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MODERN TECHNOLOGY IN IMPLEMENTATION OF RURAL DEVELOPMENT PLANS

A. The Ministry of Rural development has been making sincere efforts to bring prosperity and well- being in the villages through its programs and schemes.

B. In order to achieve the desired results of all rural development schemes great emphasis has been laid on adopting modern technology cutting-edge techniques and scientific methods in their implementation. This can be seen from the following schemes:

1. Pradhan Mantri Awas Yojana (Gramin)

- With the objective of providing pucca houses with basic facilities by 2022 to all the eligible homeless families and the households living in dilapidated houses Pradhan Mantri Awas Yojana- Gramin was launched in November 2016.
- Under this scheme the target is to construct 1 crore residential units till March 2019 and selection is done as per the socio-economic caste census 2011.
- Pradhan Mantri Awas Yojna has created employment opportunities in the country on a large scale and also catalyzed skill development in rural areas.
- The use of modern technology and new techniques in the implementation of the scheme has ensure transparency as well as helped in increasing the base of implementation process.
- In each stage of housing construction, Information Technology based MIS-AwasSoft, mobile based application Awas app and space technology are being used on a large scale for monitoring purpose. All transfer of funds to the beneficiaries are done on the basis of electronic funds transfer order (FTO).
- To monitor the progress of housing construction, showing Geo-referenced photographs with the help of mobile based application-Awas app and uploading them on awas Soft has been made mandatory. All photographs uploaded are geotagged and time-stamped. These assets can also be seen on Geo co-ordinated Bhuvan.
- Off-line module of this application has also been launched to register geotagged photograph of houses in areas where there is no network connection
- Rural housing knowledge network (RHKN) has being started in collaboration with IIT Delhi with the objective to prepare multilingual web portal in the public sector and to prepare comprehensive nationwide compilation of information related to business houses, institutions and practices associated with affordable and sustainable solution of rural housing.

2. Pradhan Mantri Gram Sadak Yojana

- Rural connectivity is an important component of socio-economic development of villagers. In India, when the year of planned development started in the year 1951, the road connectivity in the villages was negligible because only 20% of the villagers had all weather roads.
- During the fifth five-year plan, in the year 1974, the development of rural roads was made a part of Minimum Needs Programme.
- Under the various programs of Central and state government pertaining to Employment generation and poverty alleviation rural roads were constructed but overall, their remained a misconception that there was no need for detailed design and engineering for rural roads.
- As a result, many thousand km of roads were played without the aid of proper design and Engineering. The subject of rural roads is included in the constitution under the state list,
- The government had, as part of the poverty alleviation work plan meant for the assistance of the states, launched the centrally sponsored scheme of Pradhan Mantri gram Sadak Yojana in December 2000.
- The main objective of the scheme is to provide all weather roads to the habitation included in core network of planes areas not connected with two roads and having population of 500 and More (as per 2001 census). National Rural Development Agency has been constituted for technical and managerial Assistance in the implementation of the program at the Central level where state government has constituted state rural road development agencies.
- Asian Development Bank approved technical assistant in December 2017 to emphasize on sustainability, innovative technology and anti-disaster mechanism in the development of rural roads in the country. The speed of road construction in the year 2013-14 was 75 km per day, which increase to 134 kilometres per day in 2017-18.
- Pradhan Mantri gram Sadak Yojana II has been started for improvement in existing rural Road network. Under this, with the aim of making road network more vibrant, selected rural roads are being upgraded by the use of modern technology and parameters and the target has been fixed to construct 50,000 km of roads.
- Now each state is required to setup simplified maintenance plan and management system to survey the actual situation of the inventory and entire Rural Road network. Data Base is available on OMMAS and now it is also necessary to record on the GIS platform. Under World Bank assisted PMGSY-Rural Road Project-II, emphasis has been laid on adopting innovative and simplified methods of maintenance of rural roads.
- Under this mobile application Aarambh has been developed which helps in collecting necessary data for preparation of inventory of roads, GIS based mapping for survey of roads surface, cost estimation and annual road maintenance plans and monitoring work.

- National Institute of rural development and Panchayati Raj has issued guidelines on technology initiatives for promoting cost-effective technology in the construction of rural roads using new materials, waste material and locally available material.
- Keeping in view of the use of non-conventional materials and environment-friendly Green Technologies in the construction of PMGSY roads, the Ministry of Rural development has fixed State wise target regarding the use of waste plastic and cold mix technology.
- To fulfill the objectives of e-Governance and Digital India, a new mobile application Meri Sadak has been launched for resolving complaints related to PMGSY roads.

