

**1. AGRICULTURE : CHALLENGES AND INITIATIVES**

Food grain production in India has increased from 50.8 million tonnes in 1950-51 to 308.65 million tonnes in 2021-22. India is the largest producer, consumer and importer of pulses; the second-largest producer of rice, wheat, sugarcane, cotton and groundnuts; the second largest producer of fruits and vegetable in the world after China; the largest producer of fruits like mango, banana, sapota, pomegranate and aonla and vegetables like peas and okra; the second largest in the production of brinjal, cabbage, cauliflower and onion; the largest producer/consumer and exporter of spices and spice products and the largest producer of milk (continuously for more than two decades) in the world.

**Government Initiatives**

- **Soil Health Card Scheme, 2015** - Under this scheme, samples of soil are taken and tested in the labs to assess the health of soil in the form of presence/absence of required micro-nutrients. Thereafter, the experts suggest the farmers measures to improve productivity of soil through judicious use of inputs.
- **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY), 2015** - The motto is 'Har Khet Ko Paani'. Presently net irrigated area in the country is nearly 48% of net sown area, the rest dependent on rain for cultivation. The scheme aims at the expansion of net irrigated area, reduce wastage of water and improve efficiency in the use of water. It also focuses on creating sources for assured irrigation through rainwater harvesting to ensure 'Per Drop More Crop'. The Scheme also contains a **Micro-Irrigation Fund (MIF)**, with a focus on protective irrigation, and water use efficiency interventions to not only expand India's irrigation networks but improve its efficiency.
- **Pramparagat Krishi Vikas Yojana (PKVY), 2015** - It promotes organic farming. The willing farmers are required to form a group of minimum 50 farmers with minimum total area 50 acres. Each farmer enrolling in the scheme is provided a sum Rs. 20,000 (spread over three years) per acre by the government. This fund can be utilised for obtaining agriculture inputs and transporting the produce to the market.
- **Pradhan Mantri Fasal Bima Yojana, (PMFBY), 2016** - It stabilises the income of farmers. In event of any loss to the notified crop (food crop, commercial/ horticultural crop and oil seeds) due to any natural calamity, pest or disease, eligible farmers are paid compensation based on the difference between the threshold and actual yield set according to the degree of loss. The scheme is compulsory for farmers availing institutional loans but optional to others.
- **Sub-Mission on Agricultural Mechanisation (SMAM), 2014-15** – It was launched by Ministry of Agriculture and Farmers Welfare (MA&FW) to increase the reach of farm mechanisation to small and marginal farmers and to the hinterland. The endeavour is to create awareness among the stakeholders through demonstration, capacity building activities, performance testing and certification of agricultural machines at designated centres located all over the country.
- **Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) Yojana, 2019** - It was launched to augment the income of small and marginal farmers with land holding up to 2 hectares, for their occupation as well as domestic expenses, subject to certain exclusions. The government provides Rs. 6,000 to eligible farmers in three equal instalments.
- **Digital Agriculture Mission, 2021-25** – It has been started by GoI for agriculture projects based on new technologies such as AI, block chain, remote sensing and GIS technology, etc.
- **Mission for Integrated Development of Horticulture (MIDH), 2014-** It is a centrally sponsored scheme for the holistic growth of the horticulture sector and enhancing agricultural exports. The MIDH provides financial,

technical and administrative support to state governments for the development of the horticulture sector covering fruits, vegetables, root and tuber crops, mushroom, spices, flowers, aromatic plants, coconut, cashew, cocoa, bamboo and saffron.

- To promote horticultural exports, several centers for perishable cargoes and for post-harvest handling facilities have been set up with the assistance of Agricultural and Processed Food Products Export Development Authority (APEDA).
- **Transport and Marketing Assistance (TMA) scheme, 2019** - It provides financial assistance for transport and marketing of agriculture products in order to boost agriculture exports. It is likely to mitigate disadvantage of higher cost of transportation of agriculture exports due to trans-shipment and to promote brand recognition for Indian agricultural products in the overseas markets.
- In order to promote Indian brands of food products in the international market through the creation of global food manufacturing champions commensurate with India's natural resource endowment, the GoI has approved the **Production Linked Incentive (PLI)** scheme for the food processing sector in 2021.

### Conclusion

- To improve production and productivity of agriculture, adoption of quality inputs including high yield variety (HYV) seeds is critical. Access to institutional credit at affordable rate is also desired to purchase expensive agricultural inputs.
- There is an urgent need to expand the area under irrigation by adopting the appropriate technologies like sprinkler, drip irrigation and rainwater harvesting.
- The rational and efficient use of fertilisers and pesticides is also essential in order to increase productivity and avoid /crop yield losses due to pests and diseases.
- In order to supplement income from crop cultivation, the focus should be on promoting ancillary industries, non- farm activities and service units in rural areas so that the surplus manpower can get gainful employment during the slack season.
- The significance of timely government intervention in agriculture marketing can also not be denied.
- Providing-timely advisory services to farmers to adopt best farm practices, technology, through market information system is also essential.

