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YK GIST - OCTOBER 2021

- Science and Technology
- Social Transformation in Rural India

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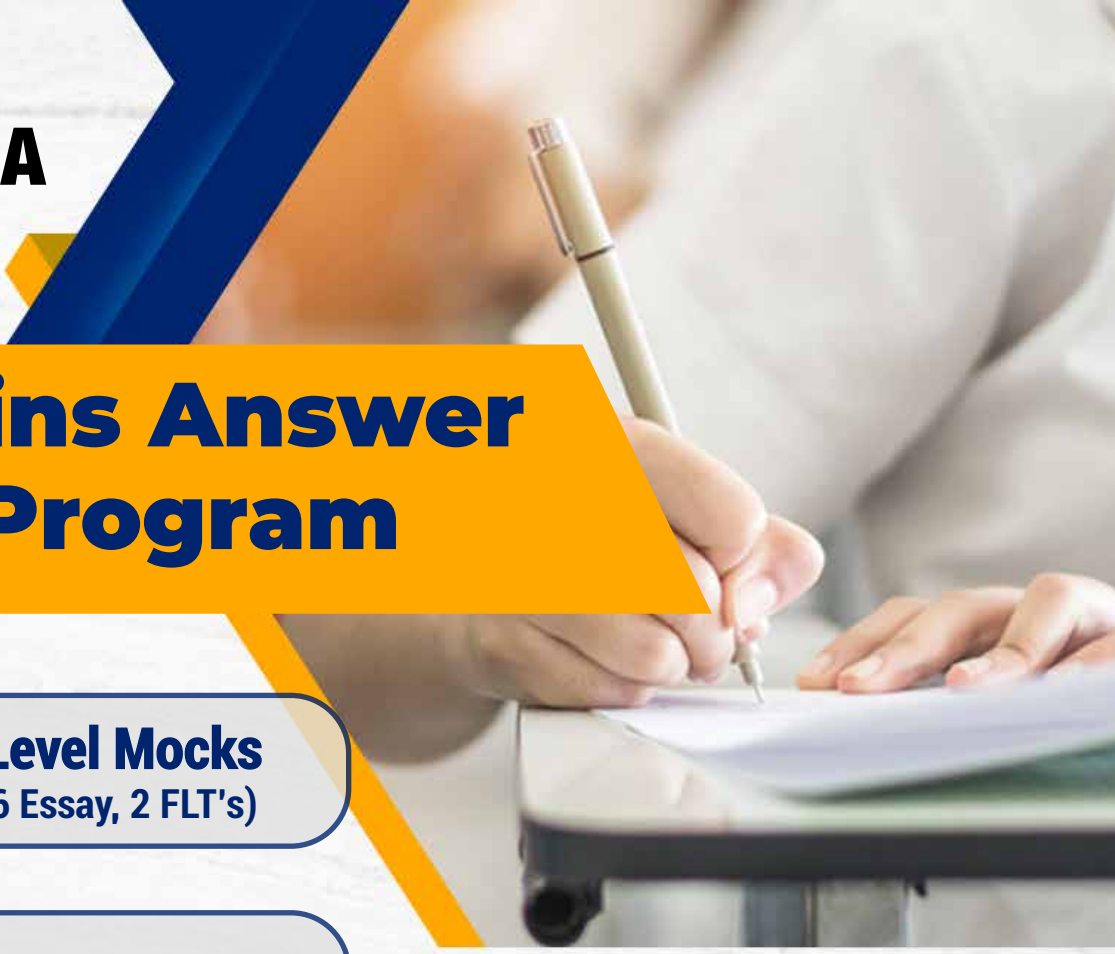

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SCIENCE AND TECHNOLOGY

Chapter 1: COMBATTING COVID-19 AND INDIA'S RESPONSE TO THE VIRUS

MISSION COVID Suraksha – The Indian COVID-19 Vaccination Development Mission

- India is using three vaccines – the Oxford-AstraZeneca jab, known locally as Covishield; Covaxin by Indian firm Bharat Biotech; and Russian-made Sputnik V.
- India has also approved its first vaccine for those under 18. The three-dose ZyCoV-D vaccine is the world's first DNA vaccine against Covid-19. It is expected to roll out in few weeks. ZyCov-D has been developed with the support of Department of Biotechnology and the Indian Council of Medical Research (ICMR).
- The government has also authorised Indian pharma company Cipla to import Moderna's vaccine, which has shown nearly 95% efficacy against Covid-19. But it's not clear yet how many doses will be made available to India.
- Zycov-D is a COVID-19 vaccine developed by the Ahmedabad based Zydus Cadilla group and is the first vaccine in India that can be administered to adults as well as those 12 and above. It's also the only DNA-based vaccine in the world and can be administered without a needle, purportedly minimizing chances of reactions. The vaccine has been developed in partnership with the Department of Biotechnology under the 'Mission COVID Suraksha'. The three-dose vaccine once administered produces the spike protein of the SARS-CoV-2 virus and elicits an immune response.

The Centre is funding the development of four vaccines, which are currently in various stages of human trials

- DNA-based vaccine candidate by Cadila Healthcare, Gujarat
- Protein sub-unit vaccine by Biological E Ltd, Hyderabad
- Adenovirus intra-nasal vaccine by Bharat Biotech Ltd, Hyderabad
- m-RNA vaccine by Gennova Biopharmaceuticals, Pune.

India's COVID Diplomacy

- **Lifted restrictions on HCQ Drug**: India lifted its ban on exports of the drug HCQ, when there was demand for it across the world.
- **Medical Assistance**: India sent medical teams to countries in the neighbourhood to assist the government to tackle the rising cases of COVID-19
- **Vaccine Supply:** Under its massive Vaccine Maitri programme, India exported more than 66 million doses of COVID-19 vaccines to 95 countries worldwide. Of these about 10 million were grants from the government, 20 million were sent as part of the global COVAX facility, and the rest 36 million were commercial export
- **Forefront of multilateral diplomacy efforts:** The Quad plan aims for production of one billion vaccines to be offered to South East Asian countries
- **Fight at WTO:** India-South Africa are putting efforts at the WTO to have all vaccine patents (TRIPs) waived for the coronavirus pandemic duration

Initial challenges to the vaccination drive

- Logistical problems
- Supply bottlenecks
- Vaccine hesitancy
- A devastating second wave of Covid-19

What caused the 2nd spike?

- **Cluster-Spreader events:** The spikes in Maharashtra were caused by a series of super-spreader events, or clusters. Experts opine that the rise in the number of cases was not due

to a variant of the virus with a tendency to transmit faster, but because of select super-spreader events.

- **Letting down of guards:** In general, there seems to be an impression among people that the country is over the worst phase of the pandemic, and hence, many are letting their guard and masks down.
- **Lack of Strict Regulations:** During the previous surge, strict regulations imposed by States along with fines and penalties for violating protocols helped ensure compliance. But, with the decreasing number of cases, safety measures were overlooked, possibly leading to the clusters that have pushed the numbers up again.
- **May be a blip:** There are others who believe that a 'second wave' is not really a wave, but more of a blip. One reason for this, according to experts, could be the fact that 60% of India's population had already been exposed to the virus and the country may have approached herd immunity.

Issues with Accelerated Rollout of the Vaccine

- **Vaccine Shortage:** Problems in scaling up production, and in the supply and management of vaccines continue amid the surge in cases. At the optimistic rate of three million doses a day, it would take at least 260 days from April for every adult to get at least a single shot.
- **Changing Vaccination Policy:** The processes initiated by the government in early January 2021 to expand India's manufacturing capacity were under the assumption that it would be at least August before vaccines could be fully opened up for all. Given the shortage of vaccines, India cannot afford to have a single or universal policy and needs to make it more targeted.
- **Weak Bargaining Power of States**: Leading international vaccinators such as Pfizer and Moderna have supply commitments already tied up and it is unclear if merely the policy move of liberalising vaccine supply will leave States in India with the finances and negotiating power to procure enough stocks of vaccines.
- **Unequal Access between States:** Leaving states to their own means will only increase policy incoherence and unequal access between states with different fiscal capacities and healthcare infrastructure
- **Shortage of Raw Material:** The inability of getting the much-needed raw materials from the United States – bags, vials, cell culture media, single-use tubing, specialized chemicals, etc. that have now been banned for export has disrupted the vaccine production in India.
- **Balancing Global Commitments:** Another issue is concerning international obligations. Of the 38 million doses the global alliance program Covax has so far distributed to 84 countries, 28 million doses were from India. That obligation may have to be followed up perhaps as they would need for their second dose.

How China Contained COVID-19 Virus? – Stellar role by Residential Committees

- At the grassroots, the most critical role was played by the residential committees (RCs). Though officially not part of the state and **defined as institutions of self-governance,** these committees are the instruments of the communist party for effective governance and political control.
- They are mandated to perform administrative tasks, implement policy, mediate local disputes, and assist government agencies with maintaining public surveillance, health and sanitation, care for the elderly, etc.
- At the outbreak of the epidemic, after the initial days of confusion and voluntary action by individuals, the **RCs soon took charge**.
- In Wuhan, for example, all 7,148 communities were closed off. Community workers strictly enforced rules of entry and exit.
- They also made calls to residents asking about family members' health and status, knocked on residents' doors to conduct regular temperature checks, gathered information about

travel history, **provided home delivery** of daily food necessities to people in self-quarantine and elderly residents, helped in **contact tracing** and transferring sick persons to community health centres. etc.

- **Central leadership made provisions** for the benefit of the workers like subsidies, provision of health equipment, insurance, publicity, and other institutional support. Clear channels were established by Central Leadership to pass down resources and authority from central to local organisations.

India crosses 100 crore COVID-19 vaccine doses

- It has fully vaccinated about 30% (291 million) of the eligible population and 707 million have had the first dose.
- India aims to fully vaccinate about a billion people by the end of 2021 but experts say the drive needs to pick up pace further to meet the target.
- This milestone makes India the second country to reach the one billion mark – China crossed it in June.

The Way Forward

- **Massive Multimedia Campaigns:** If fresh lockdowns are to be avoided, we need to enforce masks by investing in massive multimedia campaigns for information, education, and communication, like it was done for polio and HIV.
- **Strengthening Vaccine Supply Chain:** Enhancing Electronic Vaccine Intelligence Network (eVIN) system will enhance real-time information on vaccine stocks and storage temperatures across all country's cold chain points.
- **Boosting Domestic Production**: Government should provide necessary financial packages for ramping up domestic production of vaccine manufacturers for expanding their production facilities and improving upon their supply chains.
- **Learning from China's RC Model**: Many urban areas have residential associations and local governments that can undertake similar mobilisation as RCs in China. However, this cannot be done without a centralised plan of action, which is the key aspect of this model.
- **Centralised Leadership & Support to states**: Given the nature of this pandemic, the need of the hour is for the central leadership to step up and coordinate policy measures across the country.
- **Steps to be taken for Vulnerable population:**
  - An online database needs to be created to register the names and places of origin and migration of the workers e.g. An online database named as National Migrant Information System (NMIS), by the National Disaster Management Authority (NDMA). It will help streamline the movement of the migrant workers.
  - Setting up of relief camp, facilitating food and healthcare to the poor people, migrants should be priority for the regions where transport facility is not available. e.g. Over 500 hunger relief centres were set up by the Delhi government.
  - Arranging the interstate transport facility for the migrants so that their migration can be streamlined. e.g. Shramic special trains were arranged by the Government.
  - Relief measures also need to be announced. For instance, soon after the nationwide lockdown was announced in late March, Finance ministry announced a ₹1.7 lakh crore spending plan for the poor. This consisted of cash transfers and steps to ensure food security.
- **Time to reskill India:** Reskilling can be taken up in a phased manner. Initially target of reskilling should be a section of migrant workers who have returned to their source states. At least 25% of the at-risk workforce needs to be targeted, which is seeking redeployment and can be made relatively productive through reskilling. This reskilling should be a short-term mission because most of this workforce would hopefully get back to their first occupation/location once the situation improves in the medium term.

- **Remodelling skill value chain:** Candidates have to be motivated to undergo remote counselling and a predominant digital delivery of learning.
- **Leveraging of Technology:** Since vocational training is more hands-on, technologies like AR/VR-powered simulating training has to be integrated with video-based teaching.
- **Capabilities and Mindset:** Trainer capacity has to be enhanced to provide more online training. Importantly, a mindset change at all levels of skill delivery, administration and governance has to be enabled.
- **Bridging Digital Divide:** Digital infrastructure for a time-bound reskilling effort needs to be seamlessly integrated into the long-term plan of 'digital-first skilling'. This requires addressing issues like digital illiteracy & digital accessibility.