3. MGNREGA

- The scheme of providing at least 100 days of unskilled manual labour to each family in the form of guaranteed employment in a financial year according to the demand in rural areas is well known as Mahatma Gandhi National Rural Employment Guarantee Act-MGNREGA.
- An exclusive initiative named Geo-MGNREGA was introduced in the financial year 2016-17 to strengthen the scheme and also to underpin transparency and monitoring mechanism in implementation. Under this initiative space technology is being used for geo tagging of all assets created through MGNREGA.
- Secure (Software for Estimate Calculation Using Rural Rates for Employment) is an online application, specially designed and developed to prepare online estimates of MGNREGA works.
- In the financial year 2017-18, an Android-based mobile application Jan-MGNREGA was launched which has a large-scale feedback mechanism for the public.
- Ministry of Rural development has started the National Electronic Fund Management System (NEFMS) from January 1 2016 to for the simplified the fund flow system.

Conclusion:

- Use of scientific methods, state of art technology and latest techniques have greatly helped plan rural development schemes in a better way, execute qualitative work and monitor the rural schemes more effectively and with all these, it has become possible to ensure greater transparency in implementation of schemes.

BUILDING AGRICULTURE INNOVATION SYSTEM

- In India, we have daunting challenges. They range from substantial enhancement of our productivity to dealing with challenge of climate change to managing dry land farming to rapid elimination of poverty and malnourishment. Hence, India needs to rapidly move towards 'innovation led agricultural growth'.

New System:

- We have benefited from our established 'Indian Agriculture Research System'. However, we need to understand that any National Agricultural Research System is activity based. Agricultural Knowledge and Information system are output based. National agricultural innovation system (NAIS), however, are outcome based.
- This new emphasis means that rather than just supporting research and research organizations, or supporting the generation of outputs, such as agricultural knowledge and information, emphasis has to be now placed on supporting outcomes that lead to sustainable development and growth.
- In the new National Agricultural Innovation System, we must move to total innovation, involving technological and institutional innovations throughout the production, marketing, policy research and enterprise domains.
- Farmer's role no more will be confined to learning adopting and conforming. They must become co-creators of knowledge, process and innovation. We must move from 'funding for research and research infrastructure' to 'strengthening' the systemic capability for 'total innovation', backed up by an enabling policy environment that fosters innovations.
- The combination of scarcity and aspiration had helped India develop its own brand of innovation- getting more from less for more people- not just for more profit. This was called the MLM paradigm, i.e., 'More from Less for More'.
- The challenge for the Indian Agriculture Innovation System will be also to get 'more from less for more'. This means getting more output or productivity by using less resource to create benefits for more and more people, not just more and more profit.
- Indian demand for food grains would increase from 192 million tones in 2000 to 342 million tones in 2030.
- Diversion of arable lands for urbanization, industrialization and also for producing bio-fuels will mean less availability of land for agriculture. Availability of 'Less land' is also due to degradation caused by soil erosion, soil salinity and water-logging problems. Available estimates show that over 120 million hectares of land is degraded.

- Furthermore, in India, agriculture is dominated by small farmers, with small landholdings. The average size of the landholdings decreased from 2.30 ha (1970) to 1.32 (2000) and is likely to be reduced to 0.68 ha (2020) and then to 0.32 ha (2030).
- Despite this 'less' land per capita, we have to get 'more' income for our farmers. This means developing technological innovations that suit less land holding, or developing affordable implement or involving these small land holders innovatively in agrisupply chain through institutional innovations.

Getting More from Less:

- Using the power of new technology, such as information and communication technology, nanotechnology, space technology, modern biotechnology, etc can help. However, a robust policy level innovation is a must to achieve this.
- We could have innovation through technology-enabled supply chain through the use of RFID, advanced GIS/GPS, tracing and traceability systems.
- Precision agriculture could be achieved with the use of advanced GIS/GPS and sensors can guide planting/irrigation, monitor yields, find tune inputs and achieve 'more from less' by improving yields as well as reduce the use of water and fertilizer.
- Farmers can have real time market information by using mobile communications, voice-based call centers, and expert systems for real time price discovery, weather information and cultivation trends.
- Again, we can achieve 'more from less' by using leakage-free public system, which uses computerized allocation of food grains, GPS/SMS monitoring, verifiable digital identify and web portal for public grievances.
- Finally, we can have technology enabled crop insurance.
- The second powerful way of getting 'more from less' is to empower more and more farmers with more and more knowledge. This can happen if the farmer understands the soil that he is sowing his sees in (soil health card).
- The third way of getting 'more from less' is by using the power of 'collective intelligence'. We must have more innovators becoming active players in the Indian agricultural innovation ecosystem going beyond our formal research and innovation systems.
- National Innovation Foundation (NIF) recognizes such grass roots innovators across India. For example, Dadaji Khobragade from Nanded was one such as 'grassroots innovator'. NIF indentified him and honored him.
- The improved paddy variety, HMT, developed by him has now diffused to several states covering more than one lakh acres. It has been included as a standard reference for thinness by Protection of Plant Variety and Farmer's Right Variety (PPVFRA) also!

