

Digitalization of Agriculture in India: Application of IoT, Robotics and Informatics to establish Farm Extension 4.0

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Abstract: — Information Theory of Claude Elwood Shannon (1948) to Internet of Things (IOT) of Kevin Ashton (1999) have impacted digital technological applications very decisively in various development fields. The emerging GRIN (Genomics, Robotics, Informatics and Nanotechnology) Paradigm facilitates digitalization process in agricultural system very intensively. This Paradigm shift has generated a great demand for agricultural informatics and extension professionals, for attaining possible efficiency gains in Agricultural Value Systems. Industry 4.0 Technologies are making inroads in the GRIN framework, resulting in agriculture 4.0, logistics 4.0, health 4.0 etc.

Artificial Intelligence (AI) and E-Leadership are increasingly becoming the language of innovation and intelligent technologies in the modern industrial society. India has been achieving its milestones on digitalization, through its federal and provincial level much calibrated programs. The Doubling Farmers' Income by 2022 Report (2018), discusses seven mission mode projects for adopting digital technology towards digitalization of Agriculture. India is an Agrarian economy and hence requires to be become a digitalised agricultural economy.

This Paper describes the need for Farm Extension 4.0 framework for empowering more than 140 million farm operational holders of the country to adopt Farming as a Service (FaaS), by adopting technologies viz., IOTs, Robotics, Informatics and Smart Farming in villages, facilitating through AgriTech StartUps, Farmer Producer Organisations (FPOs), and Agricultural Polytechnics and Agricultural Industrial Training Institutes (ITIs). This Farm Extension 4.0 technological framework has the capacity to facilitate development of about 2.25 Lakh Deep AgriTech StartUp in India, one per each gram panchayat.

Keywords: — Digitalisation in Agriculture, Agriculture 4.0, Farm Extension 4.0, Smart Farming.

I. FROM BASIC FARMING TO PRODUCTIVE FARMING

Information Theory of Claude Elwood Shannon (1948) to Internet of Things (IOT) of Kevin Ashton (1999) have impacted digital technological applications very decisively in various development fields. The emerging GRIN (Genomics, Robotics, Informatics and Nanotechnology) Paradigm facilitates digitalization process in agricultural system very intensively, and has generated a great demand for agricultural informatics professionals, to bridge gap of ever increasing and evolving human resources for IT StartUps in farming sector throughout the Country, for attaining possible efficiency gains in the Agricultural Value System.

Agricultural efficiency has three components viz., technical efficiency, allocative efficiency and production efficiency. Related efficiency indicators are (i) land or production efficiency, (ii) labour efficiency, (iii) capital efficiency, (iv) farm income or profit efficiency. A value chain is a set of linked activities that work to add value to a product; it consists of actors and actions that improve a product while linking commodity producers to processors and markets. The primary activities of Michael Porter's value chain (1985) [1] are inbound logistics, operations, outbound logistics, marketing and sales, and service, with the goal to create value that exceeds the cost of conducting that activity, therefore generating a higher profit. IOTs and Blockchain Technologies are revolutionizing value chains through traceability and consumer satisfaction, among the others.

By 2050, there will be more than 2 billion additional people on the planet, requiring 50% more food from

the same agricultural footprint. At the same time, climate change is leading to more volatile weather, and generally warmer conditions. The two big drivers of food demand—population and income—are on the rise. This situational aspect is forcing India to shift from basic farming to more efficient, sustainable, productive and smart farming.

Formation of Economic cluster and Agricultural Value System at Village level

An agricultural value chain includes development and dissemination of plant and animal genetic material, input supply, farmer organization, farm production, post-harvest handling, processing, provision of technologies of production and handling, grading criteria and facilities, cooling and packing technologies, post-harvest local processing, industrial processing, storage, transport, finance, and feedback from markets. Agricultural services such as agricultural advisories, financial services, agricultural marketing and risk transfer, are required for the entire Agricultural Commodity Value System (AVS) of the Farmer. Economic clusters at village level, for this purpose, will strengthen Agrarian Businesses, facilitating income generation from the Wastes to the Farmers, and huge employment opportunities at the Bottom of Pyramid. In advanced economies today, clusters of related industries, are the most sustainable source of jobs, income and export growth [2].