PRELIMS ORIENTED MCQ

Q1: What is a Circumbinary planet?

1. It is a planet that orbits one star instead of two
2. It is a planet that orbits two stars instead of one
3. It is a planet that orbits three stars instead of two
4. It is a planet that orbits two starts instead of three

Solution: 2

Q2: Cryogenics finds application in

1. Surgery, Space technology and Magnetic levitation
2. Telemetry, Space technology and Magnetic levitation
3. Space technology, Surgery and Telemetry
4. Surgery, Telemetry and Magnetic levitation

Solution: 1

Q3: Who said these line for Mahatma Gandhi "Generations to come will scarce believe that such a one as this ever in flesh and blood walked upon this Earth."

1. Jawaharlal Nehru
2. Martin Luther King Jr.
3. George Orwell
4. Albert Einstein

Solution: 4

Q4: What mode of protest did Mahatma Gandhi adopt in South Africa to oppose racial discrimination?

1. Satyagraha
2. Armed Revolution
3. Do or Die
4. Quit India

Solution: 1

Q5: When was Mahatma Gandhi assassinated?

1. 15 August 1947
2. 26 January 1950
3. 30 January 1948
4. 2 October 1950

Solution: 3

Chapter 2: THE VACCINE QUEST

What should be the evaluation criteria for COVID-19 vaccine?

Evaluation of candidate vaccines for COVID-19 should be done on technical parameters and programmatic suitability. An ideal vaccine would provide all of these —

1. A vaccine that provides immunity of high degree (90% + protective especially against severe illness), broad scale (against different variants) and durable (at least five years if not lifelong)
2. A vaccine that is safe (little or no side-effects and definitely no serious adverse effects)
3. A vaccine that is cheap (similar to current childhood vaccines);
4. A vaccine that is programmatically suitable (single dose, can be kept at room temperature or at worst needs simple refrigeration between 2°C and 4°C, needle-free delivery.
5. A vaccine that is available in multidose vials, has long shelf life and is amenable to rapid production.

Stages in the development of a vaccine:

According to the Centres for Disease Control and Prevention (CDC), there are six stages of vaccine development: exploratory, pre-clinical, clinical development, regulatory review and approval, manufacturing and quality control.

- **Exploratory:** This is research-intensive phase of the vaccine development process which is designed to identify "natural or synthetic antigens that might help prevent or treat a disease."
- **Pre-clinical:** During this phase, researchers use tissue-culture or cell-culture systems and animal testing to determine whether the candidate vaccine will produce immunity or not.
- **Clinical development:** It is a three-phase process. During Phase I, small groups of people receive the trial vaccine. In Phase II, the clinical study is expanded and vaccine is given to people who have characteristics similar to those for whom the new vaccine is intended. In Phase III, the vaccine is given to thousands of people and tested for efficacy and safety.
- **Regulatory review and approval:** If a vaccine passes through all three phases of clinical development, the vaccine developer submits a Biologics License Application (BLA) to the licensing authority.
- **Manufacturing:** Major drug manufacturers provide the infrastructure, personnel and equipment necessary to create mass quantities of vaccines.
- **Quality control:** Stakeholders must adhere to procedures that allow them to track whether a vaccine is performing as anticipated.

Approaches to Vaccine Making

There are three main approaches to making Vaccine

1. **The whole-microbe approach**
   - Inactivated vaccine: The first way to make a vaccine is to take the disease-carrying virus or bacterium, or one very similar to it, and inactivate or kill it using chemicals, heat or radiation Ex: Flu & polio vaccines. Also, Covaxin is an inactivated viral vaccine.
   - A live-attenuated vaccine uses a living but weakened version of the virus or one that's very similar Ex: measles, mumps and rubella (MMR) and the chickenpox vaccine.
   - Viral Vector Vaccine: This type of vaccine uses a safe virus (different from the one that caused disease) to deliver specific sub-parts – called proteins – of the germ of interest so that it can trigger an immune response without causing disease. Ex: COVISHIELD: A chimpanzee adenovirus – ChAdOx1 – has been modified to enable it to carry the COVID-19 spike protein into the cells of humans
2. **The subunit approach**
   - A subunit vaccine is one that only uses the very specific parts (the subunits) of a virus or bacterium that the immune system needs to recognize. It doesn't contain the whole microbe or use a safe virus as a vector. The subunits may be proteins or sugars.
   - Ex: whooping cough, tetanus, diphtheria and meningococcal meningitis.

3. **The genetic approach (nucleic acid vaccine)**
    - A nucleic acid vaccine just uses a section of genetic material that provides the instructions for specific proteins, not the whole microbe.
    - DNA and RNA are the instructions our cells use to make proteins.
    - In our cells, DNA is first turned into mRNA (messenger RNA), which is then used as the blueprint to make specific proteins.
    - A nucleic acid vaccine delivers a specific set of instructions to our cells, either as DNA or mRNA, for them to make the specific protein that we want our immune system to recognize and respond to.
    - This is a new way of developing vaccines.
    - Before the COVID-19 pandemic, none had yet been through the full approvals process for use in humans, though some DNA vaccines, including for particular cancers, were undergoing human trials.

Vaccine Testing Phases

Vaccine testing typically begins with animal and lab testing before going on to different stages of human testing.

- **Phase A:** Phase one trials are small-scale, usually involving few participants, to assess whether the vaccine is safe for humans.
- **Phase B:** Phase two trials often involve several hundred subjects, and mainly evaluate the efficacy of the vaccine against the disease
- **Phase C:** The final phase involves thousands of people to further assess the efficacy of the vaccine over a defined period of time, and can last several months

Even after the vaccine is ready, there are a lot of challenges, including whether the vaccine is effective in all populations, and if it can be used for different strains of the novel coronavirus, which might start mutating as time passes.

Vaccines are a priority for global health and we have seen their value in the current pandemic. In India, we need to be able to move faster for next time, and hence proper planning and implementation is of utmost priority right now.

PRELIMS ORIENTED MCQ

Q1. Graphene is frequently in news recently. What is its importance?

1. It is a two-dimensional material and has good electrical conductivity.
2. It is one of the thinnest but strongest materials tested so far.
3. It is entirely made of silicon and has high optical transparency.
4. It can be used as 'conducting electrodes' required for touch screens, LCDs and organic LEDs.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 2, 3 and 4

Solution: (c)

Q2: 'Neutrino' has been quite frequent in news due to important scientific research. What are the possible sources of neutrinos?

a) Big Bang

(b) Cosmic Rays

(c) Supernova

(d) Nuclear Bomb

(e) Geological Reactions

(f) Nuclear Reactors

(g) Sun

Correct codes are-

(a) 1,2,4,6 and 7

(b) 1,2,3,5,and 7

(c) 2,3,4,5,6,and 7

(d) 1,2,3,4,5,6 and 7

Solution: D

Q3: Who conferred the title of the Father of Nation upon Mahatma Gandhi?

1. Sardar patel
2. Lord Mountbatten
3. Queen Victoria
4. Netaji Subhash Chandra Bose

Solution: 4

Q4: In which year did Mahatma Gandhi first appear on Indian currency?

1. 1947
2. 1950
3. 1969
4. 1975

Solution: 3

Scientific Innovation and Indigenisation in India

India has an impressive scientific heritage in terms of innovation-in fields such as mathematics, astronomy, medicine and material science which has been carried out in the Indian sub-continent since ancient times. However, in today's time a remarkable gap exist between this scientific knowledge and the 'common' man and woman, until recently, few efforts have been made by the government **to** bridge this gap.

Critical Impediments to Scientific innovation and indigenisation in India:

- **Institutional problems:** Our educational institutions are heavily exam oriented and thus lack in focusing on creativity, critical thinking, and open-mindedness. Which hampers the innovative and indigenisation spirit.
- **Poor university-industry linkage:** The curriculums are outdated and they lack focus on skill development and employability potential.
- **Administrative bottlenecks:** Dominance of bureaucratic administrative structure in Indian research units and political interference in day to day activities of research institutions by government is in conflict with intellectual sum. Public access to science and scientists is limited.
- **No cordial interaction** between interaction of the scientific community with administrators and lawmakers for public engagement and societal support for science and the scientific activity.
- **Funding Issues**: India (Public and Private) spends only 0.82% of GDP on R&D, Private sector spends less than 0.2% of GDP on R&D, India attracts only 2.7% of global spending in R&D whereas China attracts 17.5%.
- **Lack of curiosity-driven research** and role of indigenous knowledge or "folk science" in a diverse bio and geo sphere has pushed India backwards. There is no proper networking between practitioners and experts from diverse field into a national platform and share the same with scientific community and students.
- **Weak IPR regime of patents and trademarks** reduces incentives for entrepreneurs to invest in innovation and research.
- **Reducing Fiscal Deficit**: For instance, India is the second largest arms importer in the world (after Saudi Arabia). Higher import dependency leads to increase in the fiscal deficit. Despite having the fifth largest defence budget in the world, India procures 60% of its weapon systems from foreign markets.
- **World Economic Forum survey** says that only 17% of Indian respondents stated that the so-called "cultural support pillar" was available in the country. Thus it hinders people from taking up research and other activities which have uncertain outcomes. It has created a cultural affinity for stability and job security over risk-taking.
- **Large country, Diverse issues:** While literacy levels are increasing, scientific literacy is still drastically low. Given India's large population, limited resources and multitude of languages, mass science education faces particularly great challenges. Without more attention on local languages, much of the population will miss out on science communication efforts.

India's innovation policy has to shift beyond a mere focus on R&D spending to transforming the ecosystem. Our innovation policy has to shift beyond a focus on increasing R&D spending to inculcating a mindset of "out-of-the-box" thinking in our universities, start-ups and corporate.
Steps needed to be taken up:

- **Elimination of rote learning**: India's educational policies need to be redesigned, with a focus on building cognitive abilities, beyond rote learning and focus on quantitative subjects. For instance, recent New Education Policy is a step in such a direction.
- **Need to use Data analytics boom**: Need to focus on taking advantage of the data analytics boom, imp-roving educational qualities beyond our existing islands of excellence to the whole university system
- **Greater access to public data** to build innovative applications: A supporting ecosystem for this will require providing greater access to public data, through the Right to Information Act and a push to providing public data (for example, on train punctuality, water scarcity, air pollution metrics) for building innovative applications on a real-time basis.
- **Doubling national expenditures on R&D** with most of the increase coming from the private sector and universities.
- There is a need to **encourage investor-led research**. In this direction, the Science and Engineering Research Board (SERB) has already been established. It is a promising start that needs to expand with more resources and creative governance structures.
- **Impetus to various indigenous start-ups under Make in India**. Stand-up India is the need of the hour.

As a supplement to these steps following government initiatives also need to be implemented in their letter and spirit to inculcate culture of scientific innovation and indigenisation.

- **Atal Innovation Mission:** It was launched by the NITI Ayog as an innovation promotion platform involving academics, entrepreneurs, and researchers utilizing national and international experience to promote the culture of innovation, R&D in India particularly in technology-oriented areas.
- **India Innovation Growth programme (IIGP) 2.0:** The programme provides funding, capacity building, mentoring, incubation and business development support to the innovators.
- **Defence Procurement Policy:** Defence Procurement Procedure added an additional category "Buy (Indian-IDDM)" i.e. Indigenously Designed, Developed and Manufactured, as the most preferred way of defence goods acquisition.

Conclusion:

With globalisation, it is easier to notice the growing contrast between the designs for promoting innovation and indigenisation in the western world and in India. Having a young population and a strong Diaspora that is more affluent than any other country, India has the potential pioneering high-tech innovation and indigenisation. If necessary steps are implemented in letter and spirit will definitely India to be a 'Vishwaguru' in modern technological developments and their indigenisation.

Chapter 3: REDEFINING SCIENCE COMMUNICATION

Science has brought forward remarkable changes in lives of human beings. This has been possible because the researches made in laboratories and on-field sites have been documented and communicated to the world.

Science communication activities have gained momentum in India in past few years where efforts have been made from both governmental and non-governmental platforms to enhance the public understanding of science. The idea has been to help science and a scientific culture penetrate India's socio-culturally diverse society, and to transform it into a nation of scientifically thinking and scientifically aware people.

However, science communication needs to be more effective, both in terms of quality and quantity. There still exists illiteracy or ignorance about common scientific principles, such as the fact that the Earth orbits the Sun or that gravity keeps the man grounded.