- The fourth strategy is that more 'collective intelligence' of the innovators must be used in enhancing the productivity of the workers in agriculture, while reducing or removing the drudgery in their fields.
- Women comprise over fifty per cent of the total work force in tea gardens in India. Plucking of tea leaves manually involves a lot of drudgery. Can we not develop a tea leaf plucking device?

The Way Forward:

- The decade of 2010-20 was declared as the Indian Decade of Innovation.
- India's ranking among 143 nations has slipped from 62(2011) to 81(2015). However, in the
- subsequent years, it has steadily improved, 66 (2016), 60 (2017) and 57 (2018).
- Global Innovation Index is largely based on technological innovation. Other countries appear to be speeding faster than India in technological innovation. But India excels in non-technological innovations such as business model, system delivery, workflow, organizational, institutional innovations, etc. It also excels in grassroots innovation. The Global Innovation Index must be redesigned to account for all this.
- We must build our own Indian Agriculture Innovation Index. It is important to do so, because what cannot be measured, cannot be monitored.
- If we do this with determination, then we will achieve the dream of moving rapidly from 'green revolution', too much needed 'evergreen revolution' and 'nutritional revolutions'.

KRISHI VIGYAN KENDRA: PROMOTING SCIENTIFIC TEMPER

- The diffusion of science, technology and innovation in agriculture is rather the key to increase agricultural production in a sustainable manner.
- In order to draw true potential of farmers towards the state-of-the-art technologies for the betterment of agriculture, Indian government has set up a big chain of over 700 Krishi Vigyan Kendras (KVKs) across the country.
- KVKs are emerging as the regional knowledge hubs and gaining trust of the farmer community. KVKs are the integral part of the national agricultural research and extension system. KVKs conduct training and emphasize on learning by doing. Origin, Philosophy & Objectives of KVK: The concept of Krishi Vigyan Kendra was given by Dr. M.S. Swaminathan, initiator of green revolution in India and the father of Indian agricultural research.
- Its objective was to cater activities such as technology assessment, refinement and demonstration of technology product. The Government of India established first KVK in Pondicherry during 1974 with the financial support and guidance of Indian Council of Agriculture Research. In Kapgari Village of West Medinipur district, the first KVK in West Bengal and second in India was established in the year 1976.

- Presently, around 695 Krishi Vigyan Kendras are existing in different district of India.
- The objectives cum activities of Krishi Vigyan Kendras can be summarized as below:

1. On Farm Testing of new Technologies:
2. Frontline Demonstration Centre: It organizes programmes to show the efficacy of new technologies on farmer fields.
3. Capacity Building:
4. Multi sector Support and Advisory Services: Krishi Vigyan Kendras offer support to various

- private and public initiatives through its local network and expertise.
- The study found that KVKs are playing a prominent role in transforming new technology at field level with beneficial impacts.
- This study predicts a better future of KVKs. It exhibits that through KVKs, agriculture related technological development is getting momentum and the final outcome of this expedition is to support national development through a scientifically tempered approach.

Conclusion:

1. Krishi Vigyan Kendras provide requisite knowledge through trainings and other activities to improve the skill and attitude of the people particularly farmers towards new technology and approach in farming, provide groper guidance to solve any problem faced by the farming community in agriculture and allied fields.

KNOWLEDGE MANAGEMENT THROUGH DIGITAL TECHNOLOGIES

- A knowledge-based society and knowledge sharing environment can make the development process sustainable and accelerate the process of achieving the development goals.
- Reaching-out right knowledge to the right people at right time is always a challenge, owing to various reasons including accessibility and authenticity of information and knowledge from different sources. Adopting a suitable knowledge Management system or combination of systems and tools is important to reach-out the target audience with intended information and knowledge.