Indian Agricultural System

Indian Agriculture confronts with its sheer complexity, inadequate factors of production, weather uncertainties, multiplicity of schemes and multiplicity of institutions, at farm level [3]. There are more than 140 million operational holdings, of which 85 per cent farmers have small and marginal size operational holdings, as per the Indian Agricultural Census 2010-11:

- Marginal Scale Farmers (67%): (< .5 Ha & 0.5 – 1.0 Ha)
- Small Scale Farmers (18%): (1-2)
- Semi-Medium Scale Farmers: (10%) (2-3 & 3-4)
- Medium Scale Farmers (4.3%) (4-5, 5-7.5 & 7.5-10.0)
- Large Scale Farmers (0.7%) (10.0 – 20.0 & >= 20.0)

The agricultural sector is the foundation of the Indian economy. It employs more than 50 per cent of

India's workforce and contributes almost 17–18 per cent of its GDP [4]. India has delineated its geographical area into 15 Agro-Climatic Regions and more than 127 Agro-Climatic Zones, having different farming practices, evolved over the centuries, with changes in weather and climatic conditions, technological innovations and socio-cultural practices. Irrigated farming is practiced with assured water supply from sources of irrigation (canals, tanks and wells), whereas Rainfed farming is practiced under a wide variety of soil type, agro-climatic and rainfall conditions ranging from 400 mm to 1600 mm per annum. However, Tribal farming is a risk-minimizing system and its relevance has increased, in view of ongoing climate change and erratic weather occurrence.

India's labour-intensive and subsistence-based agriculture sector is particularly vulnerable to this development. At present, agricultural livelihoods are being severely impacted world over, as a result of anthropogenic global warming and climate change. Climate change has both direct and indirect effects on agricultural productivity, including changing rainfall patterns, severe drought, flooding and changes in the geographical redistribution of pests and diseases.

Farmer needs timely, location-specific, and personalised information for effective control on their production, risks and then market their produce to identified market opportunities. Many national level programmes viz., Digital India 2015, Make in India 2015, Skill India 2015, StartUp India 2015 and StandUp India 2015, have faced operational difficulties for its impact, through synergisation, at farm level and farmer level, and that too at small and marginal farmers' level. In India, sustainable agricultural and rural development is a distant dream, as there has been strategically very difficult to synergise schemes of agricultural development schemes and rural development schemes at farm level or farmer level.

Self-Reliant India Movement 2020 and Covid19 Pandemic Period

Self-Reliant India Movement 2020 is the vision of the Prime Minister of India, Narendra Modi, for making India a self-reliant nation, rested on 5 I's - Intent, Inclusion, Investment, Infrastructure and Innovation, and based on five pillars viz., (a) Economy – a quantum Jump and not incremental, (b) Infrastructure – one that represents modern India, (c) System that is 21st century technology driven, (d) Vibrant Demography - a

source of energy for self-reliant India, and (e) Demand whereby the strength of our demand and supply be utilised to full capacity.

The Government of India announced its **third tranche** of the measures, under the Self-Reliant India Movement, focussing on Agriculture and Allied Activities – **Agricultural Reforms** - on 18th May 2020. On 5th June 2020, the Central Government has promulgated TWO important Ordinances to facilitate these reforms measures for its logical conclusion at grassroots level. These measures have been a long awaited reforms in the agricultural sector, especially for the Small and Marginal operational holdings sector, of the country.

The Promulgated Ordinances and later passed through the Indian Parliament are: (a) The Farmers' Produce Trade and Commerce (Promotion and Facilitation) Ordinance, 2020 [No. 10 Of 2020] Dated 5th June 2020; (b) The Farmers (Empowerment and Protection) Agreement on Price Assurance and Farm Services Ordinance, 2020 [No. 11 of 2020] dated 5th June 2020, and (c) Amendments to the Essential Commodities Act (ECA), 1955.

The COVID19 Pandemic situation prevailing in the Country, has forced the Central Government to undertake such structural reforms – “**One Nation One Agricultural Market**”, through adoption of digitalised Agricultural Value System, and “**National framework for Farming Agreements**”. These measures are expected to facilitate Agri StartUps entrepreneurship development, on a very large scale, and also to achieve the national goal of Doubling Farmers' Income by 2022.

