big data), is a tremendous impediment keep a track of every patient's medical record at all times. In India, a lack of awareness and healthcare for all citizens also add on to the existing problem. All these ultimately take the same direction of creating 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 issues raised by the Ministry of Electronics and Information Technology (MeitY) titled 'National of Electronic Health Records: A Roadmap for India' highlighted that the country's government hospitals and health centres have very little ICT infrastructure, with only some major public hospitals having computers and connectivity.

To take about interoperable healthcare records, a very worthy example is of Israel. A country that has increased effectively in its healthcare system which has been paperless for the last 30 years. Although the EHR systems of different hospitals are not the same, they are still very well coordinated.

In India, in the light of the COVID pandemic, the National Digital Health Mission (NDHM) under the Aatmanirbhar Bharat Digital Mission - NDHM was launched in 2020, which is the implementation of the

Warmer Digital Health Systems. It intends to create a single repository of health records of all citizens. The National Digital Health Blueprint (NDHB) was prepared by a panel of Ministry of Health and Family Welfare with an objective to create a framework for the National Health Stack established in 2018 by the PM. Ayushman Bharat Health Accounts Mission and the other key initiatives will get a unified health ID under the national Digital Health Mission (DHM). The health ID will contain information about clinical, lab, diagnostic, medicine, and procedure aspects of a patient which can be accessed by an authorised person from anywhere across the country.

Since then, the cabinet has been working on developing digital modules and modules with the officials has been related to the data security, technical data points, the country (from the Central of NDHB) mainly health ID, Health Personalized Reports (HPR), Health Family Reports (HFR), and digital infrastructure for data exchange has been developed and implemented in these MoUs. As an official, Dr. K. Jitendra has been allocated to the National Health Authority (NHA) for implementation of ABHA. Till 2021 March 2022, a total of 20,97,34,722 Health IDs (ABHA Number) have been created in the country.

A comprehensive DHM would be beneficial to both patients as it would soon merge data from digital devices that display information about the patient's health problems and could include information about their lifestyle and habits. These features focus on the clinical practice strategies and diagnostic tools to monitor medication response and adherence. Most of these devices store the data from a patch or sensor to an app on the smartphone.

Genomic data can also be added to NDHB, including certain data that may or may not benefit the patient's genome. Genomic data can help a doctor know if a specific type of drug will work for a patient without trying many different treatments. This can save both doctors and patients time by eliminating the need for

multiple follow-up appointments, limiting the type of treatment and secondary reducing the risk of queries and side effects. It can also help shift healthcare from reactive to proactive, allowing doctors to address potential problems long before they become an issue.

Scope of Remote Healthcare in India

Support of the main services to prevent and a medical prescription and delivery, and this can also be done via telemedicine (TSM), directly or via a third party of health care, ensure that patients receive their medication in a medically safe way without relying on expensive pharmaceuticals, doctors or other professionals in the field. Telemedicine can effectively scale the capabilities of doctors in rural areas and patient portals that can support medical, billing, and other administrative therapy, allowing patients to benefit and community health.

One of the significant challenges faced by the rural community is the lack of healthcare expertise

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.



Ayushman Bharat Health Account (ABHA) - Ayushman Bharat Health Account is the first step towards creating safer and efficient digital health records for you and your family.

ORSA ABHA QR CODE

It is difficult for some states to meet specialized training and certification to meet the medical needs and improve the care. One possible way to overcome this is to bring the training and certification to the online health professionals. In addition to solving the problem of specialization, making it easier for people to access opportunities for their local professional career growth.

Virtual reality can be used in many ways to solve healthcare problems with training and experience through training simulators. VR is becoming the best place for a virtual healthcare experience. For example, the use of emergency simulation (ES) can be very helpful for patients and medical staff, where there is significant case practice and simulation. You are at risk with virtual reality, many scenarios can be played out that allow a person to learn in a safe way to get hands-on experience without actually being in the emergency room (ER). Increasing pressure on staff and pulling patients to the ER. VR can help improve staff with other communities and experts will enable them to learn and support the different staff members.

The healthcare industry will see substantial technology to deliver health services and support. In the near future, there will be challenges like connectivity and infrastructure are facing it now. However, these problems are being solved. More and more every day and the next major technology in the coming years will be very different from today.

The growing of telemedicine technology into healthcare in rural areas is not to replace doctors but to expand healthcare and enable more efficient and lower cost services where specialized knowledge is not always available in the field.

The Rise of Remote Healthcare

Another area in which technology plays a role will be remote care. Due to many advantages of telemedicine and telemedicine during the pandemic, many providers have built remote or virtual care. The facilities allowed them to serve some patients simultaneously. Small towns are rural areas still lack such facilities, but the technology helps the answer to bridge this. Making use of virtual care services.

The Internet of Medical Things (IoMT) is changing the way a healthcare system for long. IoMT is the collection of medical devices and systems that connect to healthcare IT systems. IoMT devices include computer programs, IoT devices that are connected to healthcare professionals and data to the consulting physician in real-time. This data can be used to monitor and control. This data can be used to monitor and control and help the existing devices make adjustments and help the existing devices make adjustments. A device collects data, the use of devices, a device collects data, making many of these IoT devices that help predict a patient's likely future condition based on historical (previous) data. These tools are helpful in providing messages and wellness, especially in providing healthcare in remote areas.

McKinsey's latest report projects that the health care industry will be worth \$1.5 trillion by 2025. According to the report, the use of telemedicine has increased 30 fold from the pre-COVID health. The industry is expected to reach \$2.5 billion in India by 2025. It has a broad reach in India's relatively unpenetrated areas with better connectivity. What contributes to its growth is the integration of tele health with other virtual health services and hybrid modes of virtual health services. These systems can improve the patient experience, quality, accessibility, affordability, and outcomes. Doing so, the result is a drastic reduction in treatment costs while making deliveries more accurate.

Remote Healthcare for Rural India

In small towns and villages, where population density is not enough, there should be supplemented by physical/OPD supporting if patients can develop more confidence in the care provided. This physical model also facilitates and curative care and second opinion for patients in smaller areas, thus eliminating the need to travel to larger institutions for treatment, saving time, money, and lost productivity. Remote care also enables them from any hospital-acquired infections.

Most Primary Health Centers (PHCs) and Community Health Centers (CHCs) in rural areas lack the necessary equipment and bandwidth required by the growing eHealth technology. Can bridge this gap. Remote care can address the issues are providing healthcare

services provided with the speed and reach of a well-orchestrated state-of-the-art hospital and systems are being supported by the government. In fact, the **AIH (Artificial Intelligence)**, initiated by 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, AIH supports the establishment of new incubation centres called **AIH Incubation Centres (AIC)**. **AIH-NCM Foundation**, which is one such AIC, has initiated a start-up named **AIH Analytics Solutions**. This is working on multiple healthcare AI solutions at once. It has the vision of bridging the gap between patients and timely medical interventions and to create digital health solutions to empower professionals to care for their patients with efficacy, accuracy, and insight, with innovative technology. **AIH Treatment Response Assessment and Prediction** is a **genetic** and **clinical** data solution for cancer and autoimmune conditions including COVID-19.

Building on the vital skills of the country, **AIH-NCM Digital Healthcare** has introduced **AIH-NCM**. The startup is incubated at **AIH Incubation Entrepreneurship Centre, Maharashtra**, and is aiming to make a real-time scalable healthcare platform, whereby an **app** handles care of patients, doctors, diagnoses, and pharmaceutical companies to have a seamless yet **highly** **secure** flow of health data. As a healthcare delivery can be far more accessible and affordable. They are working towards making healthcare accessible to the bottom of the socio-economic rural Indian population, endeavouring to contribute to **Sustainable Development Goals** through **quality** **healthcare** **delivery**. Another such start-up is **AIH-NCM**, incubated at **AIH-NCM (AIH-NCM Foundation)** **Tatva University**, **Mumbai, Maharashtra**. **AIH-NCM** is the **operating** **system** for **integrated** **services**. They are **involved** in **surveillance**, **post** **infection**, and **transmission** of **respiratory** **infections** in **rural** and **hard** to reach **locations** using **drone**, **minimising** the **R0**, and **improving** **quality**. These **drone** are capable of **carrying** **and** **delivering** **essential** **supplies** to **remote** **locations** in **remote** **regions**.

Conclusion

The **Indian** **AIH-NCM** **approach** **to** **healthcare** **is** **the** **best** **in** **the** **world**. **As** **we** **have** **only** **got**

around **the** **corner**, **these** **AIH-NCM** **initiatives** **ensure**, **the** **Indian** **model** **can** **be** **replicated** **and** **efficiently** **adapted**. **Our** **healthcare** **system** **used** **to** **be** **patient** **centric** **and** **focused** **on** **clinical** **data** **to** **improve** **the** **quality** **of** **care**. **Now** **we** **are** **moving** **towards** **data** **centric** **and** **focused** **on** **clinical** **data**. **We** **should** **gradually** **move** **from** **the** **current** **patient** **centric** **model** **towards** **a** **data** **centric** **model**. **Once** **a** **strong** **health** **infrastructure** **has** **been** **set** **up**, **technological** **innovations** **will** **be** **the** **next** **logical** **step** **to** **revolutionise** **healthcare** **delivery** **systems**, **enhancing** **healthcare** **access** **at** **AI**, **Machine** **Learning**, **and** **Blockchain** **to** **advance** **AI** **technology** **in** **healthcare** **is** **an** **immediate** **priority** **for** **the** **government** **looking** **at** **creating** **jobs** **and** **entrepreneurial** **opportunities**.

Government, **academia**, **and** **private** **initiatives** **have** **gone** **the** **length** **of** **all** **specifications**. **The** **private** **sector's** **contribution** **will** **help** **reach** **the** **goal** **of** **universal** **health** **coverage** **and** **ensure** **India's** **progress** **towards** **a** **USD** **5** **trillion** **economy** **with** **a** **healthy** **population**. **The** **country** **will** **have** **a** **long** **path** **to** **cover** **up**, **for** **bringing** **to** **real** **world** **step** **with** **the** **latest** **and** **also** **with** **global** **standards**. **With** **the** **embracement** **of** **AIH-NCM** **start** **ups**, **health** **technology**, **development** **of** **enterprise** **wide** **solutions**, **and** **the** **continued** **to** **data** **centricity**, **benefits** **that** **reach** **the** **far** **reaches** **of** **the** **roads**. **This** **is** **bound** **to** **consolidate** **the** **new** **economy** **into** **a** **sustainable** **model** **which** **is** **an** **absolute** **necessity** **for** **the** **development** **of** **the** **nation**. **What** **is** **expected** **is** **a** **strong** **secure**, **interconnected** **healthcare** **system** **with** **the** **goal** **of** **accelerating** **health** **care** **for** **millions**, **empowering** **health** **care** **workers** **and** **real** **benefits** **to** **the** **coming** **years**.