Concept of knowledge management:

- Knowledge Management (KM), a process of leveraging collective knowledge in a particular domain/institution/organization, traditionally includes four processes, i.e, knowledge creation, knowledge storage retrieval, knowledge transfer and knowledge application.
- Traditional Knowledge Management systems including classroom teaching and distance mode programs in rural in 'knowledge push' and very less scope for interactivity. These systems are

more 'process-centric' rather than 'people-centric'. But, rapid technological developments over the years, have made the knowledge management process more interactive and people centric.

- The recent trends in ICT have made 'Knowledge Sharing' more efficient and timelier.
- Different Digital Technologies:

A. Web Portal: A powerful Knowledge Management tool

- Web portals are specially designed single access points to information collected from diverse sources. The information is arranged in portlets in a uniform way for users to access.
- Web portals can be classified as horizontal (providing broad range of content for general user) or vertical (targeted offering for niche users), also called vortal. Web portals designed for rural advisory services are generally of the second type.
- Some of the key web-portals hosting credible information on Rural Development in India, include – Vikaspedia , India Panchayat Knowledge Portal , India Portal, Ministry of Rural Development Portal , NIRD & PR portal, Panchayat Enterprise Suit , Digitla India Portal and DISHA Portal monitoring 42 National Flagship Schemes.
- In India, most of the websites (76%), particularly Government websites, are available only in English and about 24% of the website host bilingual content (hindi/regional language).
- These websites are largely institute websites that have a greater focus on organization related aspects. The only predominantly available user centric information is that of policies and schemes of that particular institution.
- Limited scope for the user to share their experiences and knowledge with others and interact with experts or peers.

B. Social Media: A cost effective tool for Knowledge sharing

- Rural Development process demands continuous interaction among multiple stakeholders and learning to take collective action. These services have been called upon to be less 'top-down' and more interactive, and social media can be a potentially powerful tool in this regard.
- Social media is the best knowledge management tool as on today to reach-out the target group in rural areas in shorter time and more effectively.
- Sustainability depends upon the ability of the members to feed the content, add value to content, and support purposeful online engagement. Social media sustainability depends on the capacity of the stakeholders to address the dynamic information needs of clients and create networking opportunities with peers.

C. Smart Phones: Dynamic power house of Knowledge

- As on 31st August 2018, the total number of mobile users in India were 1167 million (91% of total population), including 519 million subscribes from rural areas, as estimated by Telephone Regulatory Authority of India (TRAI).

- The success and failure of mobile based services broadly on the target group, demand driven content, mode of delivery and sustainability model. Some of the successful mobile based services implemented in India, is listed below:

1. **Rural Development:** DISHA, Gram Samvad, Awaas App (PMAY-G), Mission Antyodaya App,
2. Agriculture and allied sectors:
3. **Banking:** BHIMApp, PhonePe, PayTm, FreeCharge, Airtel Money, Idea Money
4. **Health:** mSWASTHYA, MOTHER, Indian Blood Donors, Blood4India, eMamta, eAushadhi, Sanjeevani, 1mg App, mTIKKA.
5. Government of India has launched 'Mobile Seva' initiative for mainstreaming mobile governance in the country.

D. Expert System: A virtual expert tool providing solutions for common problems

- An Expert System is basically a software application that attempts to reproduce the performance of an expert in a particular domain. It adopts artificial intelligence to solve a particular problem with the help of pre-set conditions in the software application.
- There are expert systems available in Agriculture and allied sectors developed by Indian Council of Agricultural Research (ICAR) and are widely used in Krishi Vigyan Kendras (KVKs) and other organizations working in remote villages.
- 'Plantix' is a mobile based plant disease diagnostic tool getting popular in recent days. E. E-Learning: A solution for large scale capacity building
- Technology Enabled Learning (TEL) including online courses, remote classrooms, video conferencing etc. plays a major role in rural knowledge management.
- E-Learning platforms could be used for offering online course for focused groups in a convenient and consistent manner, providing opportunity for anytime-anywhere learning for the community.
- Massive online open courses (MOOCs) are recent trends which include, SWAYAM (MHRD, Government of India), Coursera, edX, Khan Academy, Udacity and Future Learn.