## **2. Agri-startups and Enterprises**

### Introduction

The agriculture industry is classified into four broad divisions – *agri-inputs*, *agri-financial services*, *food processing companies*, and *farm mechanization*. A startup is a company, a partnership or a temporary organization designed to search for repeatable and schedule business model.

Agri-startups have become the missing link between farmers, input dealers, wholesalers, retailers, and consumers, connecting each of them and providing strong marketing linkages and quality produce on time. India is home to the highest number of unicorn start-ups after US and China. Currently around 4% of the total recognized start-ups in the country are in agricultural space.

### Issues with Indian Agri-tech System

- Lack of human resources and capacity, huge vacancy levels in public extension system particularly in remote and disadvantaged regions.
- Slow adoption of technology, largely due to insufficient penetration and lack of awareness of existing technological advancements.
- Unorganised credit structure and absence of proper market linkages.

### Benefits of Agri-tech Start-ups

- Agri-tech start-ups with novel technologies such as AI, ML and data analytics are providing inputs such as identifying the right crop to be sold for better yield.
- Start-ups are also offering mechanized equipments, potentially unaffordable for farmers to purchase, on a rental basis thus making equipments readily available to farmers.
- With mobile applications, accessing information has become easier.
- Start-ups also enable farmers to have direct access to the market without the need for intermediaries, leading to an increase in income.
- They also ensure financial inclusion by enabling farmers to upload the records digitally and apply for credit, freeing them from the clutches of local moneylenders.
- Farming as a service (FAAS) model is emerging as the future of agriculture. It offers innovative solutions for agriculture and allied services through a subscription-based or people use model which enable stakeholders to make effective data driven decisions to help boost productivity and efficiency.

### Government Initiatives

- **Agriculture Grand Challenge** is an initiative of the MA&FW for supporting agriculture through data mining and analysis.
- **FASAL** has micro-climate forecasts tailored to farm location and performed at a point scale, not a kilometer wide special scale, for real-time benefit with actionable information relevant to day-to-day operations at the farm.
- **National Centre for Management and Agricultural Extension** in Hyderabad (**MANAGE**) and the Department of Science and Technology have given a boost to the sector.
- **START-UP INDIA** is a flagship initiative of the Ministry of Commerce and Industry, GoI with three pillars in its action plan:
  - I. Simplification and handholding
  - II. Funding and incentives
  - III. Incubation and industry academia partnerships

To be eligible under it, the start-up should be incorporated as a private limited company registered as a partnership firm or a limited liability partnership. Turnover should be less than ₹100 crores in any of the previous financial years. Eligible start-ups are also given tax exemptions for 3 consecutive financial years out of their first 10 years since incorporation.

- **Start-up India Seed Fund Scheme (SISFS)**: The Department for Promotion of Industry and Internal Trade (DPIIT) has recently created this scheme to provide financial assistance to start-ups for proof of concept, prototype development, product trials, market entry, and commercialization.

- **Innovation and Agri-Entrepreneurship Development:** Launched under the Rashtriya Krishi Vikas Yojana (RKVY–RAFTAAR) by the MA&FW, it seeks to promote entrepreneurship in agriculture. Under this programme, for ideas/pre-seed stage, a selected start-up shall be eligible for a maximum financial assistance of Rs.5 lakh; and for seed stage Rs.25 lakh.
- **Atal innovation Mission by Niti Aayog**
- The Department of Biotechnology runs Biotech Parks and Incubated programme.
- **Accelerating Growth of New India's Innovations (AGNii)** helps innovation ecosystem through initiatives like award programmes, commercialization, etc.
- **Initiative for Development of Entrepreneurs in Agriculture (IDEA):** it is an initiative of Ministry of Development of NE region to promote agribusiness ventures in any region and assistant establish in agribusiness as a profitable venture. It also provides gainful employment opportunities and makes available supplementary sources of input supply and services.
- **Start-up Accelerators for MeitY for Product Innovation, Development and Growth (SMRIDH) Scheme:** Launched on August 25, 2021, it provides funding to start-ups along with helping them bring skill sets together for success. The focus is to accelerate around 300 start-ups by extending them with customer connect, investor connect and other opportunities for international expansion in the upcoming 3 years.
- **Dairy processing and Infrastructure Development Fund:** It has been created under NABARD to support milk unions, cooperatives, dairy federations, etc.
- **The Dairy Entrepreneurship Development Scheme (DEDS)** is another scheme implemented by Department of Animal Husbandry, Dairy and Fisheries to generate self-employment opportunities in the dairy sector. The nodal agency is NABARD.

### Examples

- *Aibono*, pegged as Agri-4.0, the collective provides precision farming technologies backed by real time synchronization of supply and demand.
- Bengaluru-based *Cropin* provides a full suite of farm management, monitoring and analytics solutions through its new product called: "Smart Risk".
- Intello labs positioned as India's most awarded agri-tech start-up has developed computer vision-based solutions which uses images to derive insights and actionable recommendations for crop inspection and agriculture product grading.