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Conservation of Natural Resources

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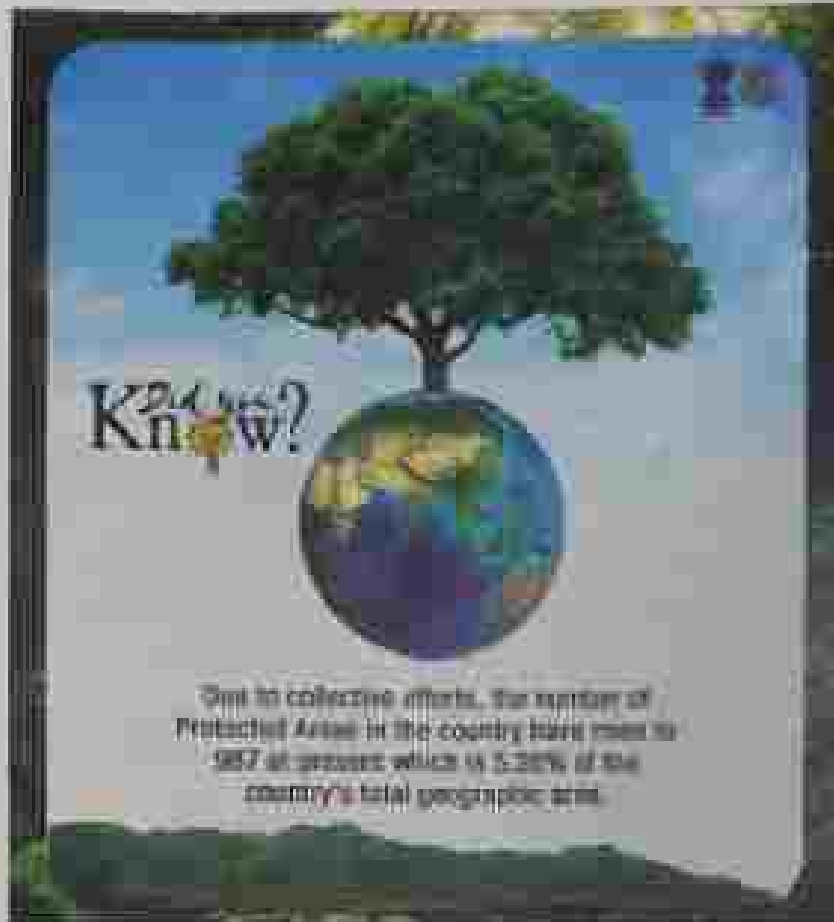
In the context of 'Biodiversity' (Part 02) (February 2022), Health & Environment (H&E) with sharing his thoughts and facilities in begin with small steps to develop vibrant temperament among their children. Today when climate conditions are changing, there is a need to associate effective environmental education along with the use of technology for environment protection, which will play an important role in sensibilizing the people about environmental issues. Environment protection is enshrined in our Constitution of India where in the State's responsibility has been laid down under Article 48-A. **GreenLife - Lifestyle for Environment** was awarded as **Leaders of Parties (LOP) - 10 of Europe**, which aims to promote environment conscious lifestyle, science and technology for environmental conservation has immense potential to strike the economic and ecological balance. Satellite based Geospatial technology has emerged as powerful tool in providing reliable information to assess natural resources of a region. Geo technologies (GIS) help and complement government's policy, process efficiently and transparently to make sound decision making.

The term "environment" was introduced by The Constitution of India in its preamble in the year 1950 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 the Indian 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 economic, natural or man-made, 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 level 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, livelihoods, 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.





1. **Inter-generational Equity:** To ensure judicious use of environmental resources to meet the needs and aspirations of the present and future generations.
2. **Integration of Environmental Concerns in Economic and Social Development:** To integrate environmental concerns with policies, plans, programmes and projects for economic and social development.
3. **Efficiency in Environmental Resource Use:** To ensure efficient use of environmental resources in the sense of reduction of their use for the sake of economic growth to minimise adverse environmental impact.
4. **Environmental Governance:** To apply the principles of good governance (transparency, openness, accountability, inclusion of the civil society, collaboration and regulatory responsiveness) to the management and protection of use of environmental resources.

7. **Enhancement of Resources for Environmental Conservation:** To ensure regular resource flow, complete finance, technology management skills, traditional knowledge, and social capital for environmental conservation through mutually beneficial multi-stakeholder dialogues, partnerships between local communities, public agencies, the academic and research community, investors and institutions and national development partners.

For the protection and conservation of Environment, several legislations exist namely Environment Protection Act, 1986; Water Prevention and Control of Pollution Act, 1974; Water Cess Act, 1977; Air Prevention and Control of Pollution Act, 1986. The law in respect of forest and

wildlife are Indian Forest Act, 1927; Forest Conservation Act, 1980; Wildlife Protection Act, 1972 and Biodiversity Act, 2002. Recently under the personal leadership of honorable Prime Minister of India, LIFE (Lifestyle for Environment) was unveiled at COP-16 in Goa, which aims to promote environment conscious lifestyle and to combat climate change. Paragunns were given that are (1) India will get its non-fossil energy capacity to 700 gigawatt (GW) by 2020. (2) India will meet 50 percent of its energy requirements from renewable energy by 2030. (3) India will reduce the total attached carbon emissions by one billion tonnes from now onwards by 2030. (4) By 2030, India will reduce the carbon intensity of its economy by 45% from 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. The

enable the individuals to adopt green habits for sustainable social development and promote a change and greater awareness for our future generations (understanding and addressing the environmental crisis is not an easy task, in fact it needs proper awareness of the problem and its source). Combining with the environmental global needs scientific, technical and political interventions, innovative solutions are needed to ensure environmental conservation 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 loves the environment, it is almost important that they are provided with quality education with regard to environment. Of the 17 Sustainable Development Goals (SDGs), SDG 4 refers to quality education and provides lifelong learning opportunities for all. And if the percentage contribution we make on towards environment protection and conservation of natural resources, then we can imagine the cascading effect it will have for nature's protection. In Strategic Pillar 500000000 by NITI Aayog, 2018, states: "It need to broaden the scope of Ministry Open Distance course (MOCs) and Open and Distance Learning (ODL) and tap their potential to provide access to quality education beyond programmed to students. It is imperative that such MOCs be scaled up for the environment education with the necessary adaptations in respect of the current environmental issues. Also National Education Policy of India (NEP) for climate change, pollution, water management, sanitation, conservation of biological diversity, management of inland resources, forest and wildlife, and sustainable development and living in some of the forest areas for environmental education."

Using above science and technology for environment conservation, a big impetus provided to take the economic and

biological balance. The knowledge of remote land cover information can help in proper management and monitoring of natural resources. Satellite Remote Sensing techniques are efficient 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 areas can be predicted and severity of forest fires through risk modeling can be controlled. Satellite Remote Sensing highlights the use of Geographic Information System (GIS) technology in wildlife mapping, land dynamics, forest fragmentation and its relation with the wildlife movement in the diverse complex forests studies conducted by researchers.

On this technology like 'bio-inquetry' can also help in generating food for around 400 million of population. This is a sustainable technology which is efficient, simple, cost-effective and which can generate energy on a local scale (http://ghpforum.com). Biomass energy from crop residues can be generated by using simple technology of biomass brooding. Under the watch of U.S. Forest National Institute of Himalayan Environment, Altimira Autonomous zone of Madhya Pradesh by manufacturing of bio-inquetry and bio-gasoline, under 12 IIT, (IIT, IIT Bombay Technology Centre), can work to involve local and marginalised groups of villagers to provide them with involve education training and furthermore livelihood generating support.



Technological Intervention of Ministry of Environment, Forest and Climate Change (MoEFCC)

- PARIVESH:** It pertains to the use of digital tools in order to capture the essence of Ministry Government and Minister's Guidance, a single window integrated environmental management system aimed at better production and expense facilitation by interactive, efficient and (environmental) single window that 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 integration process starting from submitting of application, preparation of reports, preparation of permits to grant of clearance. It facilitates online and offline decision-making and user interaction about the status of application with state as well as the states through EMIs and email notification of processing status and monitoring compliance. There will be single registration and single name for all types of clearances (water, forest, wildlife, CRZ). It has paved a way for creating the Centralised Processing Centre in the Ministry and has resulted in a paradigm shift in the environmental clearance process with features such as transparency, accountability, efficiency, cost-effectiveness, etc.

- Decision Support System (DSS):** This is a web GIS application developed to enable qualitative and quantitative information with regard to forest area in two different spatial layers for providing the information the user and forest boundary layer involves, age categories, forest type, status, forest classes, introduced species etc. available at www.parivesh.nic.in/dss.
- Clean Change Knowledge Portal:** (www.cccportal.nic.in) is a web based educational resource which captures latest and updated and information about the on going work by the various ministries in our state regarding climate information on the 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 level to address climate change.
- National Mission on Himalayan Studies:** (<http://nmhs.org.in>) MoEFCC attaches highest priority to protect unique and highly fragile Himalayan ecosystem. The portal covers all the aspects of National Mission on Himalayan Studies which is a Central Sector Scheme and Scheme through states involving of various components and their linkage, is addressing the key issues



working in conservation and sustainable management of natural resources, in Indian Himalayan region. Mission strives to work on enhancing livelihoods of local communities in line with the National Development Policy, 2005 of the Government, with a basic premise that the most located and effective basis for conservation is to ensure that people dependent on particular natural resource obtain better livelihoods from the act of conservation than from the degradation of the resource.

Wetlands of India portal: This portal (<http://www.wetlands.gov.in>) is an initiative to provide a single point access system that synthesizes information dissemination regarding wetland sites of the country, projects, initiatives and findings. Wetlands are crucial water bodies, transitional between terrestrial and aquatic systems, with high biodiversity and productivity. Twelve National Wetland Targets, outlined by the Ministry in line with the Convention on Wetlands (Ramsar), Ministry (Nov 2002-2003) 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 action plans, anchored by building a nurtured ecosystem that promotes research and innovation on the part of both individuals and organizations. To attract, nurture, synergize and retain critical human capital through a 'bespoke' science, technology, and innovation ecosystem, has been kept as one of the thrust areas of the policy. To also ensure a clean environment for people and future generations through green initiatives based on science that promote sustainability and clean energy, water, air, green, smart, green, and green-tech with (<http://www.nstip.gov.in>), Ashok Vasgawa, Minister, Science, National Science Olympiad Programme

and Mission Study, Agri-Net, National Awards and Knowledge Awards Programme shall 'The Innovation in Science Policy for Impaired Research' (INSPIRE) scheme are some of the programmes being conducted by the Department of Science and Technology. Regularly and in cooperation with different organizations to take a creative thinking towards scientific education. This year on the occasion of National Science Day (28 February 2022), Hon'ble Policy Minister while sharing his thoughts with the people through his monthly radio programme 'Mano Kallam', has urged families to begin with small steps 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 help and complement government's political, minister efficiency, transparency to make sound decision-making.

It is rightly said by environmental and green activist Dr. Anil K. Joshi (Padma Bhushan and Padma Shri) that the capital of a nation is its natural resources, and future depends balance between economy and ecology. Through science and technology, environmental conservation can be achieved in a better manner with the involvement of citizens in accessing information. Further, environmental attitude is directly linked with the level of knowledge regarding environment. It was emphasized by an individual today when scientific co-ordinate are changing, there is a need to improve effective education along with the use of technologies for environment protection, which will play an important role in sensitizing the people about environmental issues. This will aim to urge people to pose green social responsibility for the protection of environment.

The duties are Science in the Ministry of Environment, Forest and Climate Change (MEST), New Delhi and its Deputy, MEST, West Bengal's current term will be until 31st October 2022 (www.mest.gov.in).

Smart Water Future

Dr. Suresh Singh, Professor

Water is an essential life source resource and therefore conserving and managing each and every drop of water is vital. With this management involves facilities related to billions of liters and the vast quantities of intelligent available usage of technology can be to correct gaps, trends, realizations. Technology and innovations can indeed play an essential part in quality and safety, efficiency, ability operations, monitoring, treatment, and data analysis related to the water. Indeed, it leads to the path of a smart water system.