F. Community Radio:

- Community Radio is a broadcasting system established by the efforts of a specific community, operated by them for the purpose of the community's welfare. These stations are collectively owned by the community, trust or foundations in total locality.
- As on today, there are 186 Community Radio stations operational in India, including 40 in rural areas. The 'Sangam Radio' started in 2008, by Deccan Development Society (DDS) in Telangana, is the first NGO operated Community Radio, successfully operated by women's collectives for the past 10 years. Unlike other countries, Community Radios are not too

successful in India, owing to many reasons including lack of funding, program skills, technology and licencing issues. Government intervention is required to resolve these issues and promote setting-up of more community Radios in rural areas.

INNOVATIVE TECHNOLOGY FOR HIGHER PRODUCTIVITY

1. India has achieved a remarkable growth in production and productivity of various agricultural commodities over the last five decades. Major changes in agricultural production took place in mid- 1960s with introduction and adaptation of new production technologies which is known as "Green Revolution" technology.
2. The agriculture sector observed spectacular growth of over 4% per annum during 1980 to 1990. However, this growth rate did not sustain during 1990s due to several reasons including slowdown in public investment, low yield growth, decline in food productivity, declining water table and environment led stress problems, climate changes etc.

Importance of Agriculture:

3. Agriculture is still the main livelihood of approximately half of the rural households in India and contributing over 16% to its gross domestic product (GOI, 2018).
4. It is estimated that in the year 2035 the total domestic food grains demand will be 398.6 mt and milk 237.8 mt against 264 mt and 132.44 mt respectively in 2013-14. To meet the estimated demand, the yield level over the base period yield (1994-95) is required to be enhanced by more than 50%. It is pertinent to mention here that these targets are to be achieved in a scenario of several odd factors which will constraints the sustainable development of agriculture. Agricultural development will have to be therefore guided not only by the compulsion of improving food and nutritional security, but also by the concerns for eco-restoration including conservation ad harnessing of biodiversity, long-term sustainability and profitability under the pressure of global climate change scenario.

This can be done through two methods:

A) Innovations in efficient Input Resources Utilisation and

B) System based technologies for increasing resources use efficiency.

1. Innovations in efficient Input Resources Utilisation:

a) Site-specific input management which is based on the spatially and temporally variable conditions, have proved tangible yield gain, along with higher efficiency, profits and better soil health. Precision farming technologies have now been developed to spatially vary nutrients within a field based on various information sources.

1. **Site-specific Nutrient Management (SSNM):** Integration of SSNM with GIS based spatial variability mapping is much more useful technique as it provides an opportunity to

assess variability in the distribution of native nutrients. It also helps in assessing other yield limiting/improving soil parameters across a large area and thus aids in developing appropriate nutrient managements strategies leading to better yield and environmental.

2. **Real-time Nitrogen supply:** Synchronization between crop Nitrogen demand and the available N supply is an important key to improve N-use efficiency. Crop N requirements are closely related to yield levels, which is turn are sensitive to climate, particular solar radiation and the supply of nutrients and crop management practices.
3. **Use Decision Support System (DSS):** Use of software-based skills like- Nutrient, Experts, Crop manager etc, have proved to be useful.
4. **Improving Water Productivity:** Water productivity defines as the output of goods from the unit of water. The productivity of water irrespective of environment will be governed by those factors which minimize the water losses from the soil system and improve the transpiration water use by the crops.

- The alternatives for increasing water productivity are changing of crop varieties, crop substitution, deficit, supplement and precision irrigation, improved water management practices and improving non-water inputs. Reallocation of water from low value to higher value uses would generally not help in any direct water savings but may increase the economic productivity of water. On individual farms, higher productivity requires selection of appropriate crops and cultivars and proper soil and water management technology, improved planting methods. Pressure irrigation system along with fertilizer application (fertigation) resulted in remarkably high-water use efficiency and yield and thus high productivity of water.

5. **Sustained adoption of Micro-irrigation:** Several efforts and economic gains, micro-irrigation area in India remains insignificant proportion of its potential.

- The most important determinants of micro-irrigation adoption include access to groundwater, the prevailing include access to groundwater, the prevailing cropping pattern, level of education, financial resources, the social stratum of the household, and the wealth or poverty status of the farmer. Subsurface drip is a highly efficient irrigation system that uses buried drip tubes or drip tape to meet crop water needs. Since the water is applied below the soil surface (as opposed to surface irrigation or traditional drip irrigation), the effects of surface infiltration, such as crusting, saturated condition of ponding water, and water losses via evaporation and surface run-off (including soil erosion) are eliminated. Water is applied directly to the root zone of the crop as opposed to the soil surface where most weed seeds hibernate. As a result, germination of annual weed is reduced. Furthermore, some crops may benefit from the additional heat provided by dry surface conditions, and produce more biomass.