### Key Challenges

- These companies unlike the tech sector have longer investment cycles and a high need for patient capital, a need that social impact venture funds are slowly addressing.
- Small and scattered landholdings of farmers reduce the scope of technology scale up, leading to poor cost effectiveness.
- Rate of return on technology investment has not proven very profitable in case of agritech startups as compared, to other IT-based startups.
- Agri startups and enterprises are finding it hard to retain technical talent working in this sector.
- Technology adoption and penetration is a very slow process which certainly diminishes investors' interest.
- High-priced technology solutions are unaffordable for a large user group, i.e., small and marginal farmers.

- Making farmers adaptive to the required skills for working on advanced technologies requires significant effort.
- Most of the technology solutions available are not localised to emerging markets.
- Regulations, though favourable, are complex in nature.
- Facilitating adoption of proven technologies through subsidy is yet to gain momentum.

#### Way Forward

- More than 25 percent of farmers in India today have access to smart phones. There is a need to develop mobile training programmes for the capacity building of farmers and help them adapt and adopt to new technological advancements.
- Funding in the Indian agri-tech sector is 10 percent of global funding, but start-ups struggle to scale up. There is a need for large companies to effectively collaborate with start-ups.
- There is also a need for the government to help set up agritech-focused incubators and grants.
- The academia should encourage more entrepreneurs to focus on this growing sector. Other Indian States need to come up with favourable policies to attract start-ups and investors like Karnataka (home to 70 percent of agritech startups). Schemes like the government's Startup Agri-India scheme, the DigiGaon (Digital Village) initiative, and BharatNet Project can all work together to address the situation. Initiatives like agri-hackathons can also bring together aspiring entrepreneurs from diverse sectors.
- Banks and financial organisations also need to step up to the challenge and offer more creative models of financing for farmers, entrepreneurs, incubators, and accelerators.
- It is crucial to enable seamless hybridisation of relevant technology by building a promising 'new-age distribution model. There is a need to develop a new way for the farmer to buy products, access information and get credit on one unified platform.
- Agri-startups need to customise suitably before entering a market that has a very low technology adoption rate (due to limited budgets and inconvenience with usage) and re-orient their methods of selling, which essentially will be different from urban India and start-ups operating there.

### **3. National Agricultural Market (E-NAM)**

The e-NAM, an electronic trading portal which connects buyers and sellers, was launched in 2016. The objective of the portal is to create a unified national virtual market for agricultural commodities and is aimed at aiding farmers in getting better price discovery on a real time basis and providing them with marketing options.

The Small Farmers' Agribusiness Consortium (SFAC), a body promoted by MA&FW is the leading implementing agency of e-NAM. It operates and maintains the platform with the help of a strategic partner, NFCL. The Government provides free software and one time assistance of Rs. 75 lakhs per mandi for computer hardware and IT infrastructure.

Portals similar to this, exist in other parts of the world too. E.g., Virtual Farmers Market is an app-based e-commerce platform for farmers launched on a pilot basis in Zambia.

### Issues

- There are a large number of stakeholders on the e-NAM portal - States/UTs, traders, Commission Agents, Service Providers, Farmer Producer Organisations (FPOs) and farmers. Stakeholders on e-NAM are not spread evenly and skewness is definitely evident across States/UTs.
- Besides e-NAM, the Ministry of Rural Development (MoRD) also stresses on the need for developing rural haats into Gramin Agricultural Markets and linking rural markets through Pradhan Mantri Gram Sadak Yojana.
- Agriculture being in the State List of the Constitution, States have their own Agriculture Produce Market Committee (APMC) Acts. These Acts and the Agricultural markets are fragmented and hinders the fast flow of agricultural commodities. Integration with the online system has entailed the adoption of amendments in the APMC Acts of various States which involves provisions for -trading; single point levy of market fee; and unified single trading license for the States/UTs.
- Another hurdle is ensuring availability and accessibility of internet connection.
- A competitive pricing arrived at after a bidding process may not be able to do justice if the delivery point is far away especially for perishable commodities. Adequate and state-of-the-art storages at collection points, bolstered marketing infrastructure and quality testing facilities may mitigate this issue to a large extent. The cost of transport, especially inter-state, for delivery of the produce is an added cost to be borne.