Communicating the science

- The whole business of research outreach is fraught with problems.
- The standard sequence for scientific work should be patent, refereed publication, newspaper, with the first and third steps wholly optional in an academic institution.
- The danger in encouraging "communication" too much is that there would be a temptation to reverse the order and make it newspaper, mostly no publication (or controversial publication), and then no patent. This ofcourse is an extreme situation but still possible as it is already happening in some CSIR and DBT/DST laboratories, sadly even from some IITs.
- The main problem with a scientist trying to disseminate his or her work to the general public is that the detail that is lost in communicating with the public is not a superfluous extra.
- The detail is the whole work. Without this detail, there would be no point in the work. Details are hard to understand and appreciate. Many breakthrough discoveries are incredibly hard to envisage, carry out and understand.

This brings forward simple but intriguing questions

- *Do scientists in publicly funded institutions need to communicate the gist of their work to the general taxpaying public? Are they morally bound to do it?*
- *Does an increased awareness of science among lay persons increase its acceptability, and eventually create a better sense of its requirement, thereby leading to increased funding?*
- *Or on other hand, is it easy to communicate high science to the public?*
- *Is there a difference in communicating the hard and soft sciences to non-specialists?*
- *In simplifying scientific matters for the sake of explaining it to lay people, does one lose the essential thread of the work?*

These questions have no easy answers. But they can be answered by using various modes of communication to reach out to the masses.

What can be done?

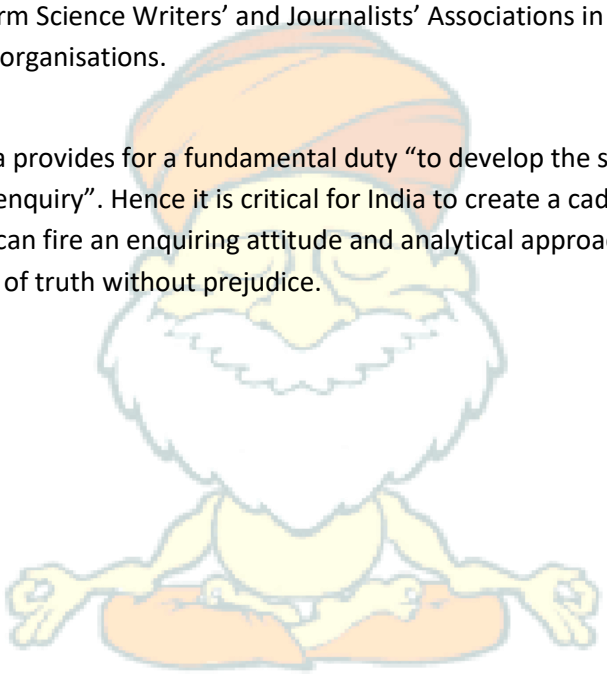
- India is a critically lacking in large mass of science communication experts, who on the one hand can talk with scientists and on the other can disseminate essential aspects of the science to the public. The community of such science experts in India is non-coordinated and sub-critical.
- The print media has taken science to common man through Vigyan (Science) — a monthly popular science magazine in Hindi —published by Vigyan Parishad since 1915. This can be

encouraged more as today, Indian science magazines such as Science Today and Bulletin of Sciences have been discontinued.

- Cue should be taken from National Institute of Science Communication (NISCOM) which has published Hindi popular science journal Vigyan Pragati (Progress in Science), Science Reporter (an English monthly) and Science Ki Dunia (an Urdu quarterly).
- Newspapers are doing their bit by including 'science and technology' coloumn which include scientific discoveries as well as advancements in existing technologies. But there can be a lot more of this in TV where people of all ages get knowledge in an appealing way.
- Folk media such as puppet shows, street plays, stage performances, folk songs and folk dances have the capability to reach segments of society where other forms of media have limitations. Such traditional means of communication are not only entertaining, but also offer two-way communication and are cost effective.
- Creation of science journalists who can present useful science in an interesting and innovative manner. Along with it, India can take initiative in mobilising like-minded people in South Asia to form Science Writers' and Journalists' Associations in each country, with help of international organisations.

Conclusion

The Constitution of India provides for a fundamental duty "to develop the scientific temper, humanism and spirit of enquiry". Hence it is critical for India to create a cadre of scientists and science journalists who can fire an enquiring attitude and analytical approach that leads to rational thinking and the pursuit of truth without prejudice.



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Chapter 4: GEOMAGNETISM - APPLICATIONS

The earth acts as a giant bar magnet with its magnetic field range up to 60,000km. This phenomenon is called 'Geo-magnetism'. The magnetic north pole lies near the geographic South Pole and vice-versa.

Causes: The earth contains a liquid lower mantle and outer core, with a solid metallic inner core. Due to extreme heat and pressure, the liquid metals, mainly Nickel and iron, are in ionic/charged plasma form. This molten metal is in constant motion due to convectional currents. Because of this constant motion of charge around a metallic centre, a very strong magnetic field is generated. The earth acts like a large solenoid. Magnetic field is also affected by rotation of the earth, ionosphere, and on local scale by large transformers, trains and aircrafts etc.

Changing of Magnetic field: The magnetic field keeps on changing with time, and the poles get shifted. Since conventional currents do not follow the same path, the fields generated by them keep changing. This is evident by the study of fossils and paleo-magnetism (the alignment of dipole in rocks due to magnetic field.). It has also been found that magnetic poles completely reversed several times in geological history. But these changes are not sudden.

Implications:

- Magnetosphere of earth protects us from solar flares and ions. It deflects the charged particles towards poles and creates an impenetrable shield around the earth. If it weakens, the solar flares will reach the earth's surface and cause irreversible damage to flora and fauna.
- Magnetism helps in navigation. A change will make communication satellite, GPS, Compasses go haywire.
- Change in geomagnetism, will affect migratory pattern of birds.
- Formation of Aurora B
- The Van Allen belts are also formed due to the geomagnetism properties. Weak field can hamper them and solar flare can punch holes through the atmosphere, harming the humans

The schematic diagram of Earth's magnetosphere shown consists of different regions:

- **Bow shock:** It occurs when the Earth's magnetosphere interacts with the nearby flowing Plasma.
- **Magnetosheath: Region** of space **between** the magnetopause and the bow shock.
- **Magnetopause:** It is the **boundary** between the planet's magnetic field and the solar wind.
- **Northern tail lobe :** Earth's magnetosphere lobe on the northern side. Magnetic field lines of the lobe point towards the earth.
- **Southern tail lobe:** Earth's magnetosphere lobe on the southern side.
- **Plasmasphere:** Earth's magnetosphere consisting of low energy (cool) plasma.
- **Solar winds:** Stream of charged particles released from the upper atmosphere of the Sun (corona).

Significance of Study of Plasma Processes:

- The plasma processes may **hamper** the **working of satellites** that are in the magnetospheric region.
- The **changes** in plasma processes can be **deciphered** only through **computer simulations.**

- The study will help **advance the knowledge** of plasma waves, instabilities and effects associated with wave-particle interactions.

Indian Institute of Geomagnetism

- It conducts basic and applied research in Geomagnetism (study of dynamics of earth's magnetic field) and allied fields.
- The Institute also supports a **World Data Centre for Geomagnetism (WDC, Mumbai),** which is the **only International centre** for Geomagnetic data in South Asia.

Scientific Social Responsibility

- Under this programme, researchers who are working on a science project funded by any of the Ministries under the Central government will have to undertake activities to popularise science and make it more accessible to the public.
- Centre would draw up a list of activities which could be taken up under the Scientific Social Responsibility programme that was similar to Corporate Social Responsibility.
- The activities could range from going to colleges delivering lectures, writing an article in a magazine or doing something beyond the curriculum.
- The move would not only bridge the gap between research institutes and the civilians, but also help scientists hone their communication skills.
- This will
    - Popularise science and make it more accessible to the public
    - Facilitate easy access to resources and knowledge about the investments and impacts of Science and Technology (S&T) on society
    - The scientific community assuming moral responsibility amongst which may trigger social entrepreneurship and start-ups impacting S&T ecosystem and society.
    - The move would not only bridge the gap between research institutes and the civilians, but also help scientists hone their communication skills.

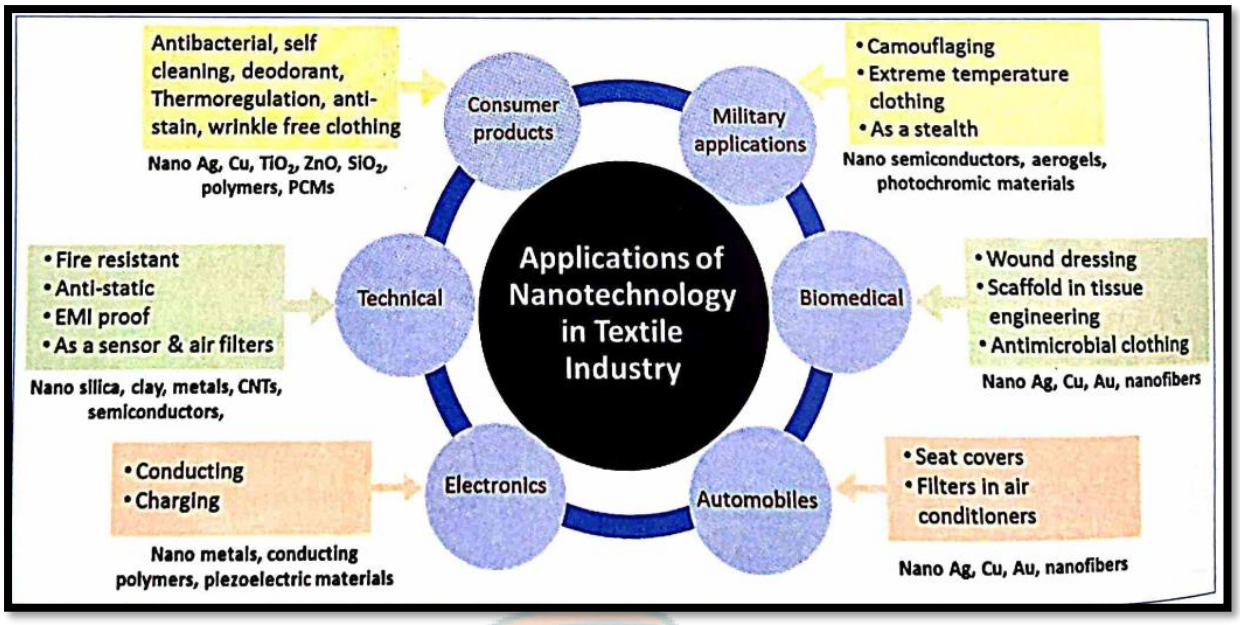
Chapter 4: NANOTECHNOLOGY IN TEXTILES

Nanotechnology is science, engineering, and technology conducted at the nanoscale, which is about 1 to 100 nanometers. The fundamentals of nanotechnology lie in the fact that the properties of materials drastically change when their dimensions are reduced to nanometer scale. Physicist Richard Feynman is the father of nanotechnology.

We can define nanotechnology in textile as the understanding, manipulation, and control of matter at the above-stated length, such that the physical, chemical, and biological properties of the materials (individual atoms, molecules, and bulk matter) can be engineered, synthesized, and altered to develop the next generation of improved materials, devices, structures, and systems. It is used to develop desired textile characteristics, such as high tensile strength, unique surface structure, soft hand, durability, water repellency, fire retardancy, antimicrobial properties, and the like.

- Textile based nanoproducts starting from nanocomposite fibers, nanofibers to intelligent high performance polymeric nanocoatings are getting their way not only in high performance advanced applications, but nanoparticles are also successfully being used in conventional textiles to impart new functionality and improved performance.
- Greater repeatability, reliability and robustness are the main advantages of nanotechnological advancements in textiles.
- Nanoparticle application during conventional textile processing techniques like finishing, coating and dyeing enhances the product performance manifold and imparts hitherto unachieved functionality.
- New coating techniques like sol-gel, layer-by-layer, plasma polymerization, etc. can develop multi-functionality, intelligence, excellent durability and weather resistance to fabrics.
- Nanocoating is relatively a new technique in the textile field and currently under research and development. Polymeric nanocomposite coatings where nanoparticles are dispersed in polymeric media and used for coating applications is a promising route to develop multifunctional and intelligent high performance textiles.
- The most researched area to produce multifunctional, smart fibers is the preparation of nanocomposite fibers where the exceptional properties of nanoparticles have been utilized to enhance and to impart several functionality on conventional textile grade fibers.
- Nanofibers which are sub-micron size in diameter are gaining popularity in some specialized technical applications such as filter fabric, antibacterial patches, tissue engineering and chemical protective suits.

