

A New Dimension of Technology for Agricultural Development - Analysis of Needs and Solution.

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Abstract

All stakeholders of agriculture industry need reliable information and knowledge about the phases of agriculture to manage them efficiently. The present technology modes are steering very little demographic dividend in agriculture. On the other hand, the number of population on land is increasing and the size of the average farm holding is lowered below one hectare.

Urbanization is increasing and by 2050, 25% of total population will be living in towns and cities. And the rural population is rapidly ageing and shrinking, which then will leave us in the scenario whether we have to look for the alternatives of manpower.

Improving the productivity and profitability of small holdings through appropriate technologies and market linkages is the goal of the development. The planning strategy must aim at channelizing the local initiative and local efforts backed by official support and technical As countries are urbanizing and incomes are rising, food expenditures are declining as a share of total spending. To help produce these other goods and services, farmers have to take jobs off the farm. Yet the process can only be sustained if productivity of labour in farming increases, through innovation in production as well as better access to markets to sell the surplus.

Keywords – Technology, agriculture, farmers, industry 4.0, sustainable economic activity productivity.

Introduction

Nowadays, all constituent elements of the future farming are rapidly developing with the main focus on the interaction of all stages of farming and the final product produced as much automated as possible with current technological progress. The 4.0 techniques will accelerate around the world, agro-bots are being practicing and will shortly take over the agricultural sector, perhaps in India, as it is a agro-based country, Agriculture is seeing rapid adoption of artificial intelligence and machine learning, both in terms of agricultural products and in-field farming. It occupies a key position in the Indian economy. About 65% of India's working population is employed in this sector. The Government has implemented various programs for increasing agricultural production. India's average GDP growth rate at present is 7.5 % and per capita income but the agriculture sector, which contributed 57 % of GDP in the early fifties, became less important and its share dropped to 17.5 % in 2007-08. Its performance continues to decline. And this can be improved only through optimum uses of resources. The literacy rate in the India is 65.38 %. Use of computers and Internet is increasing day by day in rural India. This is the outcome of the various ICT projects like Digital India and ICT initiatives. The numbers of Internet subscribers in rural India are increasing and it is approximately about 12 million Internet users.

Need For Help From Industry 4.0

All stakeholders of agriculture industry need reliable information and knowledge about the phases of agriculture to manage them efficiently. The present technology modes are steering very little demographic dividend in agriculture. On the other hand, the number of population on land is increasing and the size of the average farm holding is lowered below one hectare. Increasing population will result in increased demand for food. In coming decades, the world population is expected to grow by 33% i.e. from 7.6 billion in 2017 to 10 billion in 2050. This will eventually increase the demand for more food which will result in requirement of 69% of



¹ More food to be produced by farmers.² Farmers are getting trapped into a debt-cycle and as real estate rates continue to grow, the temptation to sell prime farmland for non- farm purposes is growing. Urbanization is increasing and by 2050, 25% of total population will be living in towns and cities. And the rural population is rapidly ageing and shrinking, which then will leave us in the scenario whether we have to look for the alternatives of manpower. Now in order to fulfill this huge void left, Agriculture 4.0 will act as a significant provider to the population.³

Improving the productivity and profitability of small holdings through appropriate technologies and market linkages is the goal of the development. The planning strategy must aim at channelizing the local initiative and local efforts backed by official support and technical advice to higher standard of economic activity in agriculture and allied sectors.

Importance Of Technology

In Farmers View:

The Indian farmers bear the burden of risks and uncertainty. Through correct information competent attitude of farming community could be more proficient to face any crucial problems. Farmers are losing lakhs because of delayed inputs of information which affects productivity. This leads to poor quality produce, inability to access competitive market and eventually food insecurity and vicious cycle of poverty. Industry 4.0 can play a significant role in addressing the challenges and play significant role in economic development and growth as it can bridge the critical knowledge gap between the farmers and stakeholders.

i) Availability of Inputs Timely:

Agricultural productivity will be sustainable and more profitable through its yearly produce that requires timely availability of inputs to generate and reap the profitable revenue. But it is unfortunate that Indian farming community could not get the required raw material or inputs of information

¹ (Matthieu De Clercq Anshu Wats Alviro Biel, 2018 feb)

² (Janet Ranganathan, 2013)

³ (Matthieu De Clercq Anshu Wats Alviro Biel, 2018 feb)

technology to make use in their fields accurately.

i) Farm Accounting:

When properly planned, Agriculture could be a boon for economic development. Therefore, farm business managers should plan the agricultural farming of given period in advance and take useful decisions. Farmers must learn to keep a record of each entry in the book, totaling, keeping monthly statements, and summarizing the financial data to be kept handy for consideration when even they incur loss or are forced to face any problem.

2. Economical & Commercial Importance of Agricultural Management and Development

i) Farm Productivity Indicators:

Farmer's financial statements are important tool to diagnosis and prescription for future planning for the farm business management. A desperate need is to nurture the same in prospective manner.

ii) Historical Analysis:

Recording and maintaining of information will guide the farmers for better and progressive development. The past analysis of overall production, pricing will lead to holistic development of rural India and agrarian economy.

iii) Farm Produce Price Policy:

The main objectives of the price policy for agricultural produce aim at to ensure remunerative prices to the producers for their produce. A comprehensive and integrated development policy with a view to encourage higher investment in production and processing of the farm products will help to develop standard of living of the farmers.

iv) Profit Oriented:

Profit making is any prime motive of any productive activity. Thus, farm decisions are not only based on costs of investment - yields or returns but also on expenditure on post-harvest activities and value added process.

i) Multi-Disciplinary:

Agriculture comprises multiple disciplines. It can help farmers and landlords in taking farming related decisions effectively while at the same time guiding them to make use-of facts and figures with detailed statistics developed by the governmental departments. Farm managers or landlords are warned not to ignore socio-political behavior of consumers, policymakers, economists. Environment and behavior of people should also be taken into account in this regard.

v) Applied Decisions:

Farming decisions are always controlled by people social attitude, values, ethics, goals of the farm managers and landlords. The skills of taking timely decisions by the landlords and managers will remain a significant aspect and a continuous process.

Comparative