II. DIGITALIZATION OF INDIAN AGRICULTURAL SYSTEM

The Government of India, through its National informatics Centre (NIC), has introduced the District Information System on Agricultural System (Agriculture, Animal husbandry and Fisheries) in 1987, prepared the first IT Blue-Print for Agricultural Sector, through a National Conference on “Informatics for Sustainable Agricultural Development (ISDA)” in May 1995, and in 2005, launched the National e-Governance Programme in Agriculture (NeGP-A). The Volume-III, IV, XI and XII (B) of the Doubling Farmers Income by 2022 (DFI-2022) Report 2018 [5] of the Government of India, have suggested reforms measures for income rise through digitalisation of farm sector:

- Volume III: Post-production Agri-logistics: maximising gains for farmer
- Volume IV: “Post-production interventions: Agricultural Marketing
- Volume XI: Empowering the Farmers through Extension & Knowledge Dissemination
- Volume XII (B): Digital Technology in Agriculture.

with the intent to achieve efficiency gains and convert into profitability from farm to fork. These reforms measures stem from the fact that agricultural logistics is the **backbone** of agri-business and agricultural marketing is the **brain** behind value realisation. The farmer's produce must connect with multiple avenues to obtain value at each place, across time & space, and in various forms. The Volume XII (B) has suggested **strategic use** of Digital Technology in Farming System Life Cycle, through seven DFI-2022 Mission Mode Programmes in its Chapter-10 as given below: -

1. *Digitalised Agriculture: Digital Technology and Innovation in Agriculture: Digital India, Make in India, Skill India and StartUps India Programmes for Transformational Reforms in Agricultural Sector (SMART Irrigated Farming, SMART Rainfed Farming and SMART Tribal Farming);*
2. *Digitalised Agro-Met Advisories & Agricultural Risk Management Solution;*
3. *Digitalized Agricultural Resources Information System (AgRIS) and Micro-Level Planning for achieving SMART VILLAGE & SMART FARMING;*
4. *Digitalized Value Chain for about 400 agricultural Commodities;*
5. *Digitalised Access to Inputs, Technology, Knowledge, Skill, Agricultural Finance, Credit, Marketing and Agribusiness Management, to Farmers;*
6. *Digitalized Integrated Land and Water Management System – Per Drop More Crop;*
7. *Digitalized Farm Health Management for reduction of Farmers' Losses.*

There have been need for creation of a “National Farmers Database” on about 140 Million operational FARM HOLDERS, including livestock and fishery farmers, of the country, facilitating “farmer-centric” and “farm-centric” value-added services on an “agricultural value chain” mode. This needs a robust digital framework for data organisation, seamless integration of agricultural information systems by

adopting open data standards, and structured approach for decision making process system, for effective service delivery to farmers, in 22 Constitutionally recognised Indian languages. The digitalisation of agricultural system facilitates achieving many Sustainable Development Goals (SDGs) of the UN.

III. SMART FARMING – THE FUTURE OF AGRICULTURE TECHNOLOGY

Smart farming refers to a farm management concept that uses modern technology with the aim of increase the quality and quantity of agricultural products [6].

Digital technologies are critical for increasing productivity in agriculture, making agriculture fair for farmers, ensuring reduction in food loss both at pre/post-harvest stages, and ensuring food safety and security. Agriculture is an Unstructured and Semi-structured problem and hence Artificial Intelligence (AI) and ML Applications are having immense applications and use in agriculture.

Various technologies from Artificial Intelligence (AI) & Machine Learning (ML), Blockchain, Drones, Satellite to IoTs are redefining the agriculture across the globe.

The Fourth Industrial Revolution (or Industry 4.0) is

the ongoing automation of traditional manufacturing and industrial practices, using modern smart technology. Industry 4.0 Technologies are making inroads in the GRIN framework, resulting in agriculture 4.0, logistics 4.0, health 4.0 etc. The key technologies are:

A: Artificial Intelligence (AI), Analytics, Operations Research; B: Blockchain; C: Cloud, IoT, 5G Communication; D: Big Data; and E: Ecosystems. Agriculture 4.0 focuses on precision agriculture, the internet of things (IoT) and the use of big data to drive greater business efficiencies in the face of rising populations and climate change.

AgriTech StartUps in India are transforming agriculture by developing innovative digital solutions to maximize productivity, improve market linkages, increase supply chain efficiency, and provide greater access to inputs for agri-businesses.

AgriTech is plainly driving India's next green transformation. Various new StartUps are taking agriculture by storm, as they aid development with new technology improved methods. Robotics Process Automation (RPA), through Virtual Software Agents (VSA), Cyber Physical System (CPS) and Physical Robots, provide enormous opportunities for products developments by emerging technology StartUps.

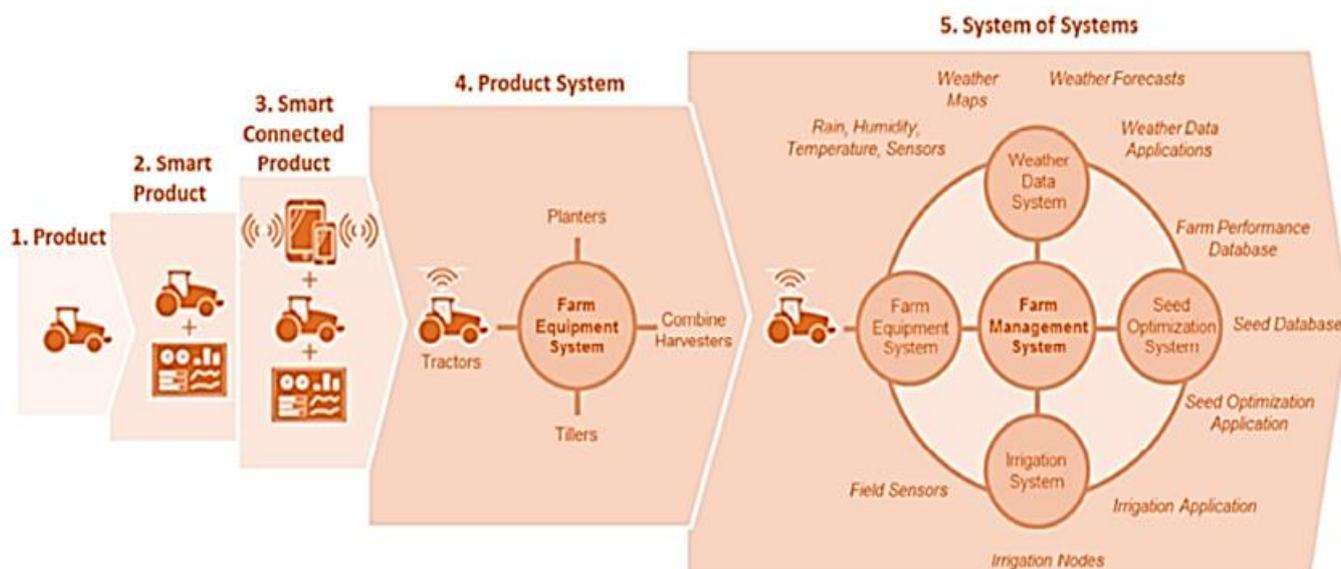


Fig. 1.:System Evolution (www.tporganics.eu)

Industry 4.0 technologies are initially based on 9 pillars of technologies, and now added Blockchain Technology and also other potential emerging technologies. Evolution of farm system technologies from “product” to “System of Systems” is depicted in Figure 1, and the SMART Farming will adopt “AI Design Pathways” in Farm Management System, in all its seriousness. Smart Farming and Agriculture 4.0 are considered as synonymous (Figure 2). The Government of India has planned to equip the NeGP-A Programme with the emerging technologies viz., new computing technologies, AI&ML, Big Data and Advanced Analytics, IOTs, Block Chain, Virtual Reality (VR) and Augmented Reality (AR). Indian AI Stack is represented in Figure 3.

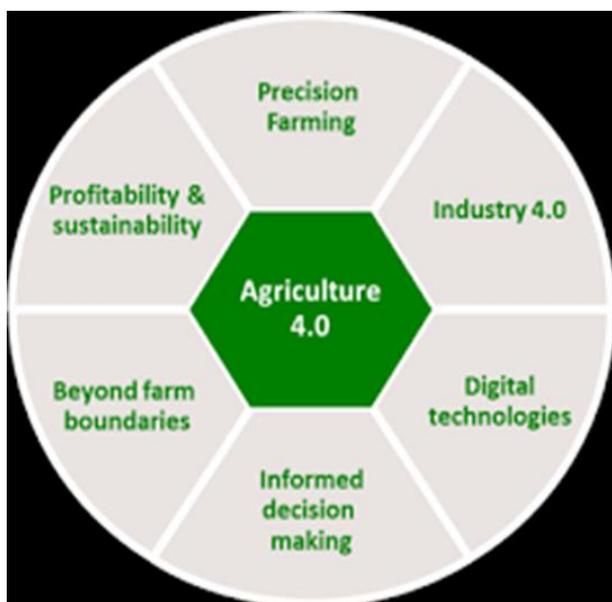


Fig. 1.- Agriculture 4.0 (Source Internet)

Agricultural Data has become a major source of competitive advantage. The “Future of Agriculture” Technology includes IOT, Big Data Analytics and Smart farming, having potential impact on Agricultural Resources Management and Agricultural Value System, through farm extension delivery mechanism. Achieving Farm Extension 4.0 at village level, leads to development of SMART Farmer, Smart Farming and SMART Village in an agricultural eco system leading to a National Open Digital Eco System (NODE) in the country. India is an Agrarian economy and hence requires to be a digitalised agricultural economy.

The NAARM Report of Soam and Venkatesan (2015) [7] on harnessing the power of ICT in the knowledge, skill, economic and social empowerment of rural farm

families in the Telangana State, has come out with wide-ranging suggestions for empowering Farmers, as given below:

- a. Free SIM Card to Farmers for Internet access, SMS and Audio with Common Free-Toll-No.;
- b. Interaction with farmers through Social Media Networks viz., Facebook, WhatsApp, CHAT, LinkedIn etc.;
- c. Use of TV, Community Radio, FM Radio, Newspaper, Periodicals etc.;
- d. Mobile Advisories & Real Time Messaging (SMS) to farmers for operational activities;
- e. Location specific crop package and Developing audio, video and web based eLearning modules;
- f. Digital Videos on Farming;
- g. Capacity building of farmers on Use of ICT;
- h. ICT based application of Good Agricultural Practices (GAP) and traceability issues using farm level and village level Geographical Information System (GIS);
- i. Geo-tagging of plots and integration of GIS and GPS application in GAP;
- j. Establishing Agricultural Produce traceability through ICTs;

There are several digital initiatives by governments, private sector corporations and NGOs and are at varying level of implementation on providing timely market update, weather data and extension information to farmers through mobile phone SMS, rural Internet kiosks, TV, Radio, Community Radio, or Call Centers. A Direct Learning Opportunities (DLO) requires a massive framework of infrastructure and intermediaries to establish a digitally accessible, learner-centered, comprehensive, accredited formal agricultural education system through TV (Cable TV, DTH), Radio, Internet and Mobile Phones. Such DLO will facilitate India’s Small and Marginal, illiterate and semiliterate Farmers in improving their livelihood conditions, leading to higher productivity, more value addition at farm and local level, and environmental sustainability. Agricultural Polytechnics, Agricultural ITIs and Agricultural schools will strengthen DLOs at grassroots level.

Operationalization of Smart Farming requires massive DLOs for small and marginal scale farmers.

Artificial Intelligence Indian Stack

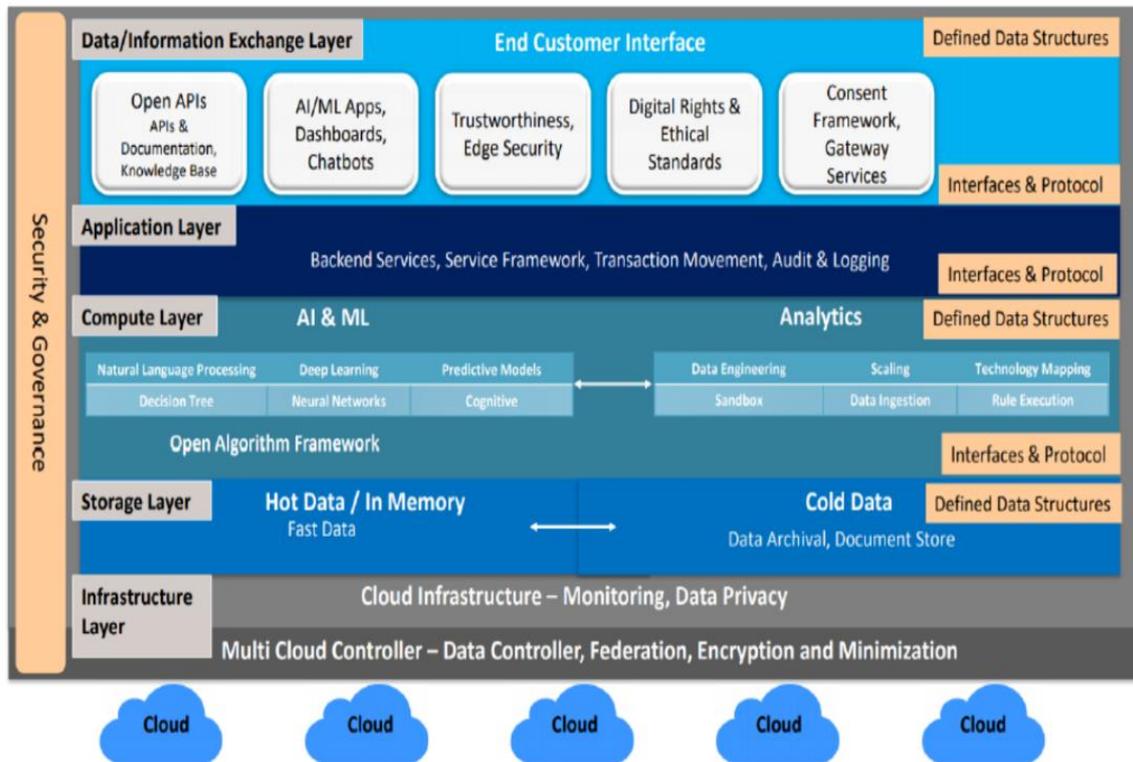


Fig.3. – Indian AI Stack (Source : GOI AI Standards Committee - 2 September 2020)

Farm Extension 4.0

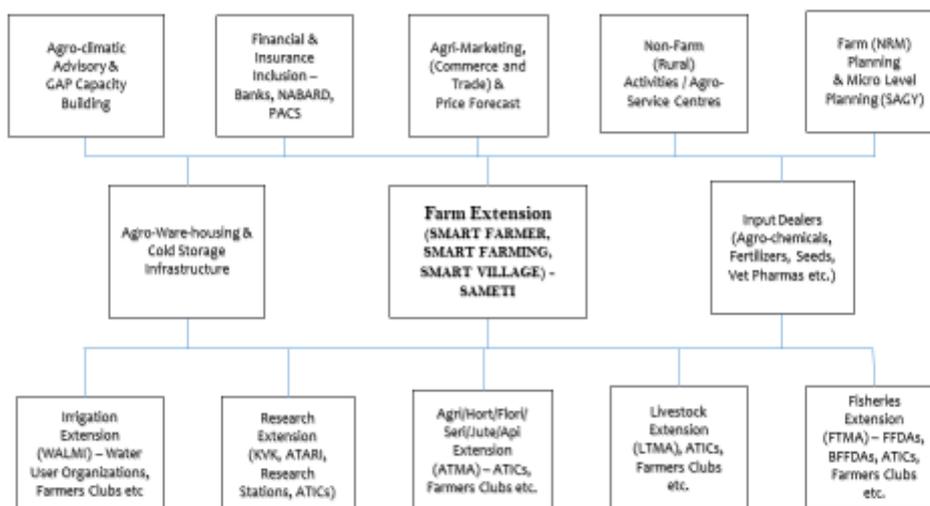


Fig. 4. - Various Components of Farm Extension 4.0

IV. FARM EXTENSION 4.0 – MAJOR STEPPING STONES FOR AGRITECH STARTUPS

Farm Extension or Agricultural Extension is the application of scientific research and new knowledge to agricultural practices through farmer education, and therefore, is central to Agricultural Growth. The paradigms of agricultural extension, ipso-facto, include: (a) Technology Transfer (b) Advisory Work, (c) Human Resource Development, and (d) Facilitation for Empowerment. Agricultural communication can take three modes—face-to-face training, training "products" such as manuals and videos, or Information and Communication Technologies (ICTs).

Social media is viewed as the most powerful tool to connect with millions of people and its role can be strengthened by: (a) quality mass media content generation, (b) Location specific and timely delivery of news, (c) enhancement of program by continuous capacity building, and (d) increasing participation of agriculture extension professional in mass communication.

In India, the Agricultural Technology Management Agency (ATMA) is a platform at district level which brings convergence between Agriculture and Allied Departments, public and private extension service providers. The Strategic Research and Extension Plan (SREP) of a district details research and extension priorities for the district, keeping in mind, agro-ecological conditions and existing gaps in technology generation and dissemination in all agriculture and allied sector areas/ activities.

The Proposed Farm Extension 4.0 (Figure 4) will have about 12 components viz.,

1. *Agro-climatic Advisory & GAP Capacity Building*
2. *Financial & Insurance Inclusion*
3. *Agri-Marketing (Commerce and Trade) & Price Forecast*
4. *Non-Farm (Rural) Activities / Agro-Service Centres Farm (NRM) Planning & Micro Level Planning*
6. *Agro-Ware-housing & Cold Storage Infrastructure*
7. *Input Dealers (Agro-chemicals, Fertilizers, Seeds, Vet Pharmas etc.)*
8. *Irrigation Extension (WALMI) – Water User Organizations, Farmers Clubs etc.*
9. *Research Extension (KVK, ATARI, Research Stations, ATICs)*

10. *Agri/Hort/Flori/ Seri/Jute/Api Extension (ATMA) – ATICs, Farmers Clubs etc.*
11. *Livestock Extension (LTMA), ATICs, Farmers Clubs etc.*
12. *Fisheries Extension (FTMA) – FFDA, BFFDA, ATICs, Farmers Clubs etc.*

The paradigms of agricultural extension, ipso-facto, include: (a) Technology Transfer, (b) Advisory Work, (c) Human Resource Development, and (d) Facilitation for Empowerment. These 12 components, as above, shall revolve around Farm Extension (SMART FARMER, SMART FARMING, SMART VILLAGE) architecture.

As of now, the farmers are experiencing the ATMA (component 10) and the KVK (component 9) institutionally through India at district level. AgriTech StartUps can come up in these 12 components to provide “**farming as a service**” (FaaS) to the farmer producers through their FPOs and Primary Agricultural Cooperative Societies (PACS). Following suggestions are worth considering:

1. *In Outreach programmes, Extension System is to popularise extensively “success stories of farmers who have demonstrated profitable agriculture” for inspiring and motivating other farmers, through the existing vast network of Television channels, Radio and Print media.*
2. *Creation of a Central Agricultural Advisory Services (CAAS) sub-sector wise to provide a decentralized, pluralistic, contract-based agricultural advisory system to improve farmers’ productivity and livelihoods;*
3. *Dissemination of regular production and sowing area updates for crops: The Government already knows the minimum area required to avoid production shortage. With satellite imagery, it is possible to know the progressive coverage area on a daily basis. If a farmer is provided with the former and later date during the sowing season, he will know exactly to plant and avoid over production, and also to overcome possible Demand-Supply constraints;*
4. *Mapping of PACS with Farmers in the Village and Acreage of farm land;*
5. *Enhancing use of “ICTs in Agripreneurship” through Quality Certification, Product Traceability*

- and Online Skill Development Certificate Courses, etc.;
6. *Bringing out attitudinal changes for*
 - a. *Innovative initiatives for ensuring fund contribution in 'ICT applications in agricultural research & extension' from private sector through Corporate Social Responsibility (CSR) mechanism, and*
 - b. *Designing ICT interventions as per type of agroecosystem scenario i.e. irrigated, dryland or peri-urban;*
 7. *ICT application for convergence of research, extension and resource centres so as to facilitate farmers to get "Single-Window-solution" for their problems;*
 8. *Operationalisation of Direct Learning Opportunities (DLO) - ICT enabled Life Long Learning of Farmers (L3F) PROJECT;*
 9. *The delivery of services to farmer shall be based on "Watershed Model" (many inlets but one outlet), wherein the Block Level Agricultural Office (BAO) shall be converted to function as "Farmer Service Centre" with Government notified "Citizen Charter";*
 10. *Development of Natural Resources Accounting using GIS technology by associating "geographers" in each Panchayat, to be the basis for agricultural and rural development planning and programmes.*
 11. *Capacity Building of Block Level Officers of Agricultural Departments (Agriculture, Horticulture, Floriculture, Marketing, Animal husbandry and Fisheries etc.) and Rural Development Departments, on Integrated Land Use Planning for sustainable agricultural and rural development, on priority basis.*
 12. *Farm journalism is an integral part of the agricultural extension system and its growth is directly proportional to the performance of extension processes, coverage & impact/adoption.*

There are numerous field studies indicating that 60 per cent of farmers do not access any source of information for advanced agricultural technologies resulting in huge adoption gaps. Both Farmers and Extension Workers are to transform as "e-Farmer" and "e-Extension-Worker" in days to come, by appropriately utilizing ICT facilities viz., Telephone,

Mobile, Radio, TV, Films, Agriculture Magazines, Internet, Social Media. It requires to undertake a massive "e-Literacy Campaign" for educating Farmers and Extension Workers for adopting ICT tools in Extension for "Access to Information". "Information to Access" – Creating of appropriate "location specific" Contents and Advisory system is challenging.

India is bestowed with large number of Agricultural Research Institutions, Agricultural Universities and Private R&D generating varieties of technologies (including location-specific). Changing role of extension in this context, extends beyond transfer of technologies, to perform activities which empower farmers to adopt latest technologies, resulting in enhanced production, productivity, profitability, and thus uplifting the living standards of farming families.

PoultryMon is a an operational example of **Smart Poultry Farming** and is hatchery/Farm information system created to deliver real time, consistent process monitoring through every level of hatchery/Farm operations, using IoT approach to deliver detailed hatchery monitoring, management, analysis and reporting on mobile [8]. Salient features of PoultryMon include Internet of Things (IOTs), Dashboard, Data Analytics & Reports, Alerts and Notifications, IT/OT Integration and Security. This Farm Extension 4.0 technological framework has the capacity to facilitate development of about 2.25 Lakh deep AgriTech StartUp in India, one per each gram panchayat, which can ease out supply-side lock in logistics of Agricultural Value System.

Sustainable Natural Resources Management (NRM) is the backbone for the food security, nutrition security and environmental security at grassroots. This means that "environmental geography" has to gain its importance and to "catch up". This means requirement of about 2.50 lakh Geography Experts, one for each Gram Panchayat, to provide advisory services on Natural Resources Management, by maintaining spatial data system and non-spatial data system in the Cloud Network through BharatNet connecting India's Panchayats.

The proposed Farm Extension 4.0 Architecture can empower more than 140 million farm operational holders of the country, by adopting technologies viz., IOTs, Robotics and Smart Farming in villages, facilitating through AgriTech StartUps, Farmer

Producer Organisations (FPOs), and Agricultural Polytechnics and Agricultural Industrial Training Institutes (ITIs) for undertaking farming related activities in villages of India.

V. WAY FORWARD

Digital Platform Economy is emerging and impacts at SDGs of the United Nations. Digital Ecosystems are essential for Digital Transformation in the Digital World. The evolving digital economy is closely associated with several frontier technologies and fuelled by data: Blockchain, Data Analytics, Artificial Intelligence (ML & DL), 3D Printing, IOTs, Automation & Robotics, GIS, Smart Phone, Internet, Cloud Computing and Language computing etc. Further advancement and adoption of AI, IoT, Cloud Computing and Big Data Analytics have produced one of the most disruptive tools in Data Economy known as the Digital Twin.

Data is the new raw material of Digital Economy and Data is the foundation of better farming. Poor data may lead to poor AI solution. The Digital Agriculture Platform Economy in India is facilitated through the Agricultural Informatics Programmes at M. Tech and B. Tech Levels as of Shobhit Institute of Engineering and Technology (Deemed to-be University) Meerut (India). There is also a growing market for agricultural journalists and broadcasters/telecasters having formal education in **Digital Agricultural Journalism**.

During this COVID19 Lockdown Period, the Shobhit Institute of Engineering and Technology (Deemed to be University) have organised /planned a series of Webinars with relevant stakeholders to build ICT enabled (a) Mango Value Chain Project, (b) Potato Value Chain Project, (c) Inland Fishery Value Chain Project, (d) Jackfruit Value Chain Project, (e) Moringa Value Chain Project, (f) Banana Value Chain Project, through its Centres of Excellence (COEs) - Centre for Agricultural Informatics and e-Governance Research Studies (CAIRS) and Centre for Agribusiness and Disaster Management Studies (CADMS). These “Digitalised Agricultural Value System” has been visualised to generate enough employment opportunities for migrant workers who have returned to their home States during this lockdown period, and also to fetch price realisation for farming community

through distant marketing within the Country. India is an agrarian economy and hence should develop as a digitalised agricultural economy at the earliest, on priority basis. The intent is as follows: -

- **Let us operationalise** the DFI-2022 Mission Mode Programmes on digitalisation of agriculture for empowering our farming community, by establishing Agriculture 4.0.
- Farm-wise Database and Farmer-wise Database are the two basic assets on which Agriculture 4.0 shall operate to minimise the crisis that can be created by a COVID-19 like situation in the future. **Let us create it** and provide accessibility to AgriTech StartUps and Development Stakeholders.
- Development of SMART Farmer, Smart Farming and SMART Village in an agricultural eco system, shall lead to a National Open Digital Eco System (NODE) of the country. **Let us achieve it**.
- It is high time that Rural India have Agricultural Polytechnics, Agricultural ITIs, and Agricultural Schools established. **Let us establish**.
- **Let us generate** Agricultural informatics professionals at M.Tech and B.Tech levels to make “farming” as a career option to rural youths.

Digital Technologies facilitate farming community empowered, progressively, through the newly evolving Agricultural Informatics discipline. Digitalisation in Agriculture in India shall be witnessing increased and unprecedented scale of application of IOTs, Robotics and Informatics, and has a promising outlook. The Covid19 Pandemic situation has facilitated adoption of digital technologies very progressively which will eventually be the stepping towards establishment of “e-Farmers” or “Smart Farmers” in India by 2025. The Process has begun.

Acknowledgements

The Author acknowledges the institutional support provided by the Chancellor and the Vice-Chancellor of Shobhit Institute of Engineering and Technology (Deemed to be University) Meerut, and Mr. Vivek Mittal, Director (HR and Strategic Partnerships) of the University for his organisational coordination, to participate online in the International Scientific Conference held at Plovdiv (Bulgaria).

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