Nanotechnology has thus emerged as the 'key' technology, which has revitalized the material science and has the potential for development and evolution of a new range of improved materials including polymers and textiles. However there are many challenges in the development of these products, which need to be intensively researched so that the wide range of application envisaged can become a commercial reality.



An excellent dispersion and stabilization of the nanoparticles in the polymer matrix is crucial to achieving the desired nano effects. The tendency to agglomerate due to extremely high surface area is the major problem facing the effective incorporation of nano additives in coatings/finishing as well as in nanocomposite preparation. Surface engineering of nanoparticles and combining them with functional surface-active polymers can bring the nanoparticles onto fibers/textiles without losing their superb, nanoscopic properties.

Other issues that need to be resolved –

1. Large scale production of nano particles and their cost
2. Impact of uncontrolled release of nanoparticles in the environments and their effect on human health and ecology widely covered under the domain 'nanotoxicology'
3. Practical philosophy and ethics on the wide spread use of nanotechnology based products.

PRELIMS ORIENTED MCQ

Q1. Consider the statements about 'Dark Energy and Dark Matter'
(1) Dark energy attracts while Dark matter repels.
(2) While dark energy shows itself only on the largest cosmic scale, dark matter exerts its influence on individual galaxies as well as the universe at large.
Which of the statements given above are correct?
(a) Only 1
(b) Only 2
(c) Both
(d) None
Solution: Only 2

Q2: Consider the following:
1. Electromagnetic radiation
2. Geothermal energy
3.Gravitational force
4.Plate movements
5.Rotation of the earth
6. Revolution of the earth
Which of the above are responsible for bringing dynamic changes on the surface of the earth?-
(a) 1, 2, 3 and 4 only
(b) 1, 3, 5 and 6 only
(c) 2, 4, 5 and 6 only
(d) 1, 2, 3, 4, 5 and 6
Solution: D

Q3: Pravasi Bhartiya Diwas (NRI Day) commemorates the return of Mahatma Gandhi to India from South Africa. On which day is it celebrated?
1. 30 January
2. 9 January
3. 31 January
4. 26 January

Solution: 2

Q4: As a sign of protest against the Jallianwala Bagh massacre, which award did Mahatma Gandhi return?
1. Kaiser-E-Hind
2. Knighthood
3. Hind Kesari
4. Rai Bahadur

Solution: 1

Q5: In which city was Mahatma Gandhi assassinated?
1. Nagpur
2. Delhi
3. Ahmedabad
4. Kolkata

Solution: 2

Chapter 5: DRONE POLICY

Unmanned Aerial Vehicle (UAV) i.e. Drones are rapidly growing in popularity even though they are still in the infancy stage in terms of mass adoption and usage. Drones have already broken through rigid traditional barriers in industries which otherwise seemed impenetrable by similar technological innovations. Drones have given one side a clear age in the conflict between Armenia and Azerbaijan ushering new age of warfare.

Drone Rules, 2021

- In March 2021, the Ministry of Civil Aviation (MoCA) published the UAS Rules, 2021 that were perceived by academia, Startups, end-users and other stakeholders as being restrictive in nature as they involved considerable paperwork, required permissions for every drone flight and very few "free to fly" green zones were available.
- Based on the feedback, the Government has decided to repeal the UAS Rules, 2021 and replace the same with the liberalized Drone Rules, 2021.
- Unmanned Aircraft Systems (UAS), commonly known as drones, offer tremendous benefits to almost all sectors of the economy like – agriculture, mining, infrastructure, surveillance, emergency response, transportation, geo-spatial mapping, defence, and law enforcement etc.

Few of the liberalized Drone Rules, 2021

- It has abolished several approvals like: unique authorization number, unique prototype identification number, certificate of manufacturing and airworthiness, certificate of conformance, certificate of maintenance, import clearance, acceptance of existing drones, operator permit, authorisation of R&D organisation, student remote pilot licence, remote pilot instructor authorisation, drone port authorisation etc.
- The relaxation in New Drone Rules stipulates, no security clearance will now be required before any registration or license issuance for the operation of drones.
- Interactive airspace map with green, yellow and red zones shall be displayed on the digital sky platform within 30 days of publication of these rules.
- No permission required for operating drones in green zones. Green zone means the airspace up to a vertical distance of 400 feet or 120 metre that has not been designated as a red zone or yellow zone in the airspace map; and the airspace up to a vertical distance of 200 feet or 60 metre above the area located between a lateral distance of 8 and 12 kilometre from the perimeter of an operational airport.
- Yellow zone reduced from 45 km to 12 km from the airport perimeter.
- No remote pilot licence required for micro drones (for non-commercial use) and nano drones.
- No requirement for security clearance before issuance of any registration or licence.

Significance of the liberalized Drone Rules, 2021

- The new rules will facilitate investments in drone technology in India and will aid in simplifying the process of registration.
- By abolishing the restrictive practices and stringent license regime under the new Drone Rules by the government, it will offer flexibility to players in the sectors.
- An airspace map on the digital sky platform will provide access to real-time updates for drone operation in India in various zones.

PLI Scheme for Drone Industry

Government has approved Production Linked Incentive (PLI) Scheme for Drone Industry

- Will incentivize emergence of Advanced Automotive Technologies global supply chain in India
- Help create additional employment of over 7.6 lakh people
- Incentives worth ₹ 26,058 crore will be provided to industry over five years

- It will bring fresh investments of over₹5,000 crore in three years and incremental production of over ₹ 1,500 crore

Exciting and wide range of applications of drones -

- **Emergency response:** Innovations in camera technology have had a significant impact on the growing use of drones. UAVs outfitted with thermal imaging cameras have provided emergency response teams with an ideal solution for identifying victims who are difficult to spot with the naked eye.
- **Disaster relief**: drones have proved useful during times of natural disaster. In the aftermath of hurricanes and earthquakes, Disaster management companies used UAVs to assess damage, locate victims, and deliver aid. And in certain circumstances, they are helping to prevent disasters altogether.
- **Healthcare:** Many rural regions around the world lack access to high quality healthcare. While medical supplies can be delivered by traditional means, certain circumstances call for quick access to drugs, blood, and medical technology, commercial organisations can fulfil these needs with the help of drones.
- **Agriculture:** Farmers across the world are continuously striving to reduce costs and expand yields. With the use of drones, agricultural workers are able to gather data, automate redundant processes, and improve efficiency.
- **Weather forecasting:** Today, most data is collected through stationary structures or captured with geospatial imaging solutions. Drones, however, offer a versatile option that can physically follow weather patterns as they develop. Moreover to that water-based unmanned surface vehicles (USVs) are changing the way data is gathered.
- **Maritime:** Inspecting ships is also an important part of the industry hence, few companies has designed an underwater drone used to inspect hulls from below.
- **Waste Management:** Innovations in waste collection are still emerging, including drones that have help to clean oceans. Few companies focus on robots used to help maintain systems for wastewater management.
- **Infrastructure Development:** While drones serve a useful purpose in construction planning and management, they also have the potential to be used to develop physical infrastructure.

Drone Response and Outreach in North East (i-Drone)

- The delivery model is aimed at ensuring that life-saving vaccines reach everyone.
- This is for the first time that a "Make in India' drone has been used in South Asia to transport COVID vaccine over an aerial distance of 15 kms in 12-15 mins from the Bishnupur district hospital to Loktak lake, Karang island in Manipur for administration at the PHC.
- This is a delivery model to make sure that life-saving vaccines reach everyone.
- This technology may prove a game changer in addressing the challenges in health care delivery, particularly health supplies in difficult areas.
- It epitomises the Government's commitment to 'Antyodaya' in health; making healthcare accessible to the last citizen of the country.

Concerns associated with drone's usage:

- Safety and security issues.
- Illegal usage and privacy concerns.
- Replacing manpower like in product delivery.
- Ecological aspect relating to birds.

Newly released regulations address some of these concerns by restricting their operations to day time; around sensitive areas (international border, airports) and not allowing delivery of payload and food items. With drone market expected to touch $ 1 trillion in the coming years, present regulations will encourage a vast Made in India drone industry.

NOTE: MQ9B Sea Guardian

- It is the maritime variant of the Predator MQ9 Unmanned Aerial Vehicle (UAV).
- It has a maximum endurance of 40 hours and a maximum flying altitude of 40,000 feet.
- It has a 3600 maritime surveillance radar and an optional multimode maritime surface search radar.
- It can be used in operations such as Anti-Surface Warfare, Anti-Submarine Warfare, Humanitarian Assistance/Disaster Relief, Search and Rescue, Law Enforcement (Drug Trafficking, Illegal Immigration and Piracy), etc.
- The drones are meant for carrying out surveillance in the Indian Ocean Region and can be deployed on the China border if asked for and if needed.

Light House Projects

The Light House Projects (LHPs) showcase the best of new-age alternate global technologies, materials and processes in the construction sector for the first time in India at such a large scale.

- They are being constructed under GHTC-India which envisages to provide an ecosystem for adoption of innovative technologies in the housing construction sector in a holistic manner.
- The LHPs are being constructed at Indore (Madhya Pradesh), Rajkot (Gujarat), Chennai (Tamil Nadu), Ranchi (Jharkhand), Agartala (Tripura) and Lucknow (Uttar Pradesh).
- They comprise about 1000 houses at each location along with allied infrastructure facilities.
- These projects will demonstrate and deliver ready to live houses at an expedited pace within twelve months, as compared to conventional brick and mortar construction, and
- They will be more economical, sustainable, of high quality and durability

Affordable Sustainable Housing Accelerators – India (ASHA-India)

- It aims to promote domestic research and entrepreneurship by providing incubation and acceleration support to potential future technologies.
- Under ASHA-India initiative, five ASHA-India Centers have been set up for providing incubation and acceleration support.
- The technologies, processes and materials identified through this initiative will provide a major fillip to young creative minds, start-ups, innovators and entrepreneurs.

PMAY-U Mission

- Pradhan Mantri Awas Yojana – Urban (PMAY-U) Mission has been designed to achieve the vision of "Housing For All by 2022".
- In order to recognize the outstanding contribution by States, UTs,Urban Local Bodies and beneficiaries, the Ministry of Housing and Urban Affairs has introduced annual awards for excellence in implementation of PMAY-Urban.

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Chapter 6: SCIENCE EDUCATION IN INDIA

Science and the scientific community are the two main pillars of a society's growth and development. Be it engineers, doctors or scientists, their expertise has contributed to shaping the world. The most recent example would be that of the COVID-19 pandemic, for which the best scientific minds across the world played a pivotal role in developing a vaccine, while also offering effective treatment and preventive measures to help us navigate the pandemic.

The significance that the scientific community holds in our lives further lays emphasis on nurturing our children in the field of science for our better future.

What ails Indian science?

Low participation of women: The report reflects an urgency to improve the participation of women in the transformation of Indian science.

- Though there are more girls than boys in the life sciences, there are fewer in physics, maths, earth science and chemistry. Enrolment of women is 28% in engineering, and "very low" in the "classical streams" (mechanical, electrical, civil, chemical), it notes.
- Previous studies have found that when compared to the U.S., European Union, and several Asian countries, India fared reasonably well when it comes to enrolment of women in science and engineering, which stood at around 35%. But the proportion of women in the science and engineering workforce was an abysmal 12%.

Failure of organisations and departments: The existing systems of science governance in this country are robust with departments reporting to ministers who in turn report to the Union Cabinet. There is no lack of sound advisory bodies and committees within these departments.

- Umbrella organisations or overarching bodies (such as Scientific Advisory Committee to the Prime Minister or Principal Scientific Adviser to the Government of India or NITI Aayog, now essentially a policy think tank, and tasked with coordinating States and research agencies) can pool the intellectual and technological resources of organisations and direct them towards specific missions. However, despite having a team of experienced scientists and eminents, they haven't substantially vaulted science and technology in the country either.
- Scientific departments in India, from the Department of Atomic Energy to the Department of Science & Technology, have bureaucracies of their own. They battle the dilemma of having to take bold, expensive risks — that science by its very nature requires — and on the other hand, be accountable to the Finance Ministry.

Solutions:

A. Need for an independent science and technology authority

- One, a 'discovery arm' that can organise the expertise of various organisations across states and regions to solve a basic research problem.
- Two, a 'delivery arm' that will closely work with industry and evolve public private partnerships.