### Steps

- For the success of e-NAM, training of stakeholders and awareness of its advantages is important. For example, online registration is possible through mobile apps. A toll free number and customer helpdesk support resolve queries of farmers and aid them to register. Some States like Andhra Pradesh, Chhattisgarh, Gujarat, Rajasthan, and Uttarakhand have introduced payment related incentives, which include rebate on mandi fee for the trader, cash prizes to best farmers and traders, etc.
- Kisan Rail (with an objective of building a seamless national supply chain for perishables, especially fruits and vegetables, through PPP model) and Krishi Udaan (to transport agricultural produce to various national and international destinations), were announced in Budget 2020-21. During the lockdown in 2020, the MA&FW had launched a mobile application, viz. 'Kisan Rath' to facilitate farmers to find suitable transport vehicles for transportation of their agriculture and horticulture produce.
- Schemes like Rashtriya Krishi Vikas Yojana, Agriculture Market Infrastructure and Agriculture Infrastructure Fund plays an important role in providing financial support in terms of interest subvention and credit guarantee for projects for post-harvest management and building community farming assets such as warehouse, cold storage, silos, e-marketing, etc.
- Under MGNREGA, the MoRD has taken steps to develop existing rural haats under the control of Panchayats into Gramin Agricultural Markets through States/UTs.

## **4. DIGITAL TRANSFORMATION OF INDIAN AGRICULTURE**

The term *precision farming* is used because use of quality data and efficient technologies driven by AI can help in farming to the extent that farmers can take precise and independent decisions for every square meter of farmland

instead of an entire field(s). Some usage of digital technology includes remote sensing, soil sensors, unmanned aerial surveying, weather information systems and market analysis and insights.

### Challenges

- The challenge is to develop simplified versions of applications and solutions which the farmers can easily learn to use and access without feeling intimidated by the advancements in technology.
- Small and marginal farmers with less than 2 hectares of land account for 86.2 percent of all farmers in India, and they own just 47.3% of the land holdings. This makes collection of precision data difficult for various reasons including the variety and diversity of crops and inability to scientifically build, access and provide quality data.
- The cost of technology may be unaffordable for most farmers and hence, the PPP model may be required for everyone's benefit.

### Government Initiatives

- **India's National Strategy on AI** aims to realise the potential economic and social benefits the technology offers in diverse areas including agriculture. It also recognises agriculture as one of the priority sector areas for implementation of AI driven solutions.
- The **Digital Agriculture Mission 2021-2025** was announced by MA&FW in September 2021 to support and accelerate projects based on new technologies, like AI, blockchain, remote sensing, geographical information systems, and use of drones and robots.
- **National-Governance Plan in Agriculture (NeGPA)** covers all states and two UTs. This aims to achieve rapid development through use of Information and Communication Technology (ICT) for timely access to agriculture related information for the farmers. Under the scheme, 60 percent contribution comes from the Centre while 40 percent of the funds are contributed by the States, the ratio being 90:10 for NE states, and 100% Centrally funded for the UTs. The revised NeGPA guidelines say that funds from 2020-21 will be released to the States/UTs only for the projects involving use of modern technologies such as AI and Machine Learning, Block Chain Technology, Internet of Things, Robotics etc.
- Many projects have come out of this initiative, e.g., **Direct Benefit Transfer (DBT) Central Agri Portal**, a unified central portal for agricultural schemes across the country which helps farmers adopt modern farm machineries through government subsidies.
- One Stop Window-Farmers' Portal, the **mKisan Portal** and mobile applications including **Kisan Suvidha**, the pan-India electronic trading portal linking the APMC Mandis called **eNAM**, are other examples of work being done in this space.
- The **Committee on Doubling Farmers' income** recognises the importance of smart farming and lists the following possible components for modern management of agriculture: (i) *Remote Sensing*, (ii) *Geographical Information System (GIS)*, (iii) *Data Analytics*, (iv) *Artificial Intelligence and Machine Learning*, (v) *Internet of Things*.

### PPP Initiatives

- In June 2021, The MA&FW signed an MoU with Microsoft to run a pilot programme for 100 villages in 6 states. 10 districts of 6 states (Uttar Pradesh, Madhya Pradesh, Gujarat, Haryana, Rajasthan and Andhra Pradesh) will be covered under the plan to develop smart '**Unified Farmer Services Interface**' through its cloud computing services covering post-harvest management and distribution.

- The MA&FW has signed 5 MoUs for pilot projects with five private Companies CISCO, Ninjacart, Jio Platforms Limited, ITC Limited and NCDEX -Markets Limited (NeML).
- › The Jio Platforms Limited will conduct its pilot project to provide advisories to farmers in two districts of Maharashtra- Jalna and Nasik. The company's **JioKrishi** platform uses stand-alone application data to provide advisory, and the advanced functions use data from various sources, feed the data into AI/ML algorithms and provide accurate personalised advice.
- › The ITC Limited has signed the MoU for building a Customised '**Site Specific Crop Advisory**' service. The implementation will be in identified villages - Shore and Vidisha districts of Madhya Pradesh. This will be a personalised site-specific crop advisory for farmers, using a digital crop monitoring platform, hosted on ITC's e-Choupal 4.0 digital platform.
- › Under the MoU with the ministry, Cisco will conceptualise 'Proof of Concept' in effective knowledge sharing between farmers, administration, academia and industry in two districts Kaithal (Haryana) and Morena (Madhya Pradesh). Cisco had developed an **Agricultural Digital Infrastructure (ADI)** solution that enhances farming and knowledge sharing.
- › The NCDEX e Markets Limited (NeML) will work on four services-Market Linkages, Aggregation of Demand, Financial Linkages and Data Sanitisation- across three districts - Guntur (Andhra Pradesh), Devanagere (Karnataka) and Nasik (Maharashtra).
- › Ninjacart will develop and host the **Agri Marketplace Platform (AMP)**, which will bring together all the participants in the post- harvest market linkage.