The last few years of the history of mankind, the best book illustrates it, there is, including films, books, movies, and blogs. One thing which is coming year after year is to find the world is a glass village while the countries are having similar opportunities and have some challenges to do with. The recent outbreak of COVID-19 disease, an outbreak of floods, and the persistent issue of climate change have substantiated the fact that the world needs to collaborate and fight the global challenges in a unified way. One of such global challenges is WWT (wastewater).

- 1. Over 1.1 billion people worldwide lack access to water.
- 2. A total of 2.7 billion liters of water were lost at least one month of the year.
- 3. Two million people, mostly children, die each year from diarrhoeal diseases.
- 4. By 2025, two-thirds of the world's population may face water shortages, the estimates are still uncertain.

The average and estimates of managing demand on water, with potable water, primarily for

drinking and other domestic purposes, is around 50 million litres per day and 1800 litres per day, with the case of constant water in a home as water tables are constantly falling and water quality rapidly declining. Due to the increasing population, the per capita annual availability of water in India, which was 1800 cubic meters per day in 2003, got reduced to 1500 cu. m. in 2011 which will reduce to 1100 m³ per day per year 2025. Any situation of availability of less than 1000 cu meter (cubic) is considered by international agencies as scarcity. By 2025, 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 is the urban management of wastewater. The per person sewage flows due to various water and sanitation loss 30 times higher in India than in China and 12 times higher than in Sri Lanka in 2010. With a country generating 140 billion litres (ML) of wastewater annually, most of it is not treated which also contaminates groundwater and if liquid waste management, poor sanitation conditions, and poor hygiene habits has continued



to a major portion of the population obtaining their water from streams.

Also, water is a secondary and tertiary resource for economic growth. As per the UN report on water and jobs, it has been estimated that reducing water availability by about 25 billion litres per day would kill and employ 10-14% of the light water and labour intensive dependent population in 2040. If we don't take any more drastic actions, then by 2040, water loss is percent of our GDP due water related issues.

Therefore, it is a right time to work on the water management in our life and adopted future. Water management also has to be without a loss of treating water to be separated from its natural environment, various population and their own own needs, the need of the near future and

the situation of other cities with such low flow and available resources when developing the smart managers. Environmental approaches combined with an traditional systems approach to water management can help create a sustainable water supply in our economy. Technology and innovation have an essential part to play in security and safety, efficiency, utility, operation, maintenance, treatment, and leak prevention related to the water sector in this sector. We are going to explore some of the ways in which technology specifically related to water management can help our days in the plant and some kind of effect of the sector available in cities which has to be done but will be done smart water future.

Smart Water Future

Smart Water mostly means the management and distribution of water while maintaining its quality. In order to ensure the sustainable supply of water in a smart future, we need to focus on two key areas: reduction in water resource usage and encouraging wastewater recycling and reuse.

Under Water Supply Management (WSM) due to low revenue, water can be considered as a special-to-intensify economy of the world building. Non-revenue water International Water



Association (IWA) described that all physical and commercial losses due to theft, pipe bursts, overflow of reservoirs, attractions and if material water loss along with a total unforced consumption could be considered as water loss under the term non-revenue water. Total unforced leakage distribution level losses of the non-revenue water it has been estimated that about 40-70 percent of water distributed is lost as a result of leakage, unbalanced structures, billing and collection inefficiency (World Bank, 2012). Moreover, the local citizens lack of water levels but not a vector water and understand the importance of the water.

Therefore, the high physical (real) losses due to poor and obsolete water distribution infrastructure need to be reduced for efficient water supply management. Reducing non-revenue water losses has considerable benefits including efficient management of water resources and re-energization for water utilities. There are four basic leakage management activities that can be undertaken by water utilities to reduce distribution losses, namely: (i) pressure management; (ii) active leakage control; (iii) pipe and quality of repairs and pipe pipe management; (iv) maintenance and renewal (APR, 2010). These steps historically follow conventional or necessary steps to manage leakage

while reducing physical inputs. For the second step, of leakage management, an active leakage control is essential to address some high-impact technological interventions, including monitoring of water supply infrastructure, by using GIS tools, installing smart devices, and telemetry. After visiting the water utility industry sector, in reviewing the literature and taking out the legal provisions early, thereby saving millions of liters of water along with time and money.

Water supply is an essential but scarce resource. Minimizing leaks and pipe drop of water is necessary. Degradation of natural resources due to rising pollution makes it even more important to drive a circular path of water by using and reusing water in the system. Smaller leaking water, that are unacceptable, negligible uses of water in a domestic household, which can be taken care of by treated wastewater. Wastewater can be treated as untreated or demineralized water depending on the level of readiness; amount of water water generated per liter available in the system. Country, infrastructure approximately 21, 500 NLD of average against the treatment capacity of 23,227 NLD i.e. 37 percent of wastewater generated only (APWC, 2015). Moreover, even the installed water 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 spur economy to improve the skill of recycling, reusing and treating wastewater in the system.

There are a number of technologies that can be used for the above purpose. Depending upon the process of recycled water, the efficient filtration technology is desired. Advanced green techniques (AGT) are also in use nowadays. They are environment friendly, energy conservative, and efficient. The new version and advanced AGT used for wastewater treatment is hybrid.

Apart from reducing consumption water and encouraging wastewater recycling and reuse, there are a number of smart solutions which help the community to save resources with water saving. Some of them are:

1. Implementation of smart meter of things (IoT) technology. This technology will reduce the loss of the water to be transmitted and a smart meter, wireless, and self-powered

to a central database to analyze and monitor the water system.

2. Sensors, remote sensing, geographic information systems (GIS) technologies, and visualization tools are other key elements to managing water resources at the very local watershed and regional scale.
3. Remote sensing/sensing technologies such as satellites and drones can be used primarily at regional to provide data for mapping water resources, managing water flows, and utility asset management. Data from such technologies can be used for precise water resource management and abilities for real-time of water storm water flow prediction, water conservation practices should be enacted during period of drought, and amount of treated water is returned to customers. In addition, satellite data can be used to provide water quality data (e.g., turbidity, age, depth, etc.) and hydrological forecasts, which when used in combination with in-situ measurements, offer 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, pressure and water level, among other parameters. Sensors can be deployed throughout systems to act early warnings by supplying the users with detecting, diagnosing and proactively preventive maintenance events such as pipe leaks, water distribution control, sewer capacity/overflow, etc. It can also provide useful information for preventative maintenance and improved long-term planning for water utilities.
5. Better water can be used to report 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 is water can work for the strategy and cost-effective operation of utilities, including better planning and execution of projects, better financial and understanding of resources, cost reduction, more efficient collection and distribution

residents, and ultimately reverse culture and societal behaviors.

- 2. **Augmented Reality and Virtual Reality** will use real technological growth. These tools enable organizations to digital water. All the VR technology for the internet to support decision-making in the field. By creating holographic representations of pipes, valves, and other assets, and offering simulations, scenario-based training for employees.
- 3. **Blockchain** algorithms from the potential for smart meter transactions. Between residents, providers and institutions. **SMART** and other smart is the water sector.
- 4. **Use of sensors** powered by solar or renewable energy. These applications will minimize piping can help to manage flows and save thousands of liters.

Good practices

It's already on the way ahead in flooding cities with advanced technologies. For example, World Bank-financed **Katanga Urban Water Service Improvement Project** (UNEP) has reduced NRW from 50 percent to 7 percent. It replaced the town of supply from 2 liters per day to 24 liters water supply.

Industrial districts and **Service Company** (SCOP) approach has introduced NRW management will show that the level of NRW dropped from 14 percent to 10 percent with continuous water supply from 7 liter per day.

In one of the unique strategies, the **Andhra Pradesh** government has launched the **Andhra Pradesh Water Resources Information and Management System (APWRIMS)**, which is a smart Water Solution (MIS) that targets the overarching objective of sustainable water management in Andhra Pradesh. The APWRIMS stream data from 1,256 personnel on a real-time basis across all the 13 districts of the state and combines the information with all 15,00,000+ data wells used for agriculture purposes in the state. All the data was collected from 2016 health in the state. The platform has data volume of 1000 terabyte, 10000 Mbit irrigation policy 73% for agriculture.

Technology also helps in important role in taking water-related disasters are floods and

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in the era of progress, sciences, and the digital world, we cannot the way from the concept of old technology but also life-saving technologies. Technologies give us the leverage to perform tasks that were inconceivable to our past generations. But, the important point to note over here is that technology alone cannot conquer the disasters created by our species. They are just a way to mitigate the issues 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 the habit to take nature for granted and work as a single unit to make our planet again a great green and beautiful planet of ours.

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Technology- Empowering the Masses

A. J. Perera

Actions 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 whether it is by the government or entrepreneurs, economic stimulation is essential. The rapid adoption of digital technology is the best way to get the message by setting a strategy of government vision, goals and ways ahead.

After recently completed, State Science & Technology Mission (SSM) of Science and Technology, Prime Minister Sri Lankeshu, made a call to bring research in science and technology into the next level. Since 2014, there has been a substantial increase in investment in the field of science and technology. Due to the efforts of the government, India's growth rate in the fiscal year 2014-15 was 7.6% against 7.5% in 2013-14. We have limited the growth from 7.5% to 7.6% in just a year time, but we do not have to stop there, we have to go higher level. The idea of the hour is that every one should focus on innovation to create local solutions according to their local problems. As said,

For a developing country, the role of science and technology can play a leading role. All its efforts should be well employed through universities, financial inclusion, education, health and transport. Investments in leading technological interventions will not only help boost productivity, better service users and efficiency, but also help ensure that the benefits of modern science reach the bottom of the pyramid, ensuring that all are able to access government services.

Actions 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. However, the key to

success of any legislation and whether it is by the government or entrepreneurs, economic stimulation is essential. In addition, innovation and digital technology over the years, many programmes for economic and social welfare of the weaker sections of the population, especially for those living in rural and remote areas, have been taken care of. Redistributing high employment opportunities and patronage would mean that only a minor percentage of the total benefits of innovation would reach the people they are meant for. For instance, the Public Distribution System has been drastically blighted down by



Journal of Management in the 21st Century, have been a catalyst and catalyst of the last year. Again, the public healthcare system has been affected by non-transparently. With its accountability and sustainability issues, particularly in the past where lack of awareness about their rights and difficulty in accessing healthcare facilities are another concern in the attempt of 1950 and some people to continue utilize the government healthcare system.

In the last few decades, technology has been the significant catalyst, forcing the idea is feasible of citizens and their ability to access government schemes. The rapid adoption of digital technology in the last few years has led the government to making drivers of government schemes better and more efficient, enabling them to reach the beneficiaries in the shortest possible time in a manner convenient to both the dispenser and the recipient of those welfare schemes. Let us look at the case 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 various software platform which connect India's 1.4 billion-plus population into the digital age. Defined as a set of open APIs and data such as mobile ID linked to unlock the economic potential of country data and promote digital inclusion. Abolition of India Stack by billions of individuals and businesses has helped process financial and social inclusion and introduced the country for the second age. The backbone of India Stack is a set of digital identity products centered around Aadhaar, the country's national digital programme. More than 1.1 billion citizens today carry their own Aadhaar number, making access to various government and non-government services easier for the citizenry. A large Aadhaar has enabled them of being for the citizen, especially the poor marginalized and deprived class through services delivery of universal benefits and other services under various state welfare schemes. Aadhaar has also been the facilitator of various banking services. More than 17 million small shops have been digitized and able to accept digital payments, bill management and loan repayment.