B. DST should set up country's first National Science and Technology Research University

The Department of Science and Technology (DST) should make efforts to set up the first-of-its-kind National Science and Technology Research University by leveraging the research strength of its autonomous institutions.

- Over the last seven years, there has been an increase in the number of resident patents filed, several Full-Time Equivalent (FTE) researchers and the number of women scientists
- There is a need for focusing on increasing numbers of beneficiaries in human resource-related schemes like MANAK, INSPIRE, doctoral and post-doctoral fellowships.

C. Science, as an educational tool for Kids

India has the largest K12 system in the world with more than 260 million enrollments, thus driving our potential to have competent scientists, engineers and doctors with the ability to shape our progress. Fostering the right attitude to scientific thinking right from the early years of education will enable us to nurture our children in science for the future.

Encourage the habit of research: When we foster their curiosity, children will naturally tend to delve deep into doing research on their own, even for basic topics. Therefore, the learning environments we create for our children must encourage them to not only ask questions but also invest time in finding answers. Fortunately today, with the increase in internet penetration, children have access to abundant resources. Online education platforms have engaging content that kindles their interest and curiosity. However, providing children access to these resources isn't enough to motivate them to learn. It's important for parents to encourage research as a part of children's daily learning activities. For instance, if your child is asked to work on a project around volcanoes, it's important to help them understand how to use the right search terms, search engines and assess reliable and unreliable sources. These skills will come in handy later on in their professional space and will encourage them to pursue successful STEM careers.

Foster practical knowledge: When children get hands-on experience and are able to test their theoretical knowledge through practical applications, they deliver better results. For instance, encouraging children to make a model of an aeroplane to learn Bernoulli's Principle or create a periscope to understand how light travels will enable them to envision their careers as engineers or architects. Studies show that by having a strong understanding of concepts, students also acquire critical thinking, problem-solving and analytical skills while creating prototypes.

Awareness of the impact of science: An early appreciation of the perennial excitement of scientific discoveries is important for attracting children to pursue scientific careers. Children who understand the impact that science and the scientific community hold in our lives, are more interested to learn the subject. It is crucial for us to sensitise our children on how medicines and surgeries save lives or help humankind find cures for deadly diseases. We must also encourage them to interact with doctors or scientists who can educate them on how their contributions to science have made a difference in several lives.

Government Schemes

Vigyan Jyoti scheme: The DST will target 75,000 girl students getting benefits of the scheme by 2022

Innovation in Science Pursuit for Inspired Research (INSPIRE)

- It is an **innovative programme**.
- It is **sponsored and managed** by the **Department of Science & Technology** for attraction of talent to Science.
- Objective:
    - To communicate to the youth the excitements of creative pursuit of science
    - To attract talent to the study of science at an early age
    - To build the required critical human resource pool for strengthening and expanding the Science & Technology system and Research & Development base.
- No competitive exams are conducted for identification of talent at any level.
- The programme relies on the efficiency of the existing educational structure

INSPIRE Awards-MANAK

The INSPIRE Awards - MANAK (Million Minds Augmenting National Aspirations and Knowledge), aims to motivate students in the age group of 10-15 years and studying in classes 6 to 10.

- The objective of the scheme is to target one million original ideas/innovations rooted in science and societal applications to foster a culture of creativity and innovative thinking among school children.
- Under this scheme, schools can nominate 5 best original ideas/innovations of students

National Science, Technology and Innovation Policy (STIP 2020)

STIP 2020 is the collective aspiration to ensure that we get the benefits of our national investments in science and technology. It is a comprehensive policy framework the guides & promotes investment in Science & Technology.

The Science, Technology and Innovation Policy will be guided by the following broad vision:

1. **Atmanirbhar Bharat:** To achieve technological self-reliance and position India among the top three scientific superpowers in the decade to come.
2. **Human Capital:** To attract, nurture, strengthen and retain critical human capital through a 'people centric' science, technology and innovation (STI) ecosystem.
3. **Investment:** To double the number of Full-Time Equivalent (FTE) researchers, Gross Domestic Expenditure on R&D (GERD) and private sector contribution to the GERD every 5 years.
4. **Globally Competitive:** To build individual and institutional excellence in STI with the aspiration to achieve the highest level of global recognitions and awards in the coming decade.

Key features of draft STIP are:

1. **Objective:** STIP 2020 by way of its decentralized, bottom-up, and inclusive design process aims to restrategize priorities, sectoral focus, and methods of research and technology development for larger socio-economic welfare.
2. **STI Observatory and Centralised Database**
   - STIP will lead to the establishment of a National STI Observatory that will act as a central repository for all kinds of data related to and generated from the STI ecosystem.
   - It will encompass an open centralised database platform for all financial schemes, programmes, grants and incentives existing in the ecosystem.
   - The Observatory will be centrally coordinated and organized in distributed, networked and interoperable manner among relevant stakeholders.
3. **Open Science Framework**
   - A future-looking, all-encompassing Open Science Framework will be built to provide access to scientific data, information, knowledge, and resources to everyone in the country and all who are engaging with the Indian STI ecosystem on an equal partnership basis.
   - All data used in and generated from publicly-funded research will be available to everyone under FAIR (findable, accessible, interoperable and reusable) terms.
   - A dedicated portal to provide access to the outputs of such publicly-funded research will be created through Indian Science and Technology Archive of Research (INDSTA).
4. **STU Education to be made more inclusive**
   - Online learning platforms will be developed using Information and Communication Technology (ICT) to address the issue of accessibility and to promote research and innovation at all levels.
   - Teaching-learning centres (TLCs) will be established to upskill faculty members which in turn will improve the quality of education.
   - Engaged Universities will be created to promote interdisciplinary research to address community needs.
   - Higher Education Research Centres (HERC) and Collaborative Research Centres (CRC) will be established to provide research inputs to policymakers and bring together stakeholders.
5. **Increasing Investments**
   - With an aim to expand the financial landscape of the STI ecosystem, each department/ ministry in the central, the state and the local governments, PSUs, private sector companies and startups will set up an STI unit with a minimum earmarked budget to pursue STI activities.

- Each State will earmark a percentage of the state allocation for STI-related activities under a separate budget head.
- STI investments will be increased through boosting fiscal incentives, enhancing support to industry, especially Medium Small Micro Enterprises (MSMEs), for pursuing research through innovation support schemes and other relevant means on a need basis.
- To ensure systematic governance of the expanded STI financing landscape, an STI Development Bank will be set up to facilitate a corpus fund for investing in direct long term investments in select strategic areas

6. **Translational Research and Promotion of Innovation**
   - The policy aims to create a fit for purpose, accountable research ecosystem promoting translational as well as foundational research in India in alignment with global standards.
   - An institutional architecture to integrate Traditional Knowledge Systems (TKS) and grassroots innovation into the overall education, research and innovation system will be established.
   - Grassroots innovators will also be supported for registration, claiming the Intellectual Property Right (IPR), filing of patent, or any type of legal claim with the help of Higher Education Institute (HEIs).
7. **Technology self-reliance and indigenization**
   - A two-way approach of indigenous development of technology as well as technology indigenization will be adopted and focused upon in alignment with national priorities, like sustainability and social benefit, and resources
   - A Technology Support Framework will be created to facilitate this development. A Strategic Technology Board (STB) will be constituted to act as a link connecting different strategic departments.
8. **Inclusivity an integral part of STIP**
   - An India-centric Equity & Inclusion (E&I) charter will be developed for tackling all forms of discrimination, exclusions and inequalities in STI leading to the development of an institutional mechanism.
   - An inclusive culture will be facilitated through equal opportunity for women along with candidates from rural- remote areas, marginalised communities, LGBTQ+ Communities and differently-abled individuals including Divyangjans.
9. **International Engagement**
   - Engagement with the Diaspora will be intensified through attracting the best talent back home through fellowships, internships schemes and research opportunities expanded and widely promoted across different ministries.
   - Appropriate facilitating channels will be created for remote contribution as well.
   - An engagement portal exclusively for the Indian scientific diaspora will be created. 'S&T for Diplomacy' will be complemented with Diplomacy for S&T '.
10. **STI Policy Institute**
    - To serve all the aspects of STI policy governance and to provide the knowledge support to institutionalised governance mechanisms , a STI Policy Institute will be established to build and maintain a robust interoperable STI metadata architecture.
    - It will conduct and promote nationally and internationally relevant STI policy research and strengthen the science advice mechanism at national, sub-national and international levels.
    - It will develop long term capacity building programs for STI policy through training and fellowships.
    - An implementation strategy and roadmap will be devised for STI policy and programs along with continuous monitoring and timely evaluation mechanisms.

Chapter 7: ARTIFICIAL INTELLIGENCE

AI is the branch of computer science concerned with developing machines that can complete tasks that typically require human intelligence. With the explosion of available data expansion of computing capacity, the world is witnessing rapid advancements in AI, machine learning and deep learning, transforming almost all sectors of the economy. According to independent studies, AI has the potential to raise India's annual growth rate by 1.3% and add USD 957 billion to the country's economy by 2035.At a global level, AI is expected to unlock USD 15.7 trillion in productivity by 2030.

Amidst the accelerated adoption of AI-based technologies, India seems to stand at the precipice of the fourth industrial revolution. The competitive advantage of low-cost labour may fade away in the near future as economies begin to reap the benefits of AI in the form of increased productivity and cost advantages, and become more profitable than labour. Hence, it would be a timely move for India to build its AI capabilities, lest the global digital divide widens even more and we are left behind.

Artificial Intelligence for inclusive growth

AI is one of the many tools that can be used to either bridge the inequalities or create more. To achieve the former, the right policy approach and business practices at the outset are crucial for cushioning the negative externalities. Hence, a collaborative approach is the first step to realise the vision of AI-driven equitable growth. The collaborative efforts are the key to accelerate technology diffusion by promoting innovations that democratise the access of new technologies, enhancing research and development in AI that address the issues of data protection, transparency and accountability so that it gains public trust and encourages greater investment. With greater inclusion of stakeholders and greater diversity at each step of building an AI ecosystem, India can look to reap the gains of automation in not only the long- ..

Machine Learning-based deep-learning algorithms in AI can

Medical: Provide insights to healthcare providers in predicting future events for patients. It can also aid in the early detection and prevention of diseases by capturing the vitals of patients. AI-based applications have helped biopharmaceutical companies to significantly shorten the preclinical drug identification and design process from several years to a few days or months. This intervention has been used by pharmaceutical companies to identify possible pharmaceutical therapies to help combat the spread of COVID19 by repurposing drugs.

Rural development and Agriculture: AI-based solutions on water management, crop insurance and pest control are also being developed. Technologies like image recognition, drones, and automated intelligent monitoring of irrigation systems can help farmers kill weeds more effectively, harvest better crops and ensure higher yields. Voice-based products with strong vernacular language support can help make accurate information more accessible to farmers. A pilot project taken up in three districts — Bhopal, Rajkot and Nanded — has developed an AI-based decision support platform combined with weather sensing technology to give farm level advisories about weather forecasts and soil moisture information to help farmers make decisions regarding water and crop management. ICRISAT has developed an AI-power sowing app, which utilises weather models and data on local crop yield and rainfall to more accurately predict and advise local farmers on when they should plant their seeds. This has led to an increase in yield from 10 to 30 per cent for farmers. AI-based systems can also help is establishing partnerships with financial institutions with a strong rural presence to provide farmers with access to credit.

Disasters: An AI-based flood forecasting model that has been implemented in Bihar is now being expanded to cover the whole of India to ensure that around 200 million people across 2,50,000 square kilometres get alerts and warnings 48 hours earlier about impending floods. These alerts are given in nine languages and are localised to specific areas and villages with adequate use of infographics and maps to ensure that it reaches all.

Education: The Central Board of Secondary Education has integrated AI in the school curriculum to ensure that students passing out have the basic knowledge and skills of data science, machine learning and artificial intelligence. The Ministry of Electronics and Information Technology (MeitY) had launched a "Responsible AI for Youth" programme this year in April, wherein more than 11,000 students from government schools completed the basic course in AI.

Concerns and Challenges

- **Big Carbon Footprint:** AI requires massive computational capacity, which means more power-hungry data centres — and a big carbon footprint.
- **Loss of low income jobs:** Robotics and AI companies are building intelligent machines that perform tasks typically carried out by low-income workers: self-service kiosks to replace cashiers, fruit-picking robots to replace field workers, etc. Many desk jobs will also be edged out by AI, such as accountants, financial traders and middle managers.
- **Widens Inequalities:** AI could compound digital exclusion. Without clear policies on reskilling workers, the promise of new opportunities will in fact create serious new inequalities.
- **Strengthen the Divide between North & South:** Investment is likely to shift to countries where AI-related work is already established, widening gaps among and within countries.
- **Can reinforce existing prejudices:** AI-enhanced recruitment engine, based on existing workforce profiles, taught itself that male candidates were preferable to female. AI facial recognition and surveillance technology discriminating against people of colour and minorities.
- **Privacy Concerns:** AI also presents serious data privacy concerns. Cambridge Analytica — algorithms and big data were used to alter voting decisions.