## **5. RENEWABLE ENERGY : OVERVIEW AND CHALLENGES**

India holds 4th position in terms of total installed RE capacity (5th in solar power and 4th in wind power). India also aims to achieve 40 percent of installed electric power capacity from non-fossil sources by 2030. India has an estimated RE potential of about 900 GW from commercially exploitable sources.

**Biogas** – Biogas is the *first clean and renewable energy* that was developed specifically for rural areas and was promoted by GoI during 1980s.

- Biogas plants are reliable source of clean, low-cost, and green fuel for cooking, lighting, and fulfilling small power needs of farmers and individual households.
- Digested slurry, obtained from biogas plants as a by- product, is an enriched organic fertiliser (NPK) with many advantages to fields and farmers.
- Initially, biogas plants were developed to use cattle dung as feed stock but in due course, biogas plants were improved to feed agriculture residues, garden waste, municipal waste, other organic waste, and human excreta.
- Of late, toilet-linked biogas system has been developed that eliminates the task of frequent emptying of faecal sludge from septic tanks or twin pits and dumping in drains or landfill sites. This system is economically viable as it saves the construction cost of septic tanks or twin pits and improves general hygiene and sanitation.

Currently, MNRE is running '**New National Biogas and Organic Manure Programme**' (NNBOMP) for dissemination and deployment of biogas plants in remote, rural, and semi-urban areas of the country. Under the programme, central subsidy is provided for installing biogas plants.

MNRE is operating a '**Biogas Power Generation (Off-grid) and Thermal Energy Application Program (BPGTP)**' for setting up biogas plants which replace diesel in DG sets and also reduce electricity bills of the individual farmers and other beneficiaries. The farmers or enterprises can also sell out surplus biogas/electricity to other households in off-grid mode.

Vivekananda Kendra - NARDEP, Kanyakumari, Tamil Nadu has developed an innovative low-volume fixed model for biogas production called '**Shakthi-Surabhi**' plant. It uses chiefly cattle dung or kitchen waste as feed stock.

**Biomass** - Gasifiers are generally installed to recover energy from biomass resources (agricultural residues/wastes, biowastes from industries, bagasse of sugar mills, etc.) for power generation. It helps in environmentally safe utilization of surplus agro-residues which if left unutilized will be disposed off by burning in open fields.

#### **Solar Power** –

- MNRE runs a comprehensive- **Off-grid and Decentralized Solar Photovoltaic (PV) Applications Programme** for deployment of solar streetlights, solar study lamps and solar power packs to meet out the electricity and lighting needs in rural areas. Central Financial Assistance is provided to local communities, institutions, and individual households for deployment of solar devices.
- Under **Atal Jyoti Yojana (AJAY)**, Phase-II, the area of coverage was expanded to include NE states, Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand and Islands of Andaman Nicobar and Lakshadweep.

**Small Hydro Power** - MNRE runs a special Small Hydro Power (capacity up to 25 MW) Programme to meet power requirements of remote and isolated areas in a decentralised manner. Under the PM's special package for Arunachal Pradesh, over 150 micro-hydel and small hydel projects have been installed in the region. Several projects are running in Ladakh and Kargil areas.

#### **PM-KUSUM**

Gol approved '**Pradhan Mantri Kisan Urja Suraksha Eva Uthaan Mahabhiyan (PM-KUSUM)**' in 2019 with the objective to *provide energy and water security to farmers, enhance farmers income, de-dieselise the farm sector and reduce environmental pollution*. It is one of the largest initiatives of the world to provide clean energy to more than 35 lakh farmers by solarising their agriculture pumps. The scheme is being implemented through three major components -

- Component - A aims addition of 10,000 MW of solar capacity through installation of small solar power plants of capacity up to 2 MW. Individual farmers, co-operatives, panchayats and FPOs are being supported for setting up solar power plants on barren, fallow, marshy, pasture or cultivable lands. A farmer can also provide his land on lease to a developer for installing the plant. Power generated from plant may be used for personal requirement, and surplus power will be purchased by DISCOMs at tariffs determined by the respective State Electricity Regulatory Commissions.
- Under Component-B, individual farmers and groups of farmers are being supported to replace their existing diesel pumps with solar pumps. Farmers are provided Central Financial Assistance (30% of cost) and subsidy by State Government (30% of cost) to ease the financial burden. This component is likely to benefit farmers in off-grid areas, with no source of electric power for irrigation.
- In component-C, Gol is providing 30% subsidy for solarization of agricultural feeders. It lowers the cost of capital and cost of power. Farmers are getting day-time reliable power for irrigation free of cost or at tariff fixed by their respective States.