Direct Benefit Transfer

Ever since Aadhaar identification programme that ensured the success of the Direct Benefit Transfer system, direct benefit transfer or DBT had triggered a long wait since its early initiation by the government of India in 2013 to change the mechanism of transferring cash benefits and benefits. The programme was aimed at transfer of subsidies and cash benefits directly to citizens through their Aadhaar linked bank accounts with a hope that creating subsidies into the bank accounts would substantially reduce leakage and associated delays going to the ground level in a multi hierarchy of administrative offices and ministries, the mid-bureaucracy. Central PDS (Public Distribution System) ICPSMS, the earlier state of the Public Financial Management System (PFMS) of the Office of Controller General of Accounts, was chosen first as the common platform for rolling out the Direct Benefit Transfer (DBT) 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 Enabled Bank of India (AEBI) DBT has emerged as a high priority fund use of the government, in reforming government delivery system by re-engineering the existing process in a variety of welfare schemes for urban and rural poor of India. India Stack, ensuring smooth logging of the beneficiaries, authentication and validation of their DBT has become the accepted way of delivering government schemes with the delivery of over 100 schemes including the Public Distribution System (PDS), PM AASHA, Mahatma Gandhi National Employment Guarantee Scheme (MGNREGS), National Social Assistance Program (NSAP), Prime Minister's Aardram system (PM AARDRA), National Health Authority Mission (NHM), National Health Authority (NHA), various schemes of welfare such as through the National Scholarship Portal (NSP), PM AASHA, DBT AARDRA, and many more to name than 800 million people through the Aardram Mission, states like Uttar Pradesh, Bihar, Madhya Pradesh, Jharkhand, 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 INR 25,07,245 crore with estimated gain of INR 2,22,800 crore up to March 2021. All thanks to Aadhaar and DBT!

TABLE 1: Digital Benefits Transfers: Making Welfare Schemes Efficient

	FY 2021-22	FY 2022-23	FY 2023-24	FY 2024-25
Total Direct Benefit Transfer (₹ crore)	2,35,278	2,36,264	5,12,523	3,41,384
Number of Transactions	212 cr	215 cr	603 cr	63 cr
Avg. of Beneficiaries	118	308	338	
Avg. Amount per Beneficiary	200	735	1519	5385

Source: <https://www.mca.gov.in/>

Digital Platforms for E-Governance

Presently, the National Informatics Centre (NIC) under the Ministry of Electronics & Information Technology is serving as an implementation role in executing key IT projects in close collaboration with Central and State Governments. Through the use of its services of government services to their citizens, mostly through a variety of digital solutions, viz., in the following pattern: (i) the use of mobile IT tools, (ii) creation of dedicated e-governance portals of government including central, state, district, industry and regulatory level. A large number of e-governance initiatives such as e-Social, e-Health, e-Justice, MyGov, e-Insurance, e-Infrastructure, e-Health, e-Travel etc. have been completely digitized using digital platforms developed by NIC. NIC offers a wide range of services which include: multi-agency information network, e-Procurement, National Data Centre, National Cloud, e-Governance Infrastructure, e-Governance and e-Health Centre, multi-agency data based platform, e-Health Registration and e-Health, etc. This is a significant role in providing digital services to citizens. It has also developed several digital platforms for the socio-economic development of the country with 'One Nation One Platform' initiatives: e-KYC, e-Health, e-Health, etc.

Digital Payments Interface

The Digital Payments Interface (UPI) developed by the National Payments Corporation of India (NPCI) has emerged as a game-changer in the digital payments space. In FY 2021-22, the digital payments interface technology has been successful for 50 percent of total retail payments, with more than 30 million UPI QR codes reported to be installed. The number of UPI transactions in August 2022 was around 650 crore (up from 528 crore in 2021-22) in July 2022. The value of UPI transactions in FY 2021-22 was ₹ 24.15 lakh crore, for 2022-23 around ₹ 38,000

and 2023-24 around ₹ 48,000 crore. UPI has emerged as a significant value through UPI which is the most used payment mode. UPI has become the dominant payment alternative for a majority of users, especially for those making payments of small denominations. Whether it is the regular vendor, the customer, buyer or the petty shopkeeper, the UPI is clearly becoming the default payment option.

In parallel, UPI system has helped India reach from a country largely dependent on cash to a country transitioned to a significantly less cash economy. UPI has allowed users to safely transfer money from a bank into bank and across multiple bank accounts without entering the details of one's bank account to other parties. In the case of the widely banking non-bankers 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), Thailand (July 2021) and recently with partners in UAE and Nepal (February 2022).

Since the launch of UPI, India has been witnessing financial inclusion at a pace of her dream. As per the report of 2022, the country has more than 100 million the extent of digitalization of payments, as per the Reserve Bank of India's Digital Payments Index and Financial Inclusion Index. This indicates a growth in UPI transactions, at a pace of 221 percent over the last five years, has been the prime mode in the recent history of digital payments in India. This growth has been powered by a confluence of technological developments and government support policies and regulations. While UPI has been the prime mode through other digital payment modes such as Bharat Bill Payment System (BBPS), e-Mudra, Aadhaar Enabled Payment System (AEPS) and e-KYC, etc., it is the only mode which

quality, and ensuring the wide adoption of digital payments. APM and IFCM continue regularly to structure their payments in rural areas. IFCM has conducted a pilot for bulk e-commerce and has based APS to promote e-commerce APM. In further, the financial services in rural areas. Later this year, IFCM launched a service of IFCM which can be used as future payments & shows that the poor primarily use. The move will further boost financial inclusion, and bring more than 40 crore people from rural areas to the fold of digital payments.

Smart Cities Mission

Moving on from the initial focus towards the core backend modules added, one of the main pillars and scientific evidences of the impact of technology, enhancing the lives of our people in the ecosystem of our Smart Cities launched in 2015, the Smart Cities Mission (SCM) has evolved into a comprehensive strategy for higher economic growth and better quality of life of people by enabling social and technological and harnessing technology especially in favour of small and medium businesses. So whether it is smart waste management, smart water and sewer solutions, smart parks, education, transportation of the cities, efficient urban mobility, improved city administration, smart health and fitness facilities for the citizens, at every stage and segment, incorporation of Smart Solutions makes these cities use technology to improve infrastructure and services. Applications of smart solutions involves the use of technology, integration and data to make infrastructure and services better. For example, IFCM Smart Solutions in the transport sector includes traffic management (TMS) and solution which transforms time or cost to travel will have positive effects on productivity and quality of life of citizens. Another example is smart water supply and smart recycling which can make a substantial contribution to better water management in the city.

The next article on each Smart City in the upcoming comment

will Smart Cities (SCM) which involves all the activities taking place in the city from a technology enabled and responsive, smart format. The SCM is designed to improve the urbanisation around transport infrastructure with the help of smart deployed across the city to provide extensive interaction with appropriate utilisation of devices makes. What makes a CC different from a conventional system or an IT enabled is the ability to control the utilities and their sub-systems in case of an emergency. As of March 2022, IFCM has been implemented in 25 Smart Cities in the country. These CCs are playing an important role in ensuring better functioning and efficiency of areas like traffic management, smart management, detection of crimes, disaster management, etc. Other than APM and APS, IFCM is also of integrated Transport Management (ITM), Intelligent Traffic Management System (ITMS), Adaptive Traffic Control System (ATCS), Development of complete

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- Use a secure password & multi-factor authentication
- Stay protected against phishing attacks
- Avoidance of fake mobile apps

Non-conventional Energy Sources

*Yashwanth Rajaraman
Assistant Professor*

India is gradually transitioning from conventional sources of energy. For its needs, India is increasingly reliant on being one of the fastest growing countries in the world and with rapid growth in energy needs, India's increasingly important position in the global market and India's efforts in climate change will give a direction for the future generation.

Energy occupies a pivotal position to facilitate the growth of a globally developed India. With energy resources and frequent droughts, global warming is no longer a mere threat but a reality. Southern states play a dominant role in determining the pace of global warming. Conventional energy sources such as the burning of fossil fuels including coal, oil, and natural gas contribute to global climate change. In fact, fossil fuels account for about 75 percent of the total global greenhouse emissions and about 80 percent of the total carbon dioxide emissions. Apart from adverse ecological implications, excessive reliance on conventional sources of energy will hamper the development of India as well as its sustainable energy future.

In the past few decades, there has been a marked reduction in the global climate change commitments and the rate of government reduction of energy particularly fossil fuels, may be modest. These reductions also led to the formation of United Nations Framework Convention on Climate Change (UNFCCC), an international environmental treaty, in 1992 to combat the increasing greenhouse emissions. One of the first major climate undertakings under UNFCCC was the Kyoto Protocol which was signed in 1997. The Kyoto Protocol made the industrialized countries and economies to commit and reduce emission of Green House Gases as per their agreed individual targets. Subsequently, the Bali Partnership was also signed which would 135 countries signed a global framework to avert dangerous climate change by limiting global warming so will below 2°C and pursuing efforts to limit it to 1.5°C. Despite all these efforts, the carbon dioxide

emissions are soaring and calls for a shift towards non-conventional sources of energy.

India is gradually transitioning from conventional sources to non-conventional sources of energy for its needs. This is particularly significant as being one of the fastest growing countries in the world and the largest economy in the Asia Pacific. India's increasingly important position in the global market and India's efforts in climate change will give a direction for the future generation. Also, considering the environmental requirements of India and growing energy needs, shifting to non-conventional sources of energy is essential for the country's sustainable and holistic development.



The developmental energy sources refer to those renewable sources of energy that are derived from the sun and are replenished at a rate faster than they are consumed under the usual circumstances. The wind, water and the sun are the sources of energy that are not yet properly harnessed. These sources, like all renewable, source of energy, are most important attributes of non-polluting source of energy. The way they impact the environment, which is much less. Biomass converted to conventional forms of energy.

The Solar energy is renewable energy source. It can be as follows:

Solar Energy

The energy refers to the energy transfer from the sun to the form of light and heat. It can be harnessed by converting solar energy into other forms of power. Solar energy is a natural source of energy. It is an ecological source of energy and is a renewable source of energy. There has been a significant amount of solar energy in India in recent years. The solar energy has been used to run water pumps in the country during regular activities like cooking, lighting and other energy needs. Installation and design further develop energy sector in India. The varied scope of the solar energy can be used in various outdoor applications. It can be used in energy for

residential production used for other sources for manufacturing of solar panels. India has made an effort to use solar energy. The scheme is aimed at using the integrated manufacturing units of high efficiency solar PV modules by providing support through Production Linked Incentive (PLI). It is expected that the scheme will create additional 10,000 MW capacity of integrated solar PV manufacturing plants. It will further create jobs of solar PV cells, and modules and provide adequate support to Research and Development for about higher efficiency solar PV modules.

Recently, India has set record of solar globally in solar power. It is led by utilizing solar. Also, the efforts of the government have resulted in increase of solar power capacity by more than 15 times in the last five years.