6. **Nanotechnology**: Application of nanotechnology has gained momentum to mitigate biotic and abiotic stress as well as other constraints causing low crop yields.

Some of the main applications of nanotools are:

1. Increase productivity using Nano-pesticides & Nano-fertilizers e.g. Nano zinc particles.
2. Improves soil quality using Nano-zeolites and hydrogels
3. Stimulate plant growth with nanomaterials (e.g. SiO_2, TiO_2 and carbon nano-tubes).
4. Provide smart monitoring using Nano-sensors by wireless communication devices.

a) System based technologies for increasing resources use efficiency I. Crop diversification

b) In general, crop diversification refers to the shift from the regional or temporal dominance of one crop to production of a number of crops, to meet ever increasing demand for cereals pulses, vegetables, fruits, oilseeds, fibres, fodder and fuel, etc.

Crop diversification has become an important option to attain the following goals:

- Natural resources sustainability o Ecological balance
- Employment generation
- Output growth and adequate buffer stocks
- Risk coverage and reducing the magnitude of risk due to mono-cropping
- Higher profitability
- Resilience/stability in production.
- Attaining self-sufficiency in some crops and earning exchange from others.
- Crop diversification is two types, first one is horizontal diversification which includes the diversification through crop substitution and crop intensification.
- Second one is vertical diversification approach in which farmers and others add value to products processing, regional branding, packaging, merchandizing, or etc to enhance the marketable access of the product.

Integrated Farming Systems:

1. One of the best approaches in building farm resilience is through spreading risks and creating buffers.
2. Integration of livestock rearing with crop production gave higher economic returns compared to crop production alone for both marginal and small farmers.
3. Under irrigated areas, the following IFS models are most suitable to maintain soil fertility and productivity.

Conservation Agriculture (CA):

- Conservation agriculture refers to the system of raising crops without tilling the soil while retaining crop residues on the soil surface.

- Conservation agriculture permits management of soils for agricultural production without excessively disturbing the soil, while protecting it from the processes that contribute to degradation.
- Maximum soil covers by leaving and managing the crop residues on the soil surface, as cover/mulch and Adopt spatial and temporal crops sequencing/crop rotation to derive maximum benefits from inputs and minimize adverse environmental impacts. The main advantages of CA are reduction in cost of production, reduced incidence of weeds, saving in water and nutrients, increased yields, environmental benefits, crop diversification opportunities, improvement in resource-use efficiency, etc.

Climate Smart Cropping

- In changing climate scenario, developing cultivars resistance to climate change may become important adaptive mechanism for maximizing resource-use efficiency. For example, crop varieties those are resistant to lodging (e.g., short rice cultivars), may withstand strong winds during the sensitive stage of crop growth, are viable alternative.
- Such adaptation measures like change in crop calendar to reduce the negative effects of increased climatic variability in arid and semi-arid tropics proved advantageous to avoid extreme weather events during the growing season.

Integrated Crop Management (ICM):

1. ICM suggests the use of good agricultural practices (GAP) which is an alternative system of crop production, which conserves and enhances natural resources while producing quality food on an economically viable and sustainable foundation.
2. It combines the best of traditional methods with appropriate modern technology for balancing the economic production of crops with positive environmental management. ICM is particularly beneficial for small and marginal farmers because it aims to minimize dependence on purchased inputs while utilizing on-farm resources.

TECHNOLOGY INNOVATIONS FOR SOIL HEALTH PRESERVATION

a. Soil is a dynamic system, consisting of organic and mineral matters, air, water and living organisms along with their interactive processes. Soil is formed through a complex process which takes thousands of years to make an inch of soil.
b. If managed unscientifically, it can easily be contaminated, eroded and destroyed in a very short span of time. Thus, there is a need to understand the soil health and the systems that affect it, so as to devise stregeis for its sustainable use for providing the human needs in the future.

Soil Health:

- Soil health is like animal health where the soil sustains production depending upon the status of soil health attributes. Soil health concept involves integration of physical, chemical and biological properties of a soil and role of its harmonious blend in sustaining growth, productivity and environmental security.
- Healthy soils maintain a diverse community of soil organisms that help to control plant disease insect and weed pests etc. A healthy soil also contributes to mitigating climate change by maintaining or increasing its carbon content.