To check facial recognition misuse

- Countries around the globe, including India, should have proper regulations to ensure governments do not use facial recognition or any other facet of artificial intelligence (AI), in a way that would impinge on peoples' most-cherished democratic freedoms
- Transparency and accountability are the foundational principles that can ensure the ethical use of AI. Before any country advances, it must advance a responsible AI that's grounded in clear and firm ethical principles.
- The bedrock of a responsible AI strategy should be accountability. Plus, it should be fair, unbiased, and it should offer security and safety, to ensure people's privacy, and most importantly, it should be inclusive, by all means.

Conclusion

We hope that India's "AI for All" strategy focuses on responsible AI, building AI solutions at scale with an intent to make India the AI garage of the world — a trusted nation to which the world can outsource AI-related work. AI solutions built in India will serve the world.

AI derives strength from data. To this end, the government should put the process of putting in place a strong legal framework governing the data of Indians. The legislation should stem from a desire to become a highly secure and ethical AI powerhouse.

India wants to build a data-rich and a data-driven society as data, through AI, which offers limitless opportunities to improve society, empower individuals and increase the ease of doing business.

SOCIAL TRANSFORMATION IN RURAL INDIA

MAJOR DRIVERS OF RURAL TRANSFORMATION

Rural Transformation is a process of comprehensive societal change whereby rural societies diversify their economies and reduce their reliance on agriculture; become dependent on distant places to trade and to acquire goods, services, and ideas.

Rural transformation is a complex and on-going process. The effects of this process extend beyond the transformation of the agricultural sector and even beyond economic transformation. However, the direction and effects of these rural transformation processes can be shaped and steered to prevent and mitigate negative effects and produce outcomes that are beneficial for rural populations on a national and subnational level. The process of rural transformation must thus be addressed by a policy agenda aimed at making rural transformation ecologically more sustainable and socially inclusive.

India's Rural Sector

India is predominantly a rural country. As per the 2011 Census, 68.8 per cent of country's population and 72.4 per cent of workforce resided in rural areas. Rural economy constitutes 46 per cent of national income. Despite the rise of urbanization more than half of India's population is projected to be rural by 2050. Thus growth and development of rural economy and population is a key to overall growth and inclusive development of the country in post COVID-19 India.

Criticality of the rural sector in the economy:

- As per NITI Aayog report, more than half of Indian industrial production comes from the rural areas. Rural construction also accounts for nearly half of the total building activity in the country. The value of rural services is about a quarter of the total services output.
- Agriculture has accounted for less than half of total rural output since the turn of the century. On the other hand, National Sample Survey Office (NSSO) data shows that more than one-fifth of rural households with self-employment in agriculture have income less than the poverty line.
- Agriculture labour productivity in terms of gross value added (GVA) in India is less than a third of that in China and 1% of that in the US. Rural sector is net importer vis-e-vis urban areas which indicate outward flow of money.

Rural transformation has a multiplier and a more significant effect on poverty reduction in the following ways:

- **Agriculture modernisation:** Development and growth in agriculture reduces rural poverty and overall poverty because the demand for chemical fertilisers, pesticides, mechanisation, processed seeds or fuels rises and this in turn promotes non-agricultural production.
- **Increase in income**: Higher incomes in rural areas promote demand for processed foods produced mainly in urban areas and generate employment.
- **Price reduction:** Decrease of food prices due to agricultural growth results in higher food security and poverty reduction in both rural and urban areas.
- **Wage reduction:** Decrease of food prices lowers the real product wage in the non-agricultural sector, raising profitability and investment in that sector.

A. AGRICULTURE AND RURAL INDUSTRY AS ENGINE OF ECONOMIC RECOVERY

- **Renewed focus on NREGA:** The government's commitment to provide an additional Rs. 40,000 crore allocation for the Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) for FY21 will help to spur rural demand.
- **Investment in farm infrastructure**: NABARD will facilitate Rs 1 lakh crore finance for funding Agriculture Infrastructure Projects at farm-gate and aggregation points like Primary Agricultural Cooperative Societies, Farmers Producer Organizations, Agriculture

entrepreneurs, Startups, etc. Local initiative for building community infrastructure, like water harvesting, canal irrigation network, huts for community market centers etc. may generate employment opportunities.

- **Opportunity for Indian agriculture to tap world markets**: As the global supply chains for agricultural products remains paralyzed in global market, Indian product can make headways as Indian rural sector is not as badly affected as the North American or European rural sector.
- **If there is no universal access to a Covid-19 vaccine** for another 18-24 months, then businesses in safer sectors and locations are likely to do well, here rural sector might act as net gainer.
- **In rural India**, where it is naturally easier to have physical distancing and outdoor work. This may shift the focus from urban markets to rural markets, for both demand and production.
- **Surplus labour**: Livestock, fisheries, dairy, vegetables, fruit and food processing are more labour-intensive and high value-yielding. After many decades of neglect in research and development, lack of market access, on-off policies for exports, and market distortions, the present adversity may be a timely opportunity for this sector. Recently, Finance Minister informed allocation of Rs 20,000 crore for fishermen through Pradhan Mantri Matsya Sampada Yojana (PMMSY). This will include Rs 11,000 crore for activities in marine, inland fisheries and aquaculture while Rs. 9000 crore to be spent on developing fishing Harbours, cold chain, markets etc.
- **Self reliant rural sector:** Local production of items of local requirement, the local weavers, artisans and craftsmen may establish micro enterprises and form local community marketing cooperatives. Finance minister announced Rs 10,000 crore scheme for the formalization of Micro Food Enterprises (MFE). This will help nearly 2 lakh MFEs to achieve technical up-gradation to attain FSSAI food standards, build brands and marketing.
- There may be **community campaigns** for buying local products, as far as possible, replacing some of the items coming from urban industrial sectors.

B. IMPROVING THE JOB LANDSCAPE: IMPERATIVE TO PROVIDE THE MUCH-NEEDED FILLIP TO THE ECONOMY

- **Agriculture** has accounted for less than half of total rural output since the turn of the century. On the other hand, National Sample Survey Office (NSSO) data shows that more than one-fifth of rural households with self-employment in agriculture have income less than the poverty line.
- **Agriculture labour productivity** in terms of gross value added (GVA) in India is less than a third of that in China and 1% of that in the US. Rural sector is net importer vis-e-vis urban areas which indicate outward flow of money, which highlights critical need of new jobs.
- **About MGNREGA:** Need to increase the number of days per household from 100 to 200 days for this year. Another approach would be to let families work as much as they wanted to – even if the number of days exceeded 100 – as long as the state average of labour days per household did not cross 100.
- **Food processing sector:** After many decades of neglect in research and development, lack of market access, on- off policies for exports, and market distortions, the present adversity may be a timely opportunity for this sector.
- **Entrepreneurship:** Local production of items of local requirement, the local weavers, artisans and craftsmen may establish micro enterprises and form local community marketing cooperatives.
- **Agri-tech start ups** will be crucial for developing innovative digital solutions to maximise productivity, improve market linkages, increase supply chain efficiency and provide greater access to inputs for agri-businesses.

- **E-commerce platform** for local products: On the lines of Amazon India initiative for tribal products of Telangana, rural crafts can be availed on major e-commerce sites with authentic branding with the help of state governments.

C. WOMENPRENEURS DRIVING CHANGE

The pre-COVID-19 situation (for rural women)

1. Rural women faced crisis of regular employment

- According to national labour force surveys, a quarter of adult rural women were in the labour force (or counted as "workers" in official data) in 2017-18
- Rural women face a **crisis of regular employment.** In other words, when women are not reported as workers, it is because of the lack of employment opportunities rather than it being on account of any "withdrawal" from the labour force

2. Paid work outside home

- Another feature of rural women's work, is that women from all sections of the peasantry, with some regional exceptions, participate in paid work outside the home
- Thus, while thinking of the potential workforce, we need to include women from almost all sections of rural households and not just women from rural labour or manual worker households.

3. Age differentiated aspiration amongst rural women

- A third feature is that **younger and more educated women** are often not seeking work because they **aspire to skilled non-agricultural work,** whereas older women are more willing to engage in manual labour.

4. Wage Inequality

- A fourth feature of rural India is that **women's wages are rarely equal to men's** wages, with a few exceptions. The gap between female and male wages is highest for non-agricultural tasks — the new and growing source of employment.

5. Underestimation of women's work

- Counting all forms of work — economic activity and care work or work in cooking, cleaning, child care, elderly care — a woman's work day is exceedingly long
- It is estimated that the total hours worked by women (in economic activity and care) ranged from 61- 88 hours in the lean season, with a maximum of 91 hours (or 13 hours a day) in the peak season.
- No woman puts in less than a 60-hour work-week.

Impact of Pandemic & lockdown on rural women

- **Limited agricultural activity for women**:
  - There was increased tendency to use more family labour and less hired labour on account of fears of infection.
  - Therefore, though agricultural activity continued during lockdown employment available to women was limited.
- **Reduced income from agriculturally allied sectors**
  - For women across the country, incomes from the sale of milk to dairy cooperatives shrank because the demand for milk fell by at least 25% (as hotels and restaurants closed)
  - Among fishers, men could not go to sea, and women could not process or sell fish and fish products
- **Collapse of non-agricultural employment for women.**
  - Non-agricultural jobs came to a sudden halt as construction sites, brick kilns, petty stores and eateries, local factories and other enterprises shut down completely

  - In recent years, women have accounted for more than one-half of workers in public works, but no employment was available through the National Rural Employment Guarantee Scheme (NREGS) till late in April
  - Accredited Social Health Activists or ASHAs, 90% of whom are women, have become frontline health workers, although they are not recognised as "workers" or paid a regular wage.
- **Effect on Women's health & nutrition**
  - During the lockdown period the burden of care work mounted.
  - With all members of the family at home, and children out of school, the tasks of cooking, cleaning, child care and elderly care increased
- **Disproportionate impact of lockdown on rural women jobs**
  - Among rural casual workers 71% of women lost their jobs after the lockdown; the figure was 59% for men.
  - Data from the Centre for Monitoring Indian Economy (CMIE) also suggest that job losses in April 2020, as compared to April 2019, were larger for rural women than men.
- **Inadequate attention** has been paid to the consequences of the pandemic for women workers and on the design of specific policies and programmes to assist women workers

Way Ahead

- Short term goal should be the expansion of the NREGS
- A medium and longer term plan needs to generate women-specific employment in skilled occupations and in businesses and new enterprises
- ASHA workers must be recognised as workers and paid a fair wage.
- Specific attention must be paid to safe and easy transport for women from their homes to workplaces
- Healthy meals for schoolchildren as well as the elderly and the sick can reduce the tasks of home cooking, which reduces care burden of women

D. MICRO-FINANCE: ABILITY TO UNLEASH RURAL INDIA'S ENTREPRENEURIAL ZEAL

Microfinance refers to providing financial services to unemployed, low income people to start small ventures and improve their livelihood. Services include micro loans, saving insurance, remittances.

Creating jobs is essential for India's socio-economic development. With issues of underemployment and overemployment in agriculture, increasing automation in manufacturing sector Government is banking on entrepreneurship to create jobs for rural masses. There are large number of products and services in rural areas which can be leveraged to set up small and micro enterprises.
Examples:
1) Cottage and Handicraft industry – pot making, clay folks, basket making;
2) Poultry industry – fastest growing industry in India.
3) Micro-food processing units – horticulture, animal husbandry, fisheries and marine products.

However, most population living in rural area being small and marginal farmers, landless labours, rural artisans have low access to institutional credit. In such a scenario, micro finance institutions providing micro loans to lower income groups without collateral have ability to unleash rural India's entrepreneurial zeal.