**DDU-GKY**

The **Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY)** launched on the 25th of September 2014, Birth Anniversary of Pandit Deen Dayal Upadhyaya, declared the 'Antyodaya Diwas', is a nationwide *placement-linked* skill training program financially supported by the MoRD. The ministry revamped its existing skill development program called **Aajeevika Skills** as DDU-GKY which emphasised on greater access, coverage, and quality. DDU-GKY is a demand driven scheme and funds are released to States as per demands against approved Action Plans.

**Origin:** DDU-GKY has its origin in the wage employment linked 'Special Projects' for skilling component of the Swarnajayanti Gram Swarajgar Yojana (SGSY), which was subsequently renamed as Aajeevika Skills when SGSY was converted as National Rural Livelihood Mission (NRLM) in 2010. NRLM was renamed as Deendayal Antyodaya Yojana National Rural Livelihood Mission (DAY-NRLM) in 2016.

Under the DDU-GKY, two special programs are being implemented –

- *Roshni* program is being implemented in 27 left wing extremist affected areas of nine States with mandatory residential courses with 40 percent coverage to women candidates. Roshni is oriented towards addressing the infrastructure, education, and health deficiencies in these areas, and leveraging the availability of natural resources, traditional skills, and knowledge.
- The *Himayat* programme is being implemented for all the youth of the UTs of Jammu & Kashmir and Ladakh.

**Funding Pattern:** 60:40 by Centre and States; 90:10 in case of eight NE States, Uttarakhand, and Himachal Pradesh; 100% Centrally funded in all UTs including UT of Jammu & Kashmir.

**Beneficiaries:** The target is rural youth from poor families including MGNREGA worker household (if any person from the household has completed 15 days of work), Rashtriya Swasthya Bima Yojana (RSBY) households, Antyodaya Anna Yojana card households, BPL Public Distribution System card households, NRLM-Self Help Groups households, participatory process of Identification of poor and Households covered under auto inclusion parameters of Socio-Economic Caste Census, 2011.

**Features**

- The implementation architecture is 3-tier in PPP mode, with the National unit responsible for policy, funding of central share and technical support; State Rural Livelihood Missions responsible for funding of state share, implementation, and monitoring controls; and Project Implementing Agencies, mostly private training partners, responsible for mobilization, training, and placements.
- The training courses are aligned with the National Skill Qualification Framework with a special component for Soft Skills.
- It mandates assured placement to 70 percent of the trained candidates and special focus on poor rural youth of age 15-35 years.
- The program also mandates compulsory coverage of disadvantaged groups belonging to SC and ST (50 percent), Minorities (15 percent), and Women (33 percent), ensuring jobs with a minimum salary of Rs. 6000 per month (after a 3 month training course) to youth and provisions for *post-placement support*.

- There is provision for career progression support to training partners and primacy to those who can train and support overseas/captive placements.

## **6. SMART FARMING : CLIMATE SMART AGRICULTURE**

**Overview:** According to the report of The Food and Agriculture Organization (FAO), about 20-40 percent of crops are lost annually due to pests and diseases and as a result of lack of good monitoring system of the state of the crop. The FAO has developed the concept of Climate Smart Agriculture (CSA), which was presented at the Hague Conference on *Agriculture, Food Security and Climate Change* in 2010. It has been defined as an approach that transforms agri-food systems towards green and climate resilient practices. It aims to tackle three main objectives/pillars:

- sustainably increasing agricultural productivity and incomes;* (A key concept is *sustainable intensification*, described as "an approach using innovations to increase productivity on existing agricultural land with positive environmental and social impacts.")
- adapting and building resilience to climate change; and*
- reducing and/or removing greenhouse gas emissions, wherever possible* (The prevention of deforestation, adoption of sustainable practices, and the management of soils and trees in ways that maximises their potential to act as carbon sinks is a part.)

FAO recommends the approach is implemented through five action points: *expanding the evidence base for CSA, supporting enabling policy frameworks, strengthening national and local institutions, enhancing funding and financing options, and implementing CSA practices at field level.*

**Understanding Smart Farming** - Smart farming technologies (SFTs) can be divided into three main categories:

- **Farm Management Information Systems (FMIS)** - FMISs represent mainly software systems for collecting, processing, storing, and disseminating data in the form required to carry out a farm's operations and functions.
- **Precision Agriculture (PA) Systems** – It optimizes input use based on recording technologies (such as remote sensing technologies with either satellite platforms or aircrafts/UAVs for aerial applications, combined use of sensors for ground data acquisition, wireless networks for interconnecting them, geospatial data analytics coming from different sources, decision support systems (DSSs)) to observe and measure inter-and intra-field spatial and temporal variability in crops, aiming to improve economic returns, maintain or even increase production rate and reduce environmental impact for optimized farming decision-making.
- **Agricultural Automation and Robotics** – They are interconnected to cover the process of applying automatic control, AI techniques, and robotic platforms at all levels of agricultural production. Agricultural robots of all types are applied with specific tasks, such as weed control, harvesting, etc. in recent years.