Sustainable Soil Health Management:

- A soil that is able to optimally sustain its native/acquired productivity potential and render ecological services is said to be in good health. It is associated with the following characteristics:

Minimum soil Erosion:

1. Good soil physical properties o Sufficient soil cover
2. Stable Soil Organic Matter, Improved soil fertility and productivity
3. Absence of Soil salinization, sodificatio and alkalinization.

Good practices for Soil health preservation:

1) Prevent Soil Erosion:

- Soil erosion causes the loss of top layer soil containing organic and mineral nutrient pools.
- It should be minimized by growing cover plants. Maintaining organic or inorganic residues also protects soil surface. Several other measures are mulching, minimum tillage, no-till by direct seeding, strip cropping, agroforestry, shelter belts, and reduced stocking and grazing intensities.

2) Increase Soil Organic Matter Content:

- It plays a central role in maintain soil functions and preventing soil degradation. A loss of soil organic matter can cause a decline in soil quality and soil structure, and increase soil erosion, potentially leading to emissions of carbon into the atmosphere.
- Innovative practices for increasing organic matter content are: managing crop residues, minimum grazing, practicing organic farming, applying integrated method of soil fertility management and pest management, applying animal manure or other carbon-rich wastes, using compost, and applying mulches or providing the soil with a permanent cover, reduced-orno- tillage practices, Implementing crop rotations etc.

3) Soil Nutrient Balance and Cycles:

- It is crucial to select an appropriate plant nutrient management system for sustainable agriculture management.

4) Mitigating Soil Salinization and Alkalinization:

- Salinization reduces crop yields and, above certain thresholds, completely eliminates crop production.
- Optimum irrigation management should ensure sufficient water for plant growth and efficient drainage to avoid problems of salinizaiton. Surface and sub-surface drainage system should be installed and maintained to control groundwater tables and control soil salinity.

5) Minimizing soil contamination:

1. Contamination occurs if the rate of addition of a given contaminant exceeds its rate of removal from the soil system.
2. Contaminated soils should not be used for foods and feed production.

6) Conserving soil Biodiversity:

- Soil organisms play key roles in the delivery of many ecosystems services. It can be maintained or enhanced through the provision of sufficient vegetative cover optimal nutrient additions, addition of diverse organic amendments, minimizing soil disturbance, avoiding salinization, and maintaining or restoring vegetation such as hedgerows and shelterbelts.
- Use of nitrogen fixing leguminous species, microbial inoculants, mycorrhizas, earthworms and other beneficial soil organisms should be encouraged where appropriate.

BIO FERTILIZERS FOR SUSTAINABLE FOOD PRODUCTION

- It has been observed that up to 90% of applied p-fertilizer (Phosphorus fertilizer) is rendered unavailable for crop uptake due to fixation.
- For P-fixation, mycorrhizal inoculation of plants is one of the alternatives. Fungi, which form symbiotic association with roots of plants are refereed as mycorrhizal fungi and the association itself is referred to as “mycorrhizae”.Mycorrhiza form a network of filaments that associated with plants roots, increases that associated with plant roots, increases the absorption of nutrients, particularly phosphorus and thus enhance the growth of crop plants and trees.
- Currently, VAM (Vesicular Arbuscular Mycorrhiza) as biofertilizer are utilized in fumigated soils, greenhouse crops, and in the reclamation of disturbed sites. Ectomycorrhizae are employed in the establishment of trees in nurseries and in the production of containerized seedling.

Various functions of the mycorrhiza (VAM) are as follows:

- The main function of the mycorrhiza is to dissolve the fixed phosphate available as insoluble phosphate in the rhizosphere zone.

- Mycorrhiza also helps in the dissolution of trace elements which are in the form of insoluble compounds due to high alkalinity and make them available to the plants.
- These fungi synthesis certain chemicals like HCN (Hydrogen Cyanide) etc. and release them in the rhizosphere zone, which protect the feeder roots of plants from the attack of various pathogens in the rhizopshere zone.
- The mycorrhiza also helps during the nitrogen fixation because the phosphate requirement in the nitrogen fixation and water transport is fulfilled through mycorrhizal activity hence mycorrhiza can be used with Rhizobium.

Conclusion:

- Mycorrhia, a potential biofertilzer is considered as a boon for agriculture because it provides phosphtae, trace elements to plants by forming a symbiotic association with plats. By the use of nitrogen fixing biofertilizers with mycorrhiza, PSB and organic manure, it will increase the C: N (Carbon to Nitrogen ratio) and ultimately, leading to increased production.