Tracing from SEWA in Gujarat, NABARD initiated program of linking SHG's with banks, Setting of Regional Rural Banks, micro finance institutions have come long way in India. Some of the challenges that MFI's faced in India were-

- Over-indebtedness: dealing with poor without collateral
- Lack of risk management framework
- Issue of multiple borrowing ex: Andhra Pradesh crisis 2010
- Higher interest rates

Y.H.Malegam committee on MFI's was constituted in 2010 which recommended capping and transparency in interest rates, Classification of NBFC as NBFC-MFI and others. Recently, microfinance industry has seen growth over the past five years, growing at a 45% CAGR. It has witnessed rapid evolution with regulatory reforms post the Andhra Pradesh crisis in 2010 to regulate product, pricing and protection of customer interest. This included

- The growth of regulated NBFC MFIs – a special class of RBI regulated entities carrying out microfinance,
- The formation of the first ever self-regulatory Organizations (SROs) of the RBI.

Owing to the increase in the economic development and growing Gross Domestic Product (GDP) of India, there is an increasing demand for financial assistance, especially in microfinance. Various schemes introduced by the present government like Micro Units Development and Refinance Agency (MUDRA) bank and Jan Dhan Yojna has aided in the growth of the micro finance institutions.

E. RURAL BANKING & FINANCIAL INCLUSION

Rural development occupies a significant place in the overall economic development of the country and Darling's statement (1925) that "the Indian peasant is born in debt, lives in debt and dies in debt," still remains true for the great majority of working households(55-60 per cent of India's population) in the countryside.

Three phases of rural banking policy since 1969

1st phase following the nationalization of India's 14 major commercial banks in1969—The declared objectives of the new policy, known as "social and development banking", were the following:

- To provide banking services in previously unbanked or under-banked rural areas;
- To provide substantial credit to specific activities including agriculture and cottage industries; and
- To provide credit to certain disadvantaged groups such as, for example, Dalit households.

2nd phase began in the late 1970s and early 1980s:

- Two major instruments of official anti-poverty policy were developed: loans-cum-subsidy schemes targeted at the rural poor and state-sponsored rural employment schemes (Integrated Rural Development Programme (IRDP))
- An expansion and consolidation of the institutional infrastructure for rural banking

3rd phase—Post Liberalization:

- Redistributive objectives "should use the instrumentality of the fiscal rather than the credit system"
- Directed credit programmes should be phased out
- Interest rates be deregulated
- Capital adequacy norms are changed (to "compete with banks globally")
- Branch licensing policy be revoked
- A new institutional structure that is "market driven and based on profitability" be created,
- Part played by Private Indian and foreign banks be enlarged

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Challenges facing Indian Rural Banking—

Priority Sector Lending:

- Priority sectors are broadly taken as those sectors of the economy which in the absence of inclusion in the priority sector categories would not get timely and adequate finance.
- Typically, these are small loans to small and marginal farmers for agriculture and allied activities, loans to Micro and Small Enterprises, loans for small housing projects, education loans and other small loans to people with low income levels
- The major challenge is to bring all farmers into the institutional credit framework—

Need to make priority sector lending competitive and commercially viable

- By reorienting the approach of banks to look at priority sector areas as the challenges in priority sector can be overcome only if banks consider priority sector lending as part of normal business operations of the banks and not as an obligation.
- Rural untapped market offers a big business opportunity to the banks and banks need to innovate new products which cater to the needs of farmers, weaker sections and other vulnerable sections of the society, develop new delivery channels and embrace technological developments which will reduce the delivery costs— **a viable business proposition**
- Need to lay emphasis on direct delivery of credit to the poor beneficiaries i.e. without the involvement of intermediaries, which will ensure better management of risks and also reduction in transaction, delivery and administrative costs for these loans, which being essentially small ticket, low value high volume loans, do generate profits translating to a stable low cost deposit stream for banks and to the fortune at the bottom of the pyramid.

Regional Rural Banks:

Regional Rural Banks (RRBs) were established in the year 1976 as a low cost financial intermediation structure in the rural areas to ensure sufficient flow of institutional credit for agriculture and other rural sectors— Narasimham committee

- RRBs were expected to have the local feel and familiarity of the cooperative banks with the managerial expertise of the commercial banks.
- RRBs are jointly owned by GoI, the concerned State Government and Sponsor Banks, the issued capital of a RRB is shared by the owners in the proportion of 50 percent, 15 percent and 35 percent respectively
- RRBs operate under the control of two institutions, the National Agricultural Bank and Rural Development (NABARD) and Reserve Bank of India (RBI)

Financial Inclusion:

Financial Inclusion (FI) is the process of ensuring access to appropriate financial products and services needed by all sections of the society in general and vulnerable groups such as weaker sections and low income groups in particular at an affordable cost in a fair and transparent manner by mainstream institutional players.

2006: Reserve Bank permitted banks to utilise the services of non-governmental organizations (NGOs), micro-finance institutions (other than Non-Banking Financial Companies) and other civil society organisations as intermediaries in providing financial and banking services through the use of business facilitator and business correspondent (BC) models. The BC model allows banks to do "cash in-cash out" transactions at a location much closer to the rural population, thus addressing the last mile problem.

Combination of strategies— ranging from relaxation of regulatory guidelines, provision of new products and other supportive measures to achieve sustainable and scalable Financial Inclusion; as well as close monitoring

Issues being faced—

Not treated as an Efficient Business Model:

- Banks are pursuing FI as a regulatory requirement rather than treating it as a business model.

- Banks have to realize that the bankability of the poor holds a major opportunity for the banking sector in developing a stable retail deposit base and in curbing volatility in earnings with the help of a diversified asset portfolio and therefore, Financial Inclusion programmes should be implemented on commercial lines as a sustainable and viable business model
- Ensure that poor people who deserve credit are provided access to timely and adequate credit in a non-exploitative manner
- Reasons—
    - **Higher non-performing loans** in rural areas because rural households have irregular income and expenditure patterns—compounded by the dependence of the rural economy on monsoons, and loan waivers driven by political agendas
    - **Low Ticket Size:** The average ticket size of both a deposit transaction and a credit transaction in rural areas is small. This means that banks need more customers per branch or channel to break even. Considering the small catchments area of a branch in rural areas, generating a customer base with critical mass is challenging.
    - **High Transaction Cost:** due to small loan sizes, the high frequency of transactions, the large geographical spread, the heterogeneity of borrowers, and widespread illiteracy
    - **Higher risk of credit:** Rural households may have highly irregular and volatile income streams. Irregular wage labour and the sale of agricultural products are the two main sources of income for rural households.
    - **Information Asymmetry:** Since many rural people do not have bank accounts, there is a lack of information on customer behaviour in rural India

Government's policies:

- High fiscal deficits and statutory pre-emptions imposed on banks
- Persisting interest rate restrictions—"floors" on short-term deposit rates and lending rates, "caps" on small loans
- Government's domination of and interference in rural banks, particularly RRBs and cooperative banks, further distort bankers' incentives;
- Inefficiencies arising from weak governance & poor management,
- Weak regulatory standards & Lack of supervision

BC Model – Viability issues:

- Scarcity of staff
- Inadequate commissions
- Accounts opened have remained non-operational

Infrastructure:

- Technology issues: Non-availability of physical and digital connectivity as well as low rural television-density
- Lack of Bank branches—Limited delivery capability as ATM penetration is low and other channels such as Phone and Internet Banking are non-existent
- Poor physical and social infrastructure—unpaved roads and limited access to modern transportation

Financial Literacy:

Financial Inclusion and Financial Literacy are two sides of the equation. Financial Inclusion acts from supply side by providing financial market/services that people demand whereas Financial Literacy stimulates the demand side by making people aware of what they can demand. Therefore, access to financial services and Financial Education must happen simultaneously and must be a continuous, an ongoing process and must target all sections of the population.

Importance: the low levels of literacy and the large section of the population still out of the formal financial system

Need to-

- Evolve an appropriate Business Model & an Efficient Delivery Mechanism
- Create awareness of basic financial products through dissemination of simple messages of financial prudence in vernacular language—activities included publication of comic books on banking and RBI; games on Financial Education; arranging school/college visits for creating financial awareness; participation in exhibitions/fairs/melas at the State & District levels; conducting essay competitions and quizzes in schools to create awareness about banking and RBI; outreach programmes undertaken by theTop Management and Regional Offices; RBI's Young Scholars Scheme, etc.

F. SMART VILLAGES: ENABLING INCLUSIVE GROWTH AT GRASS-ROOTS LEVEL IN INDIA

"The soul of India lives in its villages," declared Mahatma Gandhi about a hundred years ago. But a century later India's rural economy still has not taken off, and unchecked urbanization has led to migration of talent from the villages to the cities.

Almost 70 per cent of the Indian population lives in villages. Therefore it is natural that for 'inclusive' development, the Government must focus on them. Placing the emphasis on creating 'smart cities' is flawed policy. We must give top priority to the development of 'smart villages' — preserving the sustainability of villages will positively impact cities in the long run.

The lack of job opportunities in villages coupled with less remunerative farming (except in the case of large land holdings) compels village youth to migrate to cities. There, many of them do not enjoy a reasonable quality of life because they manage to get only subsistence jobs. The migration is also uni-directional as they continue to live in cities in the hope of landing better jobs. In the long term, this leads to desertion from villages, dilution of village culture, reduced land under cultivation and, consequently, farm output. In the cities, uncontrolled migration adds to pollution, traffic problems, crime, and over-burdening of civic amenities and infrastructure.

While the phrase 'Smart Village' has become a buzzword in policy and rural development discussion, there is no universal definition of such villages. Two things that are common to all Smart Villages are the extensive use of technology and integration of several key interventions in infrastructure and service delivery. It's an integrated approach of delivering access to skills and quality basic services including education, e-health, 24x7 power, safe food, among others.

- The top priority should be the **creation of opportunities for youths in villages**, thereby discouraging migration to cities. Farming should be made a remunerative occupation, with guidance and mentoring to small farmers on how to get the best yield and market at remunerative prices. It's important to train them to develop a secondary source of income.
- **The benefits of schemes** such as crop insurance, soil health card, and neem pesticides must reach the grassroots. Proper implementation is key. A helpdesk set up in every village and manned by trained individuals to handle farmers' queries and provide solutions would be most useful.
- We must **create an eco-system that makes youth interested in working from their villages**. BPOs/KPOs can operate from villages and young people can be encouraged to take up IT jobs there. Many jobs require computer skills instead of degrees. The digitisation of post offices, rural banks, and IT-enabled services provide excellent opportunities. Projects supported by Digital India and Skill India should be integrated through a unified agency to reach villages. For instance, Skill India can empower youths to start their own small businesses after training as masons, mechanics, electricians, and drivers or to run repair shops, poultry and dairy farms, kirana stores, tea-shops, dhabas and so on.
- **India's crafts** thrive in villages, especially as cooperative ventures. Pottery, metal craft, weaving, jewellery making, wood craft, shell craft, cane craft, embroidery, ivory craft, glass craft and paper craft could be sources of income. The arts and crafts ecosystem of villages is

impossible to recreate in cities. A great deal of export potential is hidden here. Senior/elderly artisans can be employed as 'trainers'.

- **Inclusive approach:** We have sizable tribal population in India, who live in villages, and do not wish to be uprooted. We need to make them part of development. Skill India can study the art/craft unique to each tribal cluster and train their youths to grow in their vocations. They will come into the mainstream by learning the use of new tools and techniques , without the fear of losing their lands, identity and culture.
- Villages traditionally preserve large number of water bodies like ponds, wells, bawadis, canals etc. **Training villagers in water harvesting methods**, rejuvenating ponds/wells to improve water storage and sharing these good practices systematically with others, would help mitigate hardships.The NITI Aayog can draw a master plan to make every village smart in the next five years. Invite support from private institutions or NGOs; however, execution must remain with a governmental 'nodal agency'.

Smart villages can translate into improved farm productivity, water conservation and economic independence to village youth. It makes great social, economic and political sense. The purchasing power of people in rural areas must increase for bigger industries to benefit, and the growth rate of the country to increase, adding that creation of employment in rural areas will prevent migration of labourers, potentially avoiding a crisis that has risen amid the Covid-19 pandemic.

G. PROMOTING TRIBAL ENTREPRENEURSHIP: TOWARDS A HOLISTIC STRATEGY

There are a total of 705 individual ethnic groups notifies as scheduled Tribes in the length and breadth of the country. As per 2011 census, the tribal population of the country is 10.43 crore, constituting 8.6% of the total population.

Ministry of Tribal Affairs was set up in 1999 to uplift tribal communities of India which is extremely marginalised simply because of their cultural practises and habitation in faraway areas thereby getting geopolitically excluded.

