Developing and cultivating an innovative Agriculture 4.0 farming System

Dr. Balasaheb Bhamangol[1] *Dr Abhijeet Kaiwade*[2]

ABSTRACT

Agriculture apps should go next up to roots of crops. As technology innovators look ahead to 2021 and beyond, we discover with a few ag-tech companies to gain insight into the trends shaping mobile app development for agriculture transformation. We need to address the key structural challenges, such as the lack of infrastructure, technology and financing, is crucial and success adoption of digital technology since these services will be available through mobile, apps and web. There is basic need of efficient re-inventions of existing agriculture farming practices, combined with tech-driven innovations. Promoting new technologies to strengthen India's agricultural research and productivity is one of the most important needs for agricultural growth .For disaster recover from the economic crisis, natural calamities ,farmers in India are progressively adopting smart farming technologies like Farming-as-a-Service (FaaS) , Food-as-a-Service (FaaS), Agriculture Drone-as-a-Service (DaaS), Equipment-as-a-Service (EaaS)and Software-as-a-Service (SaaS) models for Sustainable Agriculture domain to address the emerging issues. There is poor access to existing agriculture software application to all stakeholders of agriculture and there is no any unique software app having all FaaS available in single platform. In this paper researcher focuses on the importance to develop end-to-end innovative farming-as-a-Services. As technology solution for all agriculture stakeholders like farmers, start-up, Farmepreneur, governments, Agri-entrepreneurs, equipment suppliers, agronomists and IT vendors etc.

Keywords:
Farming-as-a-Service(FaaS),Food-as-a-Service (FaaS), Agriculture Drone-as-a-Service (DaaS), Equipment-as-a-Service (EaaS), Software-as-a-Service (SaaS)

1. Professor, D.Y.Patil Institute of Master of Computer Application and Management, Pune
2. HoD, Sadhu Vaswani Institute of Management studies for Girls,Pune 411001

I. INTRODUCTION

India is primarily considered to be a nation where agriculture and its allied initiatives are considered as the chief source of livelihood for more than 80 percent population. The share of agriculture in gross domestic product (GDP) has reached almost 20 per cent in year 2021 owing to resilience of farming communities amid the current diversities. Agriculture sector has been the only entity that has clocked a positive growth in the recent times and the consistent supply of staples has enabled to provide food security for Indians as well as Global citizens. Agriculture being the prime means of livelihood, there is a basic need of re-inventing the farming best practices, combined with tech-driven innovations in this segment to ensure sustainability and eliminate poverty and hunger. Promoting new technologies to strengthen India's agricultural research and productivity is one of the most important needs for a sustainable agricultural eco-system. To ensure efficiency, productivity, quality, volume and continuous supply of staples, farmers in India are progressively adopting smart farming technologies utilizing drones and robots. Subsequently with introduction of Farming-as-a-Service (FaaS), various models are being created to build sustainable eco-system to

address the emerging issues in this sector. The awareness, accessibility and availability of infrastructures, hard and soft resources to majority of Indian farmers is till date scarce and very poor and hence there is a dire need to introduce and propagate the thoughts, ideas, studies and researches with respect to implementation of Agriculture 4.0 the focus being information and technology enabled farming practices. In this chapter the authors focus on introducing relevant technology enabled services that will ensure economic sustainability, enhance food security through data driven decision making by various stakeholders like farmers, agri-business and agri-tech start-ups, farmpreneurs, government and non- government agencies, equipment suppliers, agronomists ,IT suppliers and vendors. The analyzed information will be used as a vantage by farmers to select precision farming practices to aid productivity, to empower personnel to provide timely assistance, and industries to implement real-time monitoring using sensors and devices. The chapter will help formulate concepts, methods, practices, benefits and introducing several case scenarios to effectively propagate the service mode of farming that will imbibe pay-as-you go model ensuring cost optimization and operational ease.

II. Agriculture Ecosystem

Natural ecosystems generally comprise thousands of species of organisms and therefore specific composite in their functioning. In contrast an agricultural ecosystem is comparatively artificial being changed and controlled by humans. An agricultural ecosystem is an ecosystem managed with a perseverance, typically to produce crops and animal foods. Agricultural ecosystems are designed by humans, and are based on the experiments and in of experience. The. Ecosystem processes within agricultural systems can provide services that support the provisioning services, including fertilization, pest control, genetic diversity for future agricultural use, soil retention, regulation of soil fertility and nutrient cycling. Thus agriculture produces more than just crops and foods. Agricultural practices have environmental influences that affect a varied range of ecosystem services, including water quality, carbon sequestration, pollination, nutrient cycling, soil retention, and biodiversity conservation etc..

III. Agriculture Ecosystem Services

Agriculture plays vital role in the entire life of human beings. Agriculture is the backbone of the economic system of an India. In addition to providing food and agro products, agriculture too provides employment opportunities to a very big proportion of the population. Agriculture is significant to human beings because it fulfil the basis for food as a basic need. It services human beings to cultivate the most ideal food crops and increase the right animals in harmony to environmental factors. It also assist humans to know the right way to use land so as to avoid disasters. Agricultural biodiversity provides humans with food and also cotton for clothing, wood for shelter and fuel, plants and roots for medicines, and products for biofuels and with livelihoods. Disciplined and controlled ecosystem, agriculture plays vital roles in both supplying and challenging other ecosystem services. Agriculture supplies all five main categories of ecosystem services — Farming Services, Provisioning Services, Cultural services, Regulating services, Supporting services while it also stresses supporting services that enable it to be creative. Ecosystem services processes of natural systems that directly or indirectly benefit humans and for social welfare. Agriculture ecosystem services

are the benefits that people to obtain the availability of adequate food and water, human health and well-being depends on these services and conditions from the natural environment. Ecosystems have lots of different living organisms that interact with each other. They are all important components of an ecosystem.

IV. Classification of agriculture Ecosystem Services

Ecosystem services from agriculture include regulation of water, climate systems and cultural services, as well as improved supporting services. Agriculture is a key engine of the Indian economy. It supports the livelihoods and subsistence of the largest number of people nationwide and is vital to rural development and poverty mitigation, as well as food and other farming production. The key challenge for the agricultural domain is to secure sufficient high-quality agricultural food, crop and production to meet people demand; conserve biodiversity and accomplish natural resources and improve human health and well-being. Improved demand for food and food crops requires careful management of biodiversity and agricultural ecosystems to ensure environmental health and ecosystem services producing more output with less land. Ecosystem will establishing wildlife habitats and dissimilar land cover on farms. Ecosystem experience has demonstrated that agricultural management systems and environmental are investments by farmers. Incentives and rewards for encouraging the agriculture development and use of sustainable agriculture food production systems.

Table No.1: Integration of Agriculture Ecosystem and Services provided(Page no :7)

India has the second largest population in the world and is considered by a comprehensive diversity in climate. Previously agriculture is understood as life leading activity with huge number of hidden unemployment in rural households, consequently the contribution from agriculture segment also been ignored and it was considered as a low-tech industry which has no potentiality to tackle more contribution to the economy and development. So utmost agriculture peoples are forced to migrate to nearby cities in search of work. The farmers are really heart and soul of the economy are now struggling all over the India to sell their production at an affordable cost. They work day and night to cultivate good crops, but most often they sleep with empty stomach.

The facts is that Indian agri Industry contributes to 13.7% to GDP. Provides foods to 1.30 Billion peoples and Seventh largest agricultural food exporter worldwide. Currently more than 52% of India's population is involved in agriculture.

There are many reasons for Farmer's financial distress. Some of them are as under-

1. Repeated crop failures
2. Lack of access to insurance credit system
3. Poor government support
4. Poor food security
5. Poor technology available for agriculture sector
6. Lack of availability of irrigation water
7. Unfavorable climatic conditions
8. Lack of transparency in supply chain
9. Inadequate and poorly distributed rainfall
10. Frequent crop failures

Due above issues there are increasing pressures from climate change, soil erosion and biodiversity loss, pest & disease and from consumers' changing tastes in food and concerns about how it is produced. While contemporary agriculture provides a large number of technology solutions, the outcome is not always

the same because each farm is unique: different landscapes, soils, available technology and potential productivity.

To respond to global change drivers such as population growth, changing dietary habits, and climate change. It is crucial for decision-makers to understand potential trade-offs between these goals to find a balance of human needs and environmental impacts. Other side in India old farm practices are based on the principles of sustainability, innovative, hard-working and entrepreneurial farmers. We as Indian require a shift in our approach and thinking towards agriculture transformational change and consider greatest challenges of the 21st century as –

1. Innovation & Technology in agriculture
2. Employment Generation
3. Sustaining food
4. Nutrition security
5. Adaptation and mitigation of climate change
6. Sustainable use of critical resources such as water, energy and land.

All these challenges underscore the need for a new vision for agriculture as we move forward in the 21st century.

The paradigm shift has to begin with changing the mindset of policy makers from production-centric to sustainability-focused. Unlike the green revolution, technological package under agro-ecology cannot be uniform. Each farm is unique. So, farmers should be exposed to some basic principles of agro-ecology and simple techniques, and then left free to experiment, innovate and implement what suites the local conditions.

The shift in viewpoint that this signals is simple, but fundamental. If we are interested in development, and if we agree that development is about change, let us worry less about the supply of new knowledge and technology from research and concentrate instead on the conditions needed to demand and use knowledge to bring about that change. There are now so many initiatives with an agricultural innovation component, many of them flagging their use of the innovation systems concept, that it is impossible to mention all of them here.

V. Agriculture 4.0

Agriculture 4.0 is a term for the next big trends facing the farming industry, including a greater focus 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

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In 2018, the World Government Summit published their report called *Agriculture 4.0 – The Future of Farming Technology*, in collaboration with Oliver Wyman. The report addresses the four main developments placing pressure on agriculture in the near future: Demographics, Scarcity of natural resources, Climate change, and Food waste. The term "Agriculture 4.0" has entered the public consciousness.

(Table No : 2)

To meet above challenges and grab opportunity we will require a concerted effort by governments, investors, and innovative agricultural technologies. Agriculture 4.0 will no longer depend on applying water, fertilizers, and pesticides uniformly across entire fields. Instead, farmers will use the minimum quantities required and target very specific areas. The farms and agricultural operations will have to be run very differently, primarily due to advancements in technology such as sensors, devices, machines, and information technology. Future agriculture will use sophisticated

technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. These advanced devices and precision agriculture and robotic systems will allow farms to be more profitable, efficient, safe, and environmentally

Friendly. Through smart data use, it's possible for farmers to better understand their output practices and understand what changes can generate the greatest value. Agriculture 4.0 is more than just a movement. The term has entered use as a catch-all term for the next step forward in agriculture: a smarter, more efficient industry that makes full use of big data and new technologies to benefit the whole supply chain.

VI. Conclusion

Innovative technologies are already disrupting the traditional norms of farming, with previously unaffordable mechanism and devices now accessible and regularly deployed on farms across the India. IoT based drones provide a third eye in the sky, investigation for pests in the field requiring further attention. The modern advances in sensor technology means robots, drones, Chabot are now able to use supplementary wavelengths in the variety to assess crops, pests, insect, weeds and sick crops from the air.

Blockchain like technology is also on the rise, creating an innovative mode of interaction in the supply chain. This technology eradicating the need for an intermediary. It doesn't end there. Blockchain can decrease inefficiency and significantly improve food safety and security. Traceability is also improved, with regulators quickly able to check the source of foods and detect the scope of any contamination issues and marketplace. These and other technological AI, Data Science, IIoT, Quantum Computing, RFID etc. Innovations are acting as a significant disruptor, driving change and greater efficiency for thousands of areas from agriculture like fishery, poultry farm, dairy farming etc. The awareness, accessibility and availability of infrastructures, hard and soft resources to majority of Indian farmers is till date scarce and very poor and hence there is a dire need to introduce and propagate the thoughts, ideas, studies and researches with respect to implementation of Agriculture 4.0 the focus being information and technology enabled farming practices. Smart agriculture software with artificial intelligence (AI), IoT, Data Science, Blockchain , Quantum Computing offers farmers a path to the extensive automation of manual agri work. This can help in the creation of large scale database of farmers, collection of data from farmers' fields over a period of time and enables the stakeholders to make data driven and precise decisions to boost productivity and efficiency.IT companies also plays an important role in redefining the agri sector through innovative solutions such as AI,Data Science, IIoT, Quantum Computing, RFID and - FaaS, DaaS, EaaS, RaaS, MaaS and make it more efficient through improved access to technology, capital and entrepreneurial skills.

The new wave of innovative technology goes to agriculture sector and it looks a lot like the tech disruptions which we are excepting everywhere tools like social networks to cutting-edge tech like self-driving tractor , farming is going digital, and stakeholders will have a lot of innovative solutions to choose from in the coming years.

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Table No.1: Integration of Agriculture Ecosystem and Services provided

Types of ecosystem / **Types of Services**	**Agro-ecosystem**	**Agro-forestry**	**Canal/Tank ecosystem**	**climate regulation**
Farming Services	Farming-as-a-Service(FaaS)	Machinery-as-a-Service(MaaS)	Food-as-a-Service(FaaS)	Robot-as-a-Service(RaaS)
Provisioning Services	Food, medical plants, fiber, bioenergy,	Food, timber, Medical plants, Fiber	silt collection, Food, fiber and	timber, medicinal plants, Fish, firewood, fodder
Cultural services	Agro-tourism, aesthetic, landscapes	Cultural and amenity	Festivals and other recreational	Ecotourism
Regulating services	Soil conservation, Air quality and climate regulation	Carbon sequestration, bio-drainage, natural hazard regulation, air quality	Ground water recharge, Soil and water conservation, flood control, surface	Carbon sequestration, waste assimilation, nutrient recycling, protection, shore-line protection
Supporting services	Biodiversity conservation, soil enrichment, wildlife habitat, soil fertility	Biodiversity conservation, nutrient cycling	Cropping diversity	Fish breeding nursery (ground)

Source: Compiled from seminar proceedings of ICAR-National Institute of Agricultural Economics and Policy Research

Table No.2 : Agriculture 4.0 service's

Technology Type	Category of Service	Device/System	Use Case
Internet of Things (IoT)	• FaaS • ADaaS • EaaS • RaaS • MaaS	• Drone • Robot • Autonomous tractor • Sensors • pH probe • Capacitance hygrometer	• greenhouse monitoring • Drip Irrigation leakage monitoring • Canal Water Supply • Plant & Soil Management
Blockchain	• FaaS • ADaaS • EaaS • RaaS • MaaS	• Farm Management Software (FMS) • Immutable ledger system •	• Farm Inventory Management • Agricultural Supply Chain • Microloans • Agricultural Subsidies • Payment from Consumer to Farmers
Artificial Intelligence(AI)	• FaaS • ADaaS • EaaS • RaaS • MaaS	• AI Sensors • AI Chabot's	• detecting diseases in plants • pests, and poor plant nutrition on farms • weather forecasting • improve crop yields • reduce food production costs
Data Science	• FaaS • ADaaS • EaaS • RaaS • MaaS	• MyCrop • real-time system • RFID chip	• Optimize their production cycles • Yield Predictions • Digital Soil and Crop Mapping • Fertilizers Recommendation