### **Benefits of Smart Farming**

- Increasing the amount of real-time data on the crop
- Remote monitoring and controlling of farms
- Controlling water and other natural resources
- Improving livestock management
- Accurate evaluation of soil and crops
- Improving agricultural production

- Eco-friendly farming.

### Main Pillars of Smart Farming

- **Internet of Things (IoT)** –Smart systems enhance the accuracy of devices that monitor plant growth. Smart farm management uses ICT, ground sensors, and control systems installed on robots, autonomous vehicles, and other automated devices.
- **Smart Sensors** – A sensor is a device, module, machine, or subsystem that detects a physical phenomenon, event or changes in its environment and sends the information/output signal to other electronic system, frequently a computer. A smart sensor can help in the following ways:
  - › **Soil Health Monitoring:** Sensors can estimate nitrate concentration, phosphate content, soil moisture content, soil compaction, land classification and in general soil fertility status etc. and nutrient recommendation can be made for different crops and cropping systems.
  - › **Smart Irrigation System:** Sensors can monitor water level and help in efficiency of irrigation pump, water scheduling, leakage detection and also climate driven irrigation.
  - › **Leaf Disease Identification:** Sensors are helpful in quick identification of plant diseases like tomato yellow leaf curl virus, damage due to parasites, disease in paddy leaves and leaf-based identification of banana disease, etc.
  - › **Improving Crop Yield:** Sensors can recognise premature crops, estimate fertilizer requirement, stress identification and infection of insect pests and diseases for timely action.
  - › **Improving Post Harvesting Activities:** Sensors also help in the improving the post-harvest activities viz., grain storage, inventory management, smart transportation and also freshness of crop (food), etc.
  - › **Smart Animal Husbandry:** Sensors enable monitoring of cows in dairies, honeybee colony, poultry farms, and sheep location tracking, identification of goat diseases and horse activity recognition, etc.
- **Internet Connection** - With the advent of 5G, extensive coverage with low latency can be assured.

### Characteristics of CSA - CSA differs from conventional agricultural paradigms because :

- **CSA attempts to address climate change's causes and effects:** CSA systematically integrates climate change into the planning and development of sustainable agricultural systems.
- **CSA integrates multiple goals and manages multiple trade-offs:** CSA's three primary pillars are- increased productivity, enhanced resilience, and reduced emissions. However, the resultant trade-offs often cannot maximise the pillars simultaneously, only optimise them.
- **CSA maintains ecosystem services:** CSA attempts to ensure the sustainability of the 'unpaid' services provided by the ecosystems like natural water, food, sunlight, etc.
- **CSA has multiple entry points at different levels:** CSA is not a rigid set of particular practices, technologies, or methodologies- it is a concept amenable to adaptation.
- **CSA has context-specificity.**
- **CSA involves the marginalized:** The relevant goal is to build up the adaptive capacity of vulnerable stakeholders, inclusive of women, who possess the marginal lands susceptible to climate events like drought and floods so that they can build their capacity to endure natural disasters.

### Key Initiatives of Government

- The National Institute of Rural Development and Panchayati Raj (NIRDPR) coordinated a pilot project on 'Climate Smart' Agricultural Techniques in Bihar and Madhya Pradesh-States considered vulnerable to the effects of climate change.
- **National Innovations on Climate Resilient Agriculture (NICRA)** – It was launched by Indian Council of Agricultural Research (ICAR) in 2011. The project aims at strategic research on adaptation and mitigation, demonstration of technologies on farmers' fields and creating awareness among to minimize the climatic change impacts on agriculture. In the strategic research, the main thrust areas covered are : (i) identifying most vulnerable districts/regions, (ii) evolving crop varieties and management practices for adaptation and mitigation, (iii) assessing climate change impacts on livestock, fisheries and poultry and identifying adaptation strategies.
- **National Mission for Sustainable Agriculture** - NMSA derives its mandate from Sustainable Agriculture Mission, one of the eight Missions outlined under National Action Plan on Climate Change (NAPCC). It aims at promoting sustainable agriculture through a series of adaptation measures focusing on ten key dimensions encompassing Indian agriculture namely, '*Improved Crop Seeds, Livestock and Fish Cultures*', '*Water Use Efficiency*', '*Pest Management*', '*Improved Farm Practices*', '*Nutrient Management*', '*Agricultural insurance*', '*Credit Support*', '*Markets*', '*Access to Information*' and '*Livelihood Diversification*'.
- **National Adaptation Fund for Climate Change** - NABARD is the National Implementing Entity (NIE) and aims to mitigate the adverse effects of climate change.
- **Pradhan Mantri Krishi Sinchayee Yojana (PMKSY)** - Explained on Page 1
- **Zero Budget Natural Farming (ZBNF) and Organic Agriculture** - There has been a conscious effort from the government to promote ZBNF, and other kinds of organic farming. Use of HYV seeds, pesticides, and fertilisers in modern agriculture have long term impacts on soil, human, and environmental health.