Schemes to promote Tribal culture:

- **Aadi Mahotsav**
  - a celebration of the spirit of Tribal Culture, Craft, Cuisine and Commerce, was successfully conducted by the tribal ministry in Delhi. It has been organised in the memory of legendary tribal leader Birsa Munda.
  - The Festival showed exquisite craftsmanship of tribal artisans. This included beautiful sarees, dress materials, jewellery, bamboo & cane products, paintings and hundreds of other items.
- **Swadesh Darshan Scheme Tribal circuit**
  - Union Ministry of Tourism has inaugurated India's first tribal circuit project connecting 13 tourism sites in Chhattisgarh under Swadesh Darshan Scheme Tribal circuit project
  - Major components sanctioned under tribal circuit project in Chhattisgarh includes developing eco log huts, craft haats, souvenir shops, open amphitheatre, tribal interpretation centres, workshop centres, tourist amenities centres, viewpoints, nature trails, solar illuminations etc.
  - These components will improve the existing tourist facilities, enhance the overall tourist experience and help in getting more visitors which in return will increase promotion of tribal culture and job opportunities in the area.
  - Construction of **Museums** for Tribal Freedom Fighters.
- **Tribal Handicrafts**

- TRIFED has setup **TribesIndia** a chain of showrooms where several categories of handicrafts are being marketed like tribal textiles, tribal jewellery.
- TRIFED is also working on the capacity building of the tribes

Schemes for Promotion of tribal entrepreneurship

- **Van Dhan Scheme**
  - The scheme aims at economic development of tribals involved in collection of Minor Food Produces (MFPs) by helping them in optimum utilization of natural resources and provides them with a sustainable livelihood.
  - Under it, 10 Self Help Groups (SHGs) of 30 Tribal gatherers will be constituted.
  - TRIFED– It is engaged in the marketing development of tribal products and provides marketing support to the products made by tribals through a network of retail outlets.
  - Minor Forest Produce is the main source of livelihood of tribal in the country. Recently the government initiated the fixing of the MSP of the Minor Forest Produce and its range.
- **Van Bandhu Kalyan Yojana -**aimed at the social-economic empowerment of the tribal
  - It aims at the overall development of tribal people with an outcome-base approach by bringing the tribal population of the country at par with other social groups and include them in overall progress of the nation.
- **Tribal Entrepreneurship Summit**
  - India's first Tribal Entrepreneurship Summit was organised at Dantewada in Bastar region of Chhattisgarh. The summit is part of 8th Global Entrepreneurship Summit being held in India. The event was organized by National Institute of Transforming India (NITI) Aayog in partnership with Government of USA.
  - It was organised to inspire, nurture and promote the spirit of entrepreneurship in tribal youth. It aims to ensure another step towards tribal-centric sustainable and inclusive development.
- **Stand-Up India**
  - Launched in 2015, Stand-Up India seeks to leverage institutional credit for the benefit of women entrepreneurs, Scheduled Castes and Scheduled Tribes.
  - At least one women and one individual from the SC or ST communities are granted loans between Rs.1 million to Rs.10 million to set up greenfield enterprises in manufacturing, services or the trading sector.

Skill development and promotion of rural entrepreneurship address the challenge of Naxalism in the tribal pockets of India

- To address issues of education and employment in Maoist affected regions, the Ministry of Skills Development & Entrepreneurship (MoSDE) launched two new schemes, namely, 'Skill Development in 47 LWE affected districts' and 'Pradhan Mantri Kaushal Vikas Yojana (PMKVY)' for creating infrastructure and providing employment linked skill training to youth in affected areas.
- Further, undertaking "Skill Development Programme", which includes inhouse training, aimed at equipping tribal youth to acquire the necessary knowledge, skill and proficiency in the operation of Mine/Plant to help them in seeking employment can help in attracting the youth.
- Paying appropriate stipend during the period of the programme and offer free/subsidised breakfast, lunch, uniforms, tool kits, etc along with establishment of ITI/ Polytechnic Colleges exclusively for tribal youth providing entire infrastructure facilities, including residential quarters and hostel buildings for students, to develop local talent suiting to the needs of the industry.

- These measures can help towards leaning away the tribal youth from the clutches of naxalites as many analysts have shown that in the absence of viable employment opportunities, youth tend to take up arms. Also tribal youth form the foot soldiers of Naxal/Maoist movement where ideological motivations are minimum.
- Such an approach can be seen to have succeeded in Andhra Pradesh where the core component of the counter-insurgency strategy was what is called "winning hearts and minds": cutting down the influence of the Maoists by undertaking development and good-governance measures to address the grievances of the civilian population sympathetic to the insurgent cause, including the tribal communities.
- The Andhra Pradesh state succeeded in stamping out left-wing extremism by combining police action with socio-economic programmes implemented by an effective service delivery mechanism.

GI tag can help ST entrepreneurs thrive

In the era of Inclusive development the empowerment of scheduled tribes (ST), which are largely economically and socially backward, has assumed special significance. A sustainable way to empower Schedule Tribes is help them become self-employed entrepreneurs.

Self-employment is already high amongst STs

- According to the Periodic Labour Force Survey (PLFS) 2018-19 report, a large proportion of scheduled tribe workers (57%) are self- employed, basically in the agriculture & allied activities and handicrafts.
- Around 30% are casual and agricultural labour and only around 13% are engaged in salaried employment.
- Hence, it is essential to explore skilling avenues which would help them earn more in the same occupation.

Challenges associated post giving GI Tag to traditional products of STs

- **Challenges of Middlemen:** The benefit of the GI registered tribal product, in many cases, accrues not to the artist but to traders or middlemen.
- **Issue of duplicate and fake products**: Traditional hand-woven designs are often duplicated and sold at a lower price through mass production, which deprives the tribes of their legitimate income
- A case in point is the GI registered unique hand-woven embroidery and textile designs made by the Toda tribe of the Nilgiris.
- **Challenges of Marketing and brand promotion:** The GI tag enhances the value—in terms of sales and profits—of only those products which are known, are already profitable

Way Ahead

- **Proactive State Governments:** States should try to identify traditional products, which incorporate the knowledge and skills of the scheduled tribes, and strive to get GI tag for such products
- **Effective Implementation of GI Provisions**: Any infringement of GI provisions, such as cases of proliferation of duplicate and fake products, should be dealt severely.
- **Inclusive GI Tag recognition:** There is a need to upgrade the GI Act, 1999, and make it more inclusive and responsive to ground realities so that more products are GI registered.
- **Civil Society Support:** It is also critical that NGOs and corporates support the branding and marketing of GI products. In fact, the credit for establishing Araku Valley coffee as an international brand owes essentially to the marketing efforts of an NGO and select corporates.
- **Enterprise-facilitating platform** such as a chamber of commerce, governmental help desk or a voluntary organisation dedicated to GI must be constituted. This would help connect the buyer with the original seller/tribal, thereby helping in reducing the exploitative gap between owner and seller within the GI ecosystem

- **Legal Support:** The inclusion of legal support services within the chamber of commerce and voluntary organisations also helps protect the rights of tribes.

The Way Forward

- **Financial management –** strict adherence to earmarking of funds into a separate head at every level should be made mandatory for release of funds.
- **Non-lapsable pool** for TSP fund
- **Central nodal unit** for an overview which will facilitate better coordination and efficient implementation of TSP through an online monitoring system.
- **Involvement of the local community** in the planning process inputs/ suggestions of the local tribal community should be sought before finalising the plan for implementation of any programme under TSP.

The Constitution (Scheduled Tribes) Order (Amendment) Bill, 2021

The Constitution (Scheduled Tribes) Order (Amendment) Bill, 2021 has recently been passed in both the houses of the Parliament.

- The Bill amends the Constitution (Scheduled Tribes) Order, 1950.
- The Bill has been introduced to give effect to modifications proposed by the state of Arunachal Pradesh.
- The Bill removes the Abor tribe from the list of identified STs in Arunachal Pradesh.
- Further, it replaces certain STs with other tribes.

Do you know?

- The Constitution under Article 342 empowers the President to specify the Scheduled Tribes (STs) in various states and union territories.
- Further, it permits Parliament to modify this list of notified STs.

Atmanirbhar Bharat corner for tribal products

As part of India@75, the Tribal Cooperative Marketing Development Federation (TRIFED) is setting up an Atmanirbhar Bharat corner.

- This corner will be an exclusive space to promote GI tagged tribal art and craft products besides natural and organic products.
- With the focus on "Vocal for Local" and building an "Atmanirbhar Bharat", TRIFED is undertaking several activities, while re-dedicating its efforts towards tribal empowerment.
- The TRIFED has been actively collaborating with several ministries & agencies such as:
    - Ministry of Culture.
    - Department of Promotion of Industry and Internal Trade (DPIIT), Ministry of Commerce.
    - India Posts.
    - Ministry of Tourism.
    - Office of the Prime Minister.
- TRIFED is also setting up an Atmanirbhar Bharat corner in 75 Indian Missions/ Embassies across the world in the next 90 days by collaborating with Ministry of External Affairs.
- The first Atma Nirbhar Bharat corner has been successfully inaugurated at the Indian Embassy in Bangkok, Thailand on the occasion of Independence Day.

What is TRIFED?

- It was established in August 1987 under the Multi-State Cooperative Societies Act, 1984 by the Government of India.
- **Main objective:** Institutionalising the trade of Minor forest products(MFP) and to provide the tribals of India a fair price for the surplus agricultural products produced by them.
- It is a national level cooperative body.
- **Ministry**: Ministry Of Tribal Affairs.

- TRIFED is mandated to bring about socio-economic development of tribals of the country by institutionalising the trade of Minor Forest Produce & Surplus Agricultural Produce (SAP) collected/ cultivated by them.

H. TECHNOLOGY: TRANSFORMING AGRICULTURAL EFFICIENCY IN RURAL INDIA

Technology adoption has proved that it has potential to improve agricultural efficiency by improving farmers knowledge, access to credit, and agriculture output in many ways. Hence, technology adoption can help the farm product to reach from "local to global" market in an efficient way. If addressed the remaining issues in the technology adoption, it will also help to convert the image of Indian "Peasant farmer" in to an "Entrepreneur farmer".

- **Remote sensing** (via satellites), GIS, crop and soil health monitoring, and technologies for livestock and farm management are the examples of technology which are helping to improve the agricultural efficiency.
- **Seed quality enhancing:** The quality enhancement can be done with advanced techniques, adopting seed management strategies resulted into creating high yield seed varieties.
- **Solar-powered water pumps:** These pumps use the abundant solar power available to pump water from the ground. These provide an energy-efficient way. Hence, reduce cost of production and increase profits for farmer.
- **Per capita availability of fruits and vegetables** is quite low because of post-harvest losses which account for about 25% to 30% of production. But, adoption of cold storage chain technology for perishable and other perishable allied agri – commodities has helped to reduce wastages and improve the gains to farmers and consumers substantially.
- **ICT sectors** such as e-choupal is an example of efficient supply chain system empowering the farmers with timely and relevant information enabling them to get better returns on their investment.
- **E-governance in the areas** like- maintenance of land records is a great step in removing the malpractices and creating assurance of rightful ownership.
- **Aadhar linked bank accounts and government** records provide access to monetary benefits by establishing the correct identity, in turn solving problem of access to credit.
- **Direct farm to door connectivity through e-commerce and m-commerce platforms** has facilitated large number of artisans to cut the middleman share and get fair price for their produce.
- **Agro-based small enterprises** such as providing tractor & other farm equipments on rents at reasonable rates in rural areas helped to reduce cost of production. e.g. : UBER enabled farm equipments on rent system through UBER apps.
- **Better access to information** through Kisan Suvidha app and DD Kisan Channel helped to improve efficiency in the agriculture.
- **GPS mapping**, which helps farmer in accessing the need i.e. where they need to put more fertilizer or less, as per requirement of the soil. GPS enabled services are also helping in field of documentation about yield, moisture, etc.

Though technology adoption has improved agricultural efficiency in Indian agricultural sector, some areas still need attention:

- As per FICCII's "Knowledge Paper on Indian farm equipment sector" Farm equipments use in India stands at about 40-45 percent. This is still low when compared to countries such as the US (95percent), Brazil (75 percent) and China (57percent).
- 'Tractor-isation' and not mechanisation of Industry is happening.
- As per National Digital literacy mission, digital literacy is almost no-existent among more than 90% of India's population.

Technology adoption has proved that it has potential to improve agricultural efficiency by improving farmers knowledge, access to credit, and agriculture output in many ways. Hence, technology

adoption can help the farm product to reach from "local to global" market in an efficient way. If addressed the remaining issues in the technology adoption, it will also help to convert the image of Indian "Peasant farmer" in to an "Entrepreneur farmer".

All the best
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