RENEWABLE ENERGY ADOPTION FOR RURAL AREAS

- A village is deemed "electrified", if at least 10% of the households and public places such as schools and health centres are connected and receive electricity from the grid, through the transformer established in the village. This would still leave 90% of people living in these villages "un-electrified". The government did embark on an ambitious program named "Saubhagya", in order to provide. power connections to every household by the end of March 2019. While the process of electrification involves 3 steps, the first being the extension of infrastructure to the village, followed by connecting the household, the last and most critical and challenging part would be the ensure the supply of reliable and affordable energy that is sustainable.

Need for Decentralized Renewable Energy:

- Decentralized renewable energy in the form of mini-grid and rooftop solar are a crucial part of the solution where the grid cannot reach or serve in a reliable manner. It is here that distributed renewable have crucial role to play, for energy to be universally accessible.
- It is a known fact that India relies on coal, to meet 60% of its electricity demands. With stagnation in the production of coal, it would be an uphill task for the government to provide uninterrupted power to its citizens. With India's energy distribution companies suffering huge losses and on the brink of collapse, increasing the share of renewable energy in the energy mix should be high on the policy agenda.
- Renewable energy, with its renewability and non-polluting property, promises to grow to be an effective and practical choice guaranteeing the future development of the world.

Types of Renewable Energy:

- International experts have categorized renewable energy as traditional and new. The former referring to giant hydropower and biomass burnt directly, while the latter refers to small hydropower, geothermal energy, wind energy, biomass energy, solar energy, ocean energy, etc.
- While hydroelectricity refers to potential and kinetic energy of water being converted into electricity in hydroelectric plants, Geothermal energy is available as heat emitted from within the earth's crust, usually in the form of hot water or steam.
- In solar plants the solar radiation is exploited for electricity generation and hot water production.
- In Tide/Wave/Ocean, the mechanical energy derived from tidal movement, wave motion or ocean current are exploited for electricity generation. In wind, kinetic energy of wind is exploited for electricity generation by the use of wind turbines.
- In biogas plants, the gases composed principally of methane and carbon dioxide that are produced by anaerobic fermentation of biomas, or by thermal processes which includes landfill gas, sewage sludge gas, other biogases from anaerobic digestion and biogases from thermal process are utilized.

Challenges and Opportunities:

- A number of possible constraints to RE adoption include:
- unfamiliarity with the technology,
- lack of awareness of the environmental benefits,
- opinion that the technology is unreliable,
- belief that the technology can have harmful side effects,
- unsuitable location for the installation,
- inability to access sufficient credit,
- invested capital needs elsewhere, the
- fear of the administrative work involved in re systems
- A recent study from Bihar suggests that a critical determinant of electricity access in rural India is proximity to the Central power grid. This essentially suggested that remote villages in rural India would be deprived of access to power.
- Hence, it is imperative that rural India develops and adopts self-sustaining community-managed local generation, storage and grid-connected electricity models (popularly termed microgrids).
- The Government of India should consider setting up of the solar plants through a large number of Renewable Energy Cooperatives rather than through setting up Mega Solar parks. It is better to set up 5000 numbers of 1 MW plant in each village rather than setting up a single 500

- MW in one location. Off-grid rural electrification with RE is the best alternative to provide electricity for the rural population. Grossbardorf, a village in Germany runs a successful micro grid rural cooperative model that generates four times the electricity need to power individual businesses and homes of the community. Excess power is fed back to the main electricity and through a feed-in tariff system, and the revenue generated is shared equally among the various stakeholders.
- A biomass-based rural cooperative in Tumkur district of Karnataka owes its success to institutional aspect like will-defined property rights in ownership, institutionalized markets and decentralised environmental governance.
- One of the reasons why the cooperative model of enterprise has been effective is that it responds to the increasing demand for democratization of energy.
- The growth of energy cooperatives, particularly in the renewable energy sector, suggests that cooperatives are increasingly being chosen by people around the world to respond to their needs.
- However, this growth is also attributable to increasing public interest in community-owned and locally based energy solutions, new energy regulations and support measures for renewable energy, and raised awareness on green issues and climate change.

Conclusion:

- Renewable energy-based rural cooperative models across India would require high levels of initial seed capital. Banks, governments and international agencies such as the United Nations may not help in achieving the scale of financing required.
- So, it is imperative that private players such as big industrial houses and high net-worth philanthropic individuals take the lead in establishing rural energy cooperatives. The needs of the hour is a private-cooperative partnership.