### Application of Smart Farming in Indian Context : IoT Based on Drones

- **India's National Strategy on AI** also aims to realise the potential benefits of technology and recognizes agriculture as one of the priority sector areas.
- The GoI has formulated a standard operating procedure (SoP) for use of drones for the purpose of spraying pesticides and fertilizers on agricultural crops. **Drones** can monitor the state of plants based on some vegetative indices that can be directly calculated by multi-spectral images, such as the Normalised Difference Vegetative Index (NDVI) which is considered very effective.
- **Agricultural robot** can used to perform many agricultural practices such as provide unconventional solutions to labour shortages, especially in pandemics like COVID-19. In addition, the robots can reduce the environmental pollution of up to 80% caused by farm's pesticides.
- **Grain Bank Model of ERGOS** - Ergos has developed a unique Agri-tech model called "Grain Bank Model" that provides doorstep access to *end-to-end post-harvest supply chain solutions* to small and marginal farmers, i.e., enables farmers to convert their grains into tradable digital assets, avail credit against those assets through partner NBCs and Banks, and get better prices for their produce. This model offers farmers the flexibility to store/ withdraw even a single bag of grains. Farmers get immediate liquidity and better income as they don't have to sell all their produce at once at the prevailing market rates during harvest season.
- **Smart Decision Support Systems (SDSS)** aims to support farmers in making proper decision in irrigation management, fertilization process, and other service operations. With respect to irrigation management, the

system includes spatial location data and crop characteristics in terms of crop growth stages, planting date and water requirements precipitation, temperature, as well as soil characteristics and water holding capacity. This system improves water use efficiency and quality of crop yield.

- **Monitoring and Risk Management** - Yuktix Technologies, an agritech startup based in Bangalore, is providing GreenSense, an *off-grid remote monitoring and analytics solution* for agriculture farm monitoring. Their solar powered weather stations provide real time weather conditions anytime from anywhere.
- **Automatic Watering and Irrigation** - This system still needs to be maintained by the operators. In order to improve its efficiency and ensure water demand of the crop, efforts for subsurface drip irrigation(SDI) along with moisture level detectors are helpful in better crop germination and yield.
- **Driverless Tractor** – Automated/driverless tractors integrated with hardware and special-purpose designed software are working more efficiently in field. These can perform several practices, such as spraying of crop canopy for the management of insects, diseases, and selective weed treatments, by spraying herbicide or by flame burning in the fallow land driven by automated tractor.

### Challenges

- **Fragmented Landholdings** : Due to small landholdings, the farmers are unable to adopt smart farming with limited knowledge and skills.
- **Water Conflict**: Around 80-90 percent of the country's water consumption occurs within the agriculture and allied space. The practice of flood irrigation makes agriculture's water efficiency poor. Indian agriculture requires 2-3 times water consumption compared to other major agricultural countries.
- **Soil Chemistry**: The incorrect use of fertilisers as also changing climatic patterns have created problems of salinization, desertification, and degradation.
- Most villages and farming communities do not have access to internet all the time.
- GPS signal transmission is difficult in heterogeneous topography like hilly, forests and field with a dense tree planting.
- **Energy Requirement**: Data collection and processing centres and many IoT based sensors need uninterrupted and continuous energy for a successful application whereas, developing countries like India are already running out of energy resources.
- Drones with good software, hardware tools, devices, high- resolution cameras, and thermal cameras are expensive. The drones have a small (hour or less) flight duration. Legal limitation of drone use needs permits for the operation due to security point of view. The operation of drones is also affected by climatic conditions particularly wind speed and rains.

### Way Forward

- **CSA linked Credit** - Agricultural finance to farmers willing to adopt, or those having adopted CSA techniques will be a key catalyst in accelerating the process of adoption.
- **Extension Services** - The adoption of CSA requires consistent, comprehensive, and grassroots extension services for farmers. Mobile services can be a key enabler.
- **Innovation** - Indian agri-startups have been providing affordable, scalable solutions agriculture. The government can incentivize scientific innovation in the field.

**MICCA**

The Mitigation of Climate Change Agriculture (MICCA) Programme of the FAO Nations Framework Convention on Climate Change. It offers a macro framework to address CSA through the following:

- Monitoring and assessing greenhouse gas (GHG) emissions and the mitigation potential in agriculture;
- Developing the capacity of stakeholders working on national GHG inventories and farmers using CA practices;
- Carrying out life cycle assessments to guide decision making;
- Giving guidance on climate change mitigation and adaptation options, including for peatlands and organic soils;
- Mainstreaming gender in CA, facilitating online communities of practice, and running online learning events.