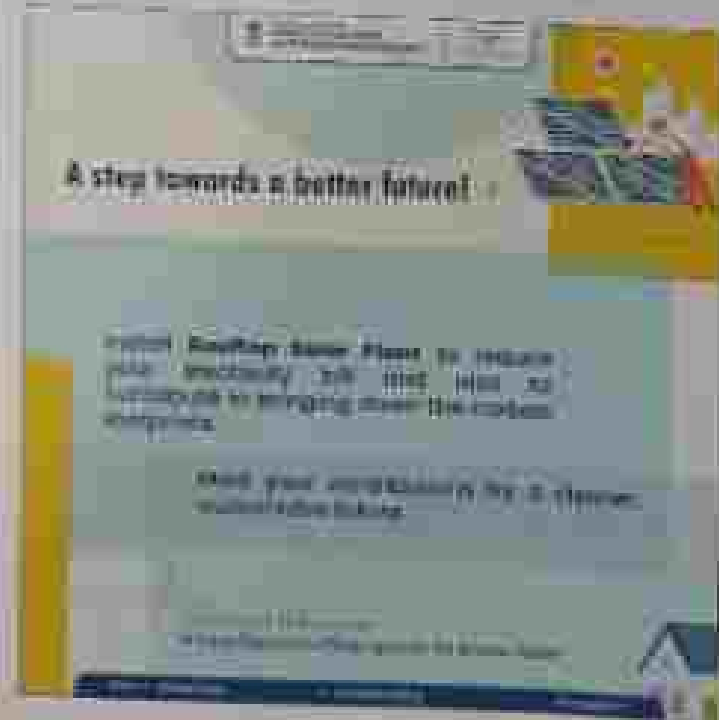
Wind Energy

The North coast of wind direction is used to generate wind energy. The expansion of the wind capacity in the country has reached a significant level. The project financing and construction have been initiated. The total capacity of 11,000 MW has been set up by 31st March, 2021. India has total potential capacity of 14,25,000 MW for the North coast and installed capacity in the country.

India with its long coastline of around 7,500 km has immense potential in harnessing offshore wind energy. The government has initiated over 200 wind financing projects across the country and has issued wind potential maps of 50 m, 100 m, 150 m and 200 m above ground level. The recent Allocation by the government has indicated a gross wind power potential of 100 GW in the country at 100 meter and 600,00 GW at 150 meter above ground level.

Tidal Energy

The energy produced from the flow of ocean water from the tidal fall of water is called tidal energy. It is a source of renewable energy. It is a source of energy for commercial purposes and it is a source of energy and development of sustainable high cost and impact availability of very high capacity high tidal energy in the country. It is a source of energy for the country.



Geothermal Energy

The energy generated from the heat derived from the earth's core is called geothermal energy. The gradual decline of radioactive particles in the earth's core generates geothermal energy.

Hydropower

Hydropower, or hydroelectric power, or liquid power, is considered to be one of the oldest and largest sources of renewable energy. It generates electricity by harnessing the flow of water.

Biomass Energy

Biomass energy is generated by living organisms or organisms that have died. Biomass is an organic material and contains stored energy obtained from the sun. Burning of biomass results in released chemical energy in form of the form of heat.

According to Ministry of Natural Resources Energy (MNR), about 22 percent of the total electricity generated in India is derived from biomass and more than 70 percent of the country's population depends on biomass for its energy in their regular energy needs. It is found, particularly in Bihar, it was estimated that the potential for use available in India is around 30 million metric tonnes annually.

Fuel Cell

This refers to the process of energy which uses hydrogen and oxygen to generate electric energy through chemical reaction with oxygen. Fuel cells convert hydrogen obtained from natural gas into electricity. Water is the only by-product of the process, making it a clean and sustainable energy source.

Significance of Non-conventional Sources of Energy

Transition to non-conventional sources of clean energy is vital for achievement of target of 175 GW of hydroelectric capacity, 100 GW of solar energy capacity, 100 GW of wind energy capacity, 100 GW of biomass energy capacity and 100 GW of small hydropower capacity by 2022. The use of such non-conventional sources of energy will help in reducing dependence on fossil fuels. According to the Ministry of Natural Resources Energy, the use of such non-conventional sources of energy will help in reducing dependence on fossil fuels. According to the Ministry of Natural Resources Energy, the use of such non-conventional sources of energy will help in reducing dependence on fossil fuels.

Additionally, shift to non-conventional sources of energy can help reduce greenhouse gas emissions. The shift towards non-conventional sources of energy can be a game-changer for the world's energy sector and can also ensure enhanced delivery of affordable clean energy that is accessible to all. The realization of India's energy goals will depend on the increased availability and affordability of green energy options.

From both environmental aspects, the economic benefits and the growing contribution to electricity generation will encourage countries to generate from renewable and natural oil plants. India has also set out ambitious national government energy goals in its national energy security strategy, rather than relying on non-renewable sources of energy, such as coal, oil, gas, and uranium. The government's commitment to renewable energy can be seen in its report of non-conventional energy sources and in its 100% green power for two quarters and energy system. India's vision for 2030 is to be a net-zero carbon economy. The government's commitment to sustainable development and energy security is a key element of its national energy strategy.

Governmental Interventions to Foster Renewable Energy Sources

In recent times, governmental policies in various forms, including financial incentives, will be implemented to promote renewable energy. The transition to clean sources of energy that can help India in achieving its energy goals.

As per government targets, as on February 2022, a total of 52,500 MW of renewable energy capacity (which has been installed) with a capacity of 55.78 GW from wind power, 20,170 MW from solar power, 31,890 MW from hydropower, 234 GW from small scale power and 65.57 GW from other hydro-power with greater capacity. India is committed to achieving 500 GW of non-fossil fuel-based energy capacity by 2030. The government's 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. The government is also working with companies to help them achieve energy security.

needs and emerging safety features. Such design process is important and indeed provides a competitive advantage.

Some of the recent environmental interventions for facilitating transition to sustainable society of energy are as follows:

- **Renewing Energy Effect Incentives (REI)** will be 100% effective under the economic zone to encourage energy projects, including offshore wind energy projects.
- **Setting up of wind-solar combined energy parks in coastal areas and inland areas** to encourage energy development in a plug and play form.
- **Winding up the State Transmission System (STS) charges** for inter-state use of power and wind power to promote local electricity generation.
- **Using of free transmission cost** and providing the infrastructure needed for installation of renewable power for clean power projects through schemes for installation of renewable power.
- **Indian Model Clean App** - **Greenhouse Gas** **Carbon** **Marketplace (IM-CO2EX)** has been launched for the operation of the first carbon market with trading of carbon credits and various other services. The scheme with a financial support of over Rs. 54,000 crore from Central Government has aimed to attract investment of Rs. 100 crore of other subjects. It has 2 components: (i) operation of 25,000 MW of Renewable Energy capacity and (ii) connected with power plants of installation of 15 lakh and renewable generating units and the installation of 20 lakh generation units powered by solar energy.
- **Energy Solar Park - II** - Expanding Under-04 Programme 2009 that will be able to (i) supply power to villages and (ii) Central Power Authority (CPA) introducing solar lighting for households in rural areas.
- **Support Hydrogen Market** - The Government is making plans to green hydrogen from water using solar in the form of production of 100 million tonnes of green hydrogen by 2030 along with other development of renewable energy

energy. The Mission program of hydrogen for other will primarily depend on Green Hydrogen. Initiatives such as performance along with higher production, research and development, manufacturing of small scale plants, in line with the National Hydrogen Mission. Incentives in August 2022 under the 100% renewable Renewable Energy Act will be provided to APJ-CRI will be used.

- **National Energy Wind Energy Park** was notified by Government of India in 2015 for the development of offshore wind power in the country. For facilitating Government through National Institute of Wind Energy has also issued guidelines for Offshore Wind Power Allocation Rules and Terms. These guidelines are aimed to make programme for offshore wind and related activities.
- **National Hydrogen Hybrid Policy** was adopted in 2018 by MoEF and it was aimed to provide a framework for integration of large and connected wind-solar PV hybrid projects for optimal land utilization, location of transmission lines, etc.
- **Ministry of New and Renewable Energy** issues New Policy Management framework related to Solar Bio-energy such as scheme to support installation of biomass based cogeneration in sugar mills and other oil seeds, Programme on Energy from Urban, Industrial and Residential Solid Wastes, Solar Power 100 MW Generation and Thermal Allocation Programme (TAP), New National Solar and Organic Matter Programme (NSOMP), etc.

The Ministry of Government is facilitating transition to renewable energy sector, but some issues in the international forum as well in the form of support from developed countries. Various initiatives, despite many efforts to solve it, will continue to exist, but awareness programmes like solar campaigns, solar panel installation, etc. are essential energy sources. It includes the following: (i) solar water heaters, (ii) solar home energy systems, (iii) solar water heaters, (iv) solar panel 50 billion of its energy requirements. This renewable energy by 2030. The Union will provide the total

projected carbon emissions by the 2030s under the 1.5°C scenario. The 1.5°C scenario is based on the carbon intensity by 2030 being 45 percent below the 2019 level. India aims to achieve the target of Net Zero which effectively means to completely negate the production of greenhouse gases.

This 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 attained great momentum. India today ranks 47th in the world in installed renewable energy capacity. India's non-fossil fuel energy mix increased by more than 25 percent in the last 7 years and now it has replaced around 40% of our energy mix.

Challenges in Transition to Non-Conventional Energy Sources:

The transition to non-conventional energy sources is a transformational one necessitating a robust technical and financial policy framework. Investing in enabling infrastructure and enabling ecosystem for building a green economy to renewable energy is a matter of concern. The plan includes the challenge of expanding power infrastructure to generate increased use of diverse energy sources and ensuring system flexibility through investment in solutions to utilizing mostly renewable to non-conventional energy sources. Among other things, financial incentives to use long-term loans at low interest rate to finance the system is one of the major challenge. International green funds have promise are gradually emerging but we still require the state support to India's net-zero goals. The shortage of green finance is shared by most of the green power investors. India has, however, a renewable energy sector is increasingly a viable for investors, despite its growth potential, with energy policy details largely left to international investors as opposed to the energy bill.

Further investment policies to address the issue of low creditworthiness and thereby lack of investor confidence in the renewable energy sector. Renewable energy sector still requires immediate attention and it should be ensured that investment

in conventional energy sources does not offset the renewable energy investments. Supporting private sector investments in the oil and coal to build the business to clean energy is also a possible challenge. The new financial strength of some of the electricity consumers will have a strong ability to make heavy payments. In renewable energy projects is also a tremendous leverage. It can also affect the viability of renewable energy sector and further slow down the pace of development.

Further coping up with immediate job and revenue loss due to switch from fossil fuels will also be a challenge. Addressing this requires strategic planning for young workers, frame and working of an energy market.

Way Ahead

Facilitation of transition to non-conventional energy sources will be the key to India's sustainable prosperity. A revolutionary shift to non-conventional energy sources can bring about transformational opportunities for sustained economic development. It will also create energy security and sustainable employment, income, health, education, and other socio-economic benefits. Sustainable growth and economic transition to non-conventional sources of energy utilization at zero fossil fuels need to be adopted as a basic plan. Global environment and climate situation of renewable energy resources. We green bonds, green funding, infrastructure debt fund, can help in this regard. Further financing required public private partnership for funding and making necessary technological investments is also needed. The state, regulators, and investors required and incentives which is necessary to the financial health of renewable energy sector. The existing government policies in this sector give a long way to address these challenges.

It is also important to further explore markets and investments spending on the domain of clean energy sources. In addition to will, utilize the existing investments, it will have innovation, and also the need of energy policies that are resilient to future economic and technological shifts. Identifying the renewable sources of energy will also help the country.

get further details about what to do towards the COVID-19 pandemic, please contact the following numbers. Further details are available on the COVID-19 website. Through a preliminary approach and assessment process, a further report from the Joint WHO/ICMR team towards the country of origin. The report from a WHO/ICMR mission in WHO/ICMR will be available for subsequent management and control measures. To stay healthy, creation of a good outdoor, indoor and workplace works. The facilitation of use of a number of international health goods, drugs and vaccines efforts from all the different countries and sectors involved.

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S&T: Towards Women Empowerment

Abhishek

Having women leaders at tables of power is crucial to bring a suppressed and frozen change in lives of both urban and rural women. This article talks about the initiatives of various leaders, women leaders, women health, national women commission and the government for promoting gender equality and empowering women in science and technology. The development stages (socially regulated) starts from the year 2011 onward.

On the occasion of the Independence Day on 15th August, 2022, Honorable Prime Minister Shri Narendra Modi emphasized that women power is significant for the growth of India as a rising. "If we look at North India, in law, education, science and politics our daughters and granddaughters are making major contributions to society. Globally, governments and organizations are focusing on promoting gender equality and women empowerment to untap the potential of women as the primary human capital. The first step date back to the UN Conference on Women in Mexico in 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 advancing women in developmental activities by creating opportunities for full participation at diverse workplaces.

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

Science and Technology is the most powerful catalyst that drives a nation's development, but historically women in this area are under-represented globally, and India has been no exception. The first Science and Technology policy in India (Scientific Policy, 1956) acknowledged women's role in science and technology and stated: "To ensure that the creative talent of men and women is encouraged and free to engage in scientific activity." However, the policy was more in words than in action and women continued to be absent from research and technology spaces. The various socio-cultural barriers and economic obstacles:

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



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The following initiatives were taken by the IITs since 2008 to address an achievement of provincial women scientists and progress in the field led by the IISc teacher Dr. Ananda Murthy, a pioneer in using gender representation in science textbooks and how it would influence young scientists who was invited to Dr. Sagar Chikmawala, IISc, Mumbai, and a national conference showcasing the achievements of women scientists was organized on Women's Day, 2nd March, 2008 at IISc, Mysore.

Recommendations of the Task force

The task force made several recommendations. These include recruitment of deserving women scientists in institutions, constituting committees to make women scientific committee members to avoid apathy, systems with internet group box and for selection of the exceptional female scientists.

Additional training, mentorship programs and schemes for career advancement will be only to those women who had been on a break due to family reasons were rolled out. In addition, women friendly workplaces with availability of crèches, camp housing and safeguarding policies against sexual harassment at work were rolled out.

To promote scientific temper among school girls, support of women science camps and interaction with established women scientists from industry was suggested. New programs with focus on nationally level, lifting up gender ratio in IITs, IITs, IISc, strengthening women's connectivity in geographical areas, dates with the members of women in science, developing schemes to provide mentorship and self-employment for women scientists with other key economic activities. Many of these recommendations were later developed into schemes and programs in support of the opening sectors.

RIDAN (Knowledge Advancement in Research Advancement through Mentoring) is a scheme inaugurated at IISc in 2014 to cover all the women inclusive members to bring parity with men in IIT and provide a framework for gender mainstreaming. It supports Women Scientist Scheme (WSS), originally launched in 2002-2003, Care Program (2003-09) and the first women funded Mobility scheme.

Women Scientist Scheme (WSS)

WSS provides an incentive to women scientists who have taken a break in a career primarily due to family responsibilities, migration, etc. for pursuing research in their related scientific or further special courses and engineering. WSS is divided into subject to award identify for promoting IIT scientists for visiting positions that may still promoting social benefits. Women Scientist Salary C. WSS provides a one year fellowship in the domain of Intellectual Property rights (IPR), participants who participate in the scheme get benefit of getting a career in IPR.

Cultiv Vigyanale (2008-09) – Promoting IIT infrastructure

One of the main goals that was identified by the National Task force was to increase the number of women in IIT by providing them access to cutting edge IIT infrastructure and promote scientific skills training towards the IIT coordinated and utilizing a special program. Establishment of University Research for Innovation and Excellence in Advanced Technologies (URIE) and subsequent with women university access limit to enhancing their R&D infrastructure.

Currently, the program is expanding into a new component 'Support for Women in Colleges' with a focus to improve STEM education and research in rural graduate colleges to provide quality science education to girls in small cities.

Mobility Scheme

Many women scientists face difficulties in their career due to relocation, marriage, transfer of spouse to a different location etc. and struggle to establish careers in their new place. Mobility scheme offers a contractual support towards conducting independent research in any location. The mobility scheme to undertake research during early phases of their career with minimal key career responsibilities.

Biotechnology Career Advancement and Re-orientation Programme (Bio-CARE) was launched by IIT in 2011 for career development of employed biotechnological women researchers up to 45 years of age by providing financial research grant support. The scheme is focused towards bringing women

throughout the population almost after a period interval. So far, 100 women scientists have benefited of whom 30-40 percent have been successfully implementing research projects.

Role of National Science Academies

The three science academies in India advised their work towards empowering women in science. Indian Academy of Sciences (IAS) formed a panel for Women in Science (WIS) in 2005 and came out with a collection of the journals of eminent women scientists published in a book series 'Women Scientists: The Women Scientists of India' (2007) and another with 'WIS: A Guide to life in Science' (2012). It was also got involved in creating Centre for Women further focused on promoting women scientists to make their full potential and to promote retention of women scientists in science and academic jobs under the guidance of science and society research program programme on 'Technological Empowerment of Women' during the year 2012-13. It has undertaken an initiative through its research institute - IAS and rural women scientists network, satellite centres, Regional Technology Centres etc. A few recommendations of their workshop were also implemented by government agencies.

The 8th panel of IAS was conducted a survey along with Council Institute of Advanced Studies National Training Bureau to form an expert group to set up a working group of IAS initiative a committee of Rural Women in Science in 2008.

The three science academies came together to establish a committee that reports to the President and Council on the status of women in government as well as in the life of women scientists. It should also report to the rural women's empowerment trust staffers. An inter academic panel on Women in Science of India was constituted in June 2008. It came out with a 100-page report titled 'A Strategy for Women in Science and Technology - 2012' which led to constitution of a Working Committee on Science of Women by DST in 2010. Together, the efforts of the three support scientific academies have generated a motivation for generally promotion of already existing or women are young girls, desired increasing opportunities in workforce and gender equality issues due to the state of women scientists.

Application of S&T for Women's Welfare

Rural women contribute in scientific domain of work is traditional agricultural practices interaction with science and technological advancements and with science activities such as agriculture, animal husbandry, post harvest operations, fisheries etc. However, all of these involve significant progress towards women, increasing skillsets, training, knowledge, knowledge to fund work and provide better methods and solutions to rural women. Under Ministry of Agriculture Farmers (MAF) under Ministry of Agriculture Farmers (MAF) along with IAS has initiated many programs and have received awards by honour contributions of scientists and technologists with design innovation solutions to reduce the labour of rural women in agriculture activities.

'S&T for Women' is a special theme called out by DST in 2001 and to directly engage women scientists to foster research and development of technology with a potential to improve the quality of life of rural women. Since its inception more than 2000 projects have been sponsored and around 500 technologies have been transferred in various areas of self-employment and empowerment of rural women.

Under this theme, rural women do not only provide access to technology solutions but are even training to adopt innovative methods to improve their working conditions. Women scientists are reported to have an alleviating technologies for empowerment of rural women in their work and rural regions. Some of the key themes and areas of intervention include - R&D in post-harvest technology like storage, processing, controlling, developing of improving tools and equipment and try and realize for egg industry such as labelling of eggs and groundnut and training women on the use of such new innovative methods and their handling and development of rural women for tapping the potential of local resources and novel ideas. Developing entrepreneurship centers in women key focuses.

Women Technology Park is another innovative approach towards women empowerment in S&T in rural areas - these represent a link between rural women scientists and scientists and researchers. The key mandate of women technology parks is to promote technology development and to demonstrate and adoption of products women.



employment in the areas of dairy, poultry, sheep and goat farming, aquaculture, horticulture, mushroom cultivation, vermiculture and vermicomposting. Other areas either focus on value added products, bio-fertilizer, bio-fertilizer production, vermi and fish products, FPO and vegetable quality products, etc.

Women Technology Parks are centres that are science-empowered and empower farmer's community to facilitate demonstration of innovations by women scientists. The goal is to train rural women through an attitude that innovation and practice of self-transforming technologies will help them build their own self-employment and generate knowledge self-reliance. These centres work in collaboration with purchase and sale who provide financial assistance. A national award for Women's Development through Application of Science and Technology has been instituted to honour individual innovators who have made significant S&T achievements for women's development at grass root level.

S&T also supported setting up a Centre for the Women's District Unit of District Industries District in 2007 as a pilot project under Government of India. It has an investment of Rs. 400 lakh. The Centre is an entrepreneurial, locally available scientific first generation, women empowerment and women working and provides support towards setting local level investments to micro-enterprises like up production of value added products such as herbal cosmetics and essential oil. The Centre also promotes, analysis and market etc.

Application of science and technology have become a key for providing a healthy lifestyle to rural women with special focus on nutritional, health, hygiene and computer and education and training projects.

International collaboration is also an important highly impacts area of rural women and the scientists are engaged in undertake environmental sustainability projects with a provision for making the objectives by involving the rural women.

Agri-1000, a programme introduced by S&T in the year 2005-20, with an aim to provide exposure to numerous young girls in 1000 districts and provide and their ideas to pursue a career in STEA. The programme involves field visits and

interviewing the girls from their school days to 10th. A spectrum of activities such as laboratory, special reports, mapping of parents and relatives with various scientific are provided to girls as a part of agri-1000 in science and related courses. The Navodaya Vidyalaya Centre (NVC) is the implementing partner of Agri-1000 with 100 girls annually across in 1000 rural knowledge Centres to girls from field, projects, of rural area and total areas.

Recent Developments

On 28th January 2020, India celebrated National Science Day with 'Women in Science' as the focal theme, emphasizing the fundamental need of quality sciences to enhance gender equality across all scientific disciplines and employment. S&T launched S&T Gender Advancement: The Transforming movement as a vision mode program S&T aims to push higher education institutions, research institutes and universities towards supporting diversity, equity and inclusion (DEI) with a belief that embracing a diversity of talent will ultimately allow institutions to flourish in their field. 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 initiatives will be applied to create policies, practices, and a plan for the extended self, workplace and accommodation needs and will be assessed for a S&T award. Apart from accelerating and strengthening institutions through certification and awards S&T would mentor, coach and provide training support to institutions to develop global best practices in gender equality.

Attention to women's concerns has raised the value of cognitive diversity in the scientific process. They are not many facts to be concerned, for example recently Dr. H. Kulkarni became the first woman DG, S&T and Secretary, DSI. With the ongoing efforts, the coming years shall hopefully see S&T workplaces where women representation is normalized in all roles, starting from entry to reaching higher echelons of leadership and policy making.

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Science and Technology in Agriculture

Sandeep Datta

The government's focus on new digital technologies, incentives and focus on research and development in the agriculture sector has helped various 'start-ups' come but also ensure that the country remains self-sufficient in most of the agricultural commodities.

The 'green revolution' initiated in the 1960s was an iconic country's foodgrain production that required expert interventions through the translation of scientific findings into planting varieties of wheat and rice and usage of pesticides and fertilizers. Through continuous development of new varieties of rice, wheat, cotton, maize, sorghum and other crops in the last few decades, India has emerged as a significant food and agricultural power achieving self-sufficiency in foodgrain production. India has emerged as the largest producer of rice in the world since long back.

The agriculture sector also plays a critical role in rural livelihood, employment and national food security. The sector covers the largest share of households in the country. Proportion of the total population depending directly or indirectly on agriculture for employment opportunities is

more than that of any other sector. It is estimated that around 75-80 percent of the rural population depend primarily on agriculture for their livelihood. According to the agricultural census 2015-16, there are 14.5 crore farming 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 highest growth in the past two years. The sector which is the largest employer of workforce, accounted for a weight 14.8 percent (2021-22) in Gross Value Added (GVA) of the country registering a growth of 3.6 percent in 2020-21 and 3.3 percent in 2021-22. The survey stated that the growth in allied sectors including livestock, dairy and fisheries has been the major drivers of overall growth in the sector.



Digital Technologies

The Committee on Drilling Excess, issued in its report 2018 has noted the role of digital technology, which will play a pivotal role in modernising and improving how rural India performs its agricultural activities.

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

The Government has finalised the new concept of India Digital Ecosystem of Agriculture (IDEA) framework which would lay down the architecture for the federated farmers' database. The database related to the schemes governed by the department have been integrated. The IDEA would serve as a foundation to build innovative, sex-focused solutions leveraging emerging technologies to coordinate effectively in creating a better ecosystem for Agriculture in India. This ecosystem shall help the Government in effective planning, monitoring and 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, Precision Farming, etc.

The sub-mission on Agricultural Mechanisation is being implemented since April, 2014. AFR is making the unreachd by bringing to the small and marginal farmers in the core and giving the benefits of farm mechanisation by promoting Custom Hiring Centers (CHCs), leasing 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-linked and certification at designated hiring centers located all over the country.

e-NAM: Online Marketplace

The National Agriculture Market (e-NAM) is a pan-India electronic trading portal which links 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 Organisations (FPOs), Mandis 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) in their respective APMC Acts for integrating their mandis with e-NAM platform - provision for a trading single point levy of market fee and unified open trading license for the State. States without APMC Act need to provide highly 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 market access to farmers to sell their agricultural produce. More than 1.7 Lakh farmers and more than 2.20 Lakh traders have been registered on e-NAM platform. Trading parameters for 143 agricultural and horticultural commodities such as cereals, pulses, oilseeds, fruits and vegetables, brass flowers and fibre crops have been provided. FPO trading module has been launched whereby FPOs can trade their produce from their collection center/ direct to market bringing the produce to APMC. Warehouse based trading module are provided in e-NAM to facilitate trade from warehouse based on e-NAM. Further, the e-NAM platform is fully interoperable with India's e-Market Services Private Limited (IbPS) platform of Government of Karnataka which will facilitate farmers of other the platforms to sell their produce in other platforms thereby increasing their market access.

In July, 2022, the Agriculture Ministry launched the Platform of Platform (PoP) under e-NAM intended to promote trade and marketing of agricultural produce wherein farmers will be facilitated to sell the produce outside the state borders. The PoP would increase farmers' digital access to multiple markets, buyers and service providers and bring transparency in business transactions with the aim of increasing price, search mechanism, authenticity, convenience, price realization, so far 43 service providers from different platforms are covered



order for such farmers to get accurate market prices, quality checks, warehousing, freight, market information, transportation, etc. The system creates a digital ecosystem for farmers who are benefited from the expertise of various partners in different segments of the agricultural value chain.

Through e-NAM, GPS based e-NAM Mandi location, farmers & sellers can locate their nearby e-NAM mandis using GPS based maps based feature through e-NAM mobile app. According to an Agriculture Ministry official, the idea for farmers to easily locate and purchase selected mandis 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 mandis as well as see e-NAM mandis on e-NAM mobile app. All the users going to the mandi, currently, the e-NAM portal is available in several languages: Hindi, English, Marathi, Gujarati, Tamil, Telugu, Punjabi, Odia, Bhojp, Malayalam and Kannada and English as Default. Next, to use e-NAM in the language of their choice.

PM KISAN Digital Payment

Under the PM KISAN scheme, the Government of India has been considering how the bank account of the farmer comes under Direct Benefit Transfer (DBT). According to agriculture ministry data, over 80 lakh in February 2019, 11 crore farmers have been benefited under the PM KISAN. Over 1000 to 2 lakh crore pay have been transferred to about 11.17 crore eligible farmers through DBT scheme. Farmers can do their self registration through the farmer corner on the portal.

The PM KISAN scheme will benefit 10

crore farmers in the form of the interest. Where farmers can view the status of their application, register or carry out correction of name based on their Aadhar 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. The PM KISAN will offer whether and farmers' Aadhar schemes to be launched in the future. The database will have all the information related Aadhar, bank account of farmers and the land records of farmers will be linked with their records. The last priority of the Government will be to digitally convert all credit the database.

AGMARKNET portal

Integrated Scheme for Agricultural Marketing Scheme (AGMARKNET) to improve condition of agricultural marketing infrastructure by providing backward linkage support to farm, cooperative and private sector. AGMARKNET services are provided through AGMARKNET portal which is a 62% government portal that caters to the needs of various stakeholders such as farmers, industry, trade, government and other institutions by providing agricultural marketing related information from a single window. It facilitates web-based electronic flow of the daily arrival and price of commodities in the agricultural produce markets throughout the country.

National Alliance on Horticulture

It provides holistic management of the horticulture sector (including banana and coconut). NORNET project is a web-enabled user-focused system for providing financial assistance under the PM KISAN Integrated Development of Horticulture 2.0 (PMKISAN 2.0) to small and medium horticulture Government

in NMSI where its 100% financing has been provided to all the operational activities – other activities being, infrastructure, processing and other services to the beneficiary's bank account through CCI.

Agriculture Infrastructure fund

To making a national – long term safe source facility for investment in water projects for improved management, infrastructure and community farming assets through incentives and financial support in order to enhance agricultural infrastructure in the country. Financial assistance is provided directly in the form of Interest Subsidies and Credit Guarantee for setting up post-harvest management infrastructure to beneficiaries such as farmers, Farmer Agricultural Credit Societies (FACS), Farmer Producers Organisations (FPOs), Self Help Groups (SHGs), State Agricultural Marketing Boards (SAMS) along with other schemes in the country from other Central/State government schemes. Can also be linked along with all the total cost of the fund is Rs. 3,648 crore. All rural and K 2 (rural per gram) under this financing facility has interest subvention of 3% per annum. The subvention is available for a maximum period of 7 years.

National Project on Soil Health and Fertility

The Government has reorganised all soil health related and integrated nutrient management through composite use of both organic and inorganic sources such as nutrient, biofertilisers, green manuring, mulch crop residue recycling etc. of soil nutrients with 4Rs approach – right quantity, right time, right place and right type of fertilizer for judicious use of chemical fertilizers and to reduce use of chemical fertilizers. In addition, Soil application and slow releasing fertilizers including water treated sludge and growing leguminous crop are also advocated and use of resource conservation techniques as soil storage, integrated Nutrient Management has been provided through Implementation of Soil Health Cards scheme from 2015.

Soil Health Card provides nutrient status of the soil along with recommendation about balanced and Integrated use of inorganic and organic fertilizers to maintain good soil health that results in increased production. To save soil health cards to farmers

all the country, it is to provide a loan to address delivery differences in fertilization practices. Soil Health Card Portal is a system 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 issues – weather forecast, market notified list, market price of commodities, advisories about diseases of fertilizer, seeds, pesticides, weedicides, insecticides for 12 major crops, crop varieties, soil health card, soil testing lab, soil cover and guidelines, nursery subsidization and diagnostic centres, crop insurance and government schemes, budget, Pusa Krishi mobile application for information about the latest technologies developed by the Indian Agricultural Research Institute. The app provides details about GIS technologies.

Usage of Drones in Agriculture

To promote the use of drones in agriculture, the Department of Agriculture and Farmers Welfare has issued the Standard Operating Procedures for use of drones to provide and nutrient application, which provide simple instructions for effective and safe operation of drones. In order to make drone technology affordable and available to the farmers and other stakeholders of the sector, financial assistance of 100 percent cost of drone upto Rs. 50 lakh per drone together with the contingent expenditure is provided under sub-scheme on Agricultural Mechanisation to the Institutions of Indian Council of Agricultural Research (ICAR), State Veterinary Services (SVS), State Agricultural Universities (SAUs), State and other Central Government Agricultural Institutions, ICAR/ICAR and public sector undertakings (PSUs) engaged in agricultural activities for its dissemination to the farmer's field.

Farmer Producers Organisations (FPOs) are provided grant of 75 percent for purchase of drone for its dissemination to the farmer's field. It aims to provide agricultural services through drone application. Financial assistance of 50 percent of the basic cost of drone and its attachments up to a maximum of Rs. 200 lakh is also provided for drone purchase by the Custom Hiring Centres (CHCs) under

Cooperative Society of Farmers, FPOs and Rural entrepreneurs.

ICAR has also launched more than 300 mobile apps developed by ICAR, State Agricultural Universities and VVs and uploaded on its website. These mobile apps developed in the areas of fruits, horticulture, veterinary, dairy, poultry, fisheries, natural resource management and allied allied subjects, offer valuable information to the farmers regarding various aspects of practices, market prices of various commodities, weather related information, advisory services, etc. The Government is providing incentives towards on various crop related activities to the marginal farmers through SMS.

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 etc. high yield, quality and climate resilient, conservation of resources and development of intelligent identification technology (IT) enabled platform for technology transfer among farmers and stakeholders. According to an official report, Indian Council for Agricultural Research (ICAR) during 2021-22 developed and released 309 varieties/ hybrids of field crops including 25 varieties

with special traits and 54 varieties of horticulture crops for cultivation by ICAR.

The government, during 2020-21 and 2021-22, had allocated funds to the tune of Rs. 1756 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. 7402 crore and Rs. 7708 crore in 2020-21 and 2021-22 respectively to ICAR for undertaking Research and Development in Agriculture for introducing new technologies, their demonstration at farmers' field and regularly holding seminars for diffusion of new technology.

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

High yielding, pest/disease, drought resistant and climate-resilient varieties and technologies in crops, horticulture, animal and fisheries sector developed besides precision farm management for production and post production



agriculture developed by ICAR have proved 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 enabled farmers to enhance their income and overcome their economic condition. Besides, State specific strategies for increasing farmers' income, provided by ICAR, are also helping farmers to expand their income.

Collaborative Institutional Thrust of Research

National Agricultural Research System consisting of more than 100 Research Institutes, 65 core agricultural universities, three major agricultural universities and four universities having agriculture faculty besides 63 All India Coordinated Research Projects and Farmers' Projects, each having a large number of coordinating centres across the nation, is amongst the largest and strongest research systems of the world.

Empower 4 plan by ICAR to shift research from a commodity-based to farming system based approach. ICAR has issued multidisciplinary research complexes in different regions of the country to address this. A dedicated institute ICAR Centre for Integrated Farming Systems (ICIFS) Modbury, Uttar Pradesh is working on Chancesville, creating, adapting and refining the farming system models in all the agro-climatic zones. Another institute, ICAR National Centre for Integrated Farming Research Institute has been established to facilitate and promote dissemination and commercialisation of the technology for integrated farming through various farmer's approach. Sub-Group, Region Specific Integrated Farming System Models developed by ICAR are disseminated through the network of research institutes and KVM across the country.

ICAR's Roadmap for Food and Nutritional Security

ICAR has developed a road mapping for next 30 years focusing the areas of strategy and initiatives for ensuring food and nutritional security of our people, farmers' prosperity and to enhance the natural resources base to promote inclusive growth and sustainable development of the Indian agriculture sector. The focused areas of research

and development include: Genetic enhancement of plants/animals for higher productivity, water efficient varieties of crops and stress tolerant productivity enhancement through sustainable fertilisation and mechanisation of agriculture and food systems, enhancing value, safety and health through food processing, development of energy efficient technologies and farming practices, education and human resource development & developing and promoting innovative technology based systems.

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

The government's thrust has been to help farmers adopting 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.

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Technology and Innovation in Rural Economy

Aravind Haldar

Time and Technology are making social communities, a learning and innovation capacity that increases the effectiveness of their efforts to solve problems and improve their lives. The technological advancements empower these communities and increase the effectiveness of their development efforts through enhanced digital literacy to achieve the objectives of growth, innovation, food security and sustainable development in rural areas. It effectively reduces the poverty impact of the rural industrial revolution (a concept of science in critical technology (AI) models, the Internet of Things (IoT), green computing, machine computing and more). All elements are necessary to design the gap between digital and analog India.

I f it's a matter of access and more than that, it's a matter of quality of India's population. The digital literacy is not a simple matter but there is no getting away from the fact of AI. To bring with the local level (are limited) from the development in various technology and economic industry as well as directly benefit from innovations and of some important digital literacy to the expansion efforts in telecommunication and rural through such means, yet to be done, technology for one area that is used in various rural

employment, varying, wanted to make value-added products. Rural welfare through digital literacy, driving water sanitation, alternative of projects, providing all communications using climate change and conceptualized better economic system, particularly for remote areas in AI. Science and Technology can develop in rural communities, a learning and innovation capacity that increases the effectiveness of their efforts to solve problems and improve their lives. The technological advancements empower these communities and increase the effectiveness of



their development efforts through efficient decision making to achieve the objectives of growth, employment, food security and sustainable development in rural areas. Agriculture is the mainstay of India's vast populace.

Let us first discuss a few key services in agriculture that are very closely related to Science and Technology. An access to information through different types of Agricultural Information Systems (AIS). Monitoring the situational status, regional and environmental impact through efficient information processing tools. Socio analysis of environment deterioration, soil health, geo-information etc. Education and Communication Technologies that are playing a significant role in generating new opportunities for learning and knowledge management, facilitating value chains and Technology can contribute greatly to solving complex problems, among them and facilitating the emergence of Virtual Communities of Stakeholders that generate and exchange information and knowledge among themselves, and Decision Support Systems (DSS) through which data and information provide relevant knowledge about the informed decision-making and playing an important role in connecting information systems into knowledge systems. In fact, if well managed, networking is the first step in the direction of developing effective knowledge development processes that may lead to learning networks.

The Government of India has rolled out schemes from education to financial literacy and agritech to skill development that cater to nearly 500 million people living in rural areas. It is admirable to see that the central and state governments are aligned with a vision for the betterment of rural India. Digital literacy and connectivity have revolutionised the labour market and provided a platform to upscale and become financially independent. Advanced information has helped the rural areas improve their growth prospects and the policymakers would reform the broader strategies and sector-specific (APFCs).

Centre for Monitoring Indian Economy (CMIE) data from the consumer pyramid household survey shows the share of agriculture in GDP employment has gone up from 18 percent in 2019-20 to 41.48 percent in 2020-21. So, it has become

highly apparent to work towards the creation of employment specific schemes and technological interventions in agriculture. In April 2021, the Government of India launched a NAM (National Agriculture Market) digital platform for farmers that integrates agricultural markets practices with a theme of e-NAM (e-National Market). The platform will farmers and buyers to use its Agriculture Market Trading Committee (APMC) e-NAM interfaces, commodity arrivals, buy and sell trade offers, this helping farmers bid for the best prices across markets, thereby promoting uniformity in agricultural marketing and remove the information asymmetry between buyers and sellers through technology. The number of registered farmers has increased to 60 crore, while 1.33 lakh traders transact on this platform. More than 1000 Farmer Producer Organisations (FPOs) have also been enrolled on the platform.

In view of the Ja. Health Ministry's focus on using and improving core skills for creating appropriate livelihood forecasting structures in all the districts in the country, the Government of India is mandating to mapping all of India's aquifers. Through national program on Aquifer Mapping and Management (NAQM) which aims at 3D mapping the aquifers and characterising them in terms of quantity, quality and spatial and temporal distribution of water level and resources. The Union Budget of 2022 has also provided for an array of digital technologies and digital to propel growth in the rural sector. The government of India to monitor the progress and take appropriate will help some appropriate learning methods.

To effectively reduce the positive impact at the fourth industrial revolution is through of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), genetic engineering, quantum computing and more. It is essential to use technology to bridge the productivity divide and provide access. As more and more rural households access skills training to create access to wealth of employment opportunities, the area of agriculture is being done by workers who may have to perform highly labour-intensive jobs on their own, resulting in lower productivity levels. They must face a lack of access to and, if given, credit, inputs, and markets.

Digitalisation will go a long way in reducing traditional barriers such as opening markets and the ability that have been obstacles of starting big and small businesses. Digitalisation offers more and more ways that can lead to acquisition of skills, wherever skilled individuals from rural areas connect first the huge employment opportunities and small businesses that get an opportunity to grow. Digitalisation, undoubtedly, can provide huge growth opportunities and opportunities for better employment offers opportunities in rural areas. Skilled rural areas will gain the advantage of getting better of products and services, and therefore step to add and join the business for themselves to benefit of the digitalisation might be beneficial for local communities. As a digital entrepreneur can have more exposure, allowing rural areas to tap into new markets, local goods and services are likely to reach more distant markets at a reasonable and affordable price than they are now. Many of new technologies, digital services, for example, can operate 24 hours a day and reach to the customers that are far away, lowering transportation costs and distance time. Digitalised solutions are also expected to be cost-effective with overall cost reduction, where operations are less disrupted and risks are not populated by high risk activities using outdated or obsolete hardware. This type of digital system can help rural entrepreneurs overcome economic and infrastructure challenges.

In rural communities, new technology can also help to improve the entrepreneurial business environment. Digitalisation is beneficial as a business through digital solutions for greater access of learning, other benefits for education and SMEs looking to set in competitive markets. Finally, new technologies such as additive manufacturing, for example, 3D printing, has the potential to reduce the need for availability of skills by making small scale production more cost-effective. Local businesses can use 3D printing to create items and distribute parts according to local demand without importing or using vast quantities of materials from elsewhere, reducing their dependency on imports.

Over the last few years, especially in the context of the ongoing COVID-19 pandemic, the financial

recovery in the country has indeed seen digitalisation and smartification. Technology has been used as a catalyst in establishing a network that includes farmers, groups and societies, rural extension and many related sectors and industries. These efforts have also helped to build resilience that can overcome various setbacks and ensure sustainability of rural businesses. Several efforts of the Government of India to attain a technology-oriented performance-based strategy in rural areas are going on. For instance, the Direct Benefit Transfer (DBT) programme launched by the Government of India aims at reducing a huge number of benefits across the country. Currently, more than 300 lakh people has been transferred through DBT mode as of September 2022. In addition, a programme by the Union Aadhaar ID programme, has not only streamlined applications and funds but also has been instrumental in increasing transparency and accountability in financial transactions, including benefit transfers to people, farmers and other beneficiaries of various schemes.

One of the important schemes for technology related rural development is Technological Advancement for Rural Areas (TARA). The scheme under the Skill Enhancement Education and Development Program (SEED) is aimed at providing the necessary support to science based voluntary organisations and field institutions to raise and offer differentiated plans to promote and nurture their as 'Upi incubators' and 'Active field organisations' to work and provide technical solutions and effective delivery of technologies for employment generation and social benefits. Another a Shriya is a platform developed by Ministry of Labour and Employment to benefit unorganised workers who are not member of Unions, Provident Fund Organisations (PF/O) or Employees State Insurance (ESI). Starting in 2019 the Shriya aims and working on a plan and initiatives to provide many benefits. The country's 177507 plan and funds have already been linked to National Optical fibre network (NOFN) by June 2022 using existing Public Access Undersea Fibre Cable (PAFCN), Pacific and Power Grid and using this fibre to connect all 25000 panchayats in 100 days future, thus giving the connectivity of broadband given per household and schools.

Common Service Cell (CSC), the Digital India mission, and projects, drive to the rural parts for essential utility services, such as internet programmes, healthcare, finance, education, agricultural services and a variety of government-to-citizen (G2C) services to different levels in rural and urban areas of the country. It also caters to aspects that come in to regional, geographic, linguistic, and ethnic diversity, enabling the government to fulfil its mandate of a socially, fiscally, and ecologically inclusive society. Digital India Land Records Modernisation Programme (DLIR) involves with modernising land records by adopting e-governance. It is an effort to develop an appropriate Integrated Land Information Management System (ILIMS) to make land records more specific, transparent and demand-driven, thereby ensuring

it is the universal responsibility that support for the land. It helps and providing for entrepreneurial development in the village, not for accelerating the overall development of rural India. Rural India is becoming digital, with smartphone and internet usage increasing 40 percent over the last four to five years. Online dissemination through e-governance is a major step for digital adoption amongst rural population because they have more now ways to explore advanced financial services. There has been a significant decline in the cost of technology access as well. Data costs have decreased 84 percent over the last three years, from Rs. 18/GB in 2018 to Rs. 3/GB in 2021. While having a digital India includes initiatives, we find Aadhaar and Aarogya (mobile health and disease system), Abroad Rural National Initiative, The system, social documentation, investments for programs like opening bank accounts and making the benefits of government schemes and welfare, the program starts the Digital India (PM-DI) with roughly 46.25 of their accounts already opened as of August 2022. We made significant strides in cashing all government benefits from the centre, state and local bodies via the digitally accounts and furthering the digital India mission of 50% farmers who signed up for the digital India scheme. One of the major efforts in rural financial inclusion, ensuring that women have control over their bank accounts. On farmers women's labour force participation

through independence, bringing power and social economic inclusion. The Reserve Bank of India set up an Rs. 145 Cr. Payment Infrastructure Development Fund to create 20 lakh digital payment bank accounts over time.

The surge in start-ups have drawn million new players into the market to offer technology based solutions. The all-time marketplaces, digital and transportation services and especially delivery services. Large traditional players are adopting technology to reduce operational costs and costs, either by diversifying without changing or by partnering with emerging players. Several global tech giants (e.g., IBM, Microsoft) see the space as a new growth opportunity and are investing in innovative solutions for this sector, monitoring IoT and automation.

In the next few years, India's food and agriculture ecosystem will face the risk of massive disruption. Much planning is underway to reduce this risk and will include and replace traditional agriculture with new farming models, advanced agribusiness services, and new food products. In the last 10 years, several start-ups have emerged to reduce systemic inefficiencies among inputs and materials, precision farming, processing and storage, farm-to-fork, and services like logistics and distribution are increasing distribution efficiency, which can cause 17 percent to 24 percent leakage when profitable commodities are moved from farm to market.

Technology's strengthening seems to FPOs and enabling rural rural information sharing and greater transparency. For example, WhatsApp groups have become a common communication platform for teaching farmers, while ITC partnered with NITI Aayog on its Transformation of Agricultural Districts programme, they had built upon their e-Choupal ecosystem's experience and leveraged 5.1K WhatsApp groups to 5.1K villages and enabled capacity building of 5.44 lakh farmers through digital training and dissemination of farming-related information. Leveraging local languages and voice messages, the two-way communication proved to be major facilitators for increasing engagement, resolution of physical payments, and enabling faster and easier access to such participants in rural areas that have been well-served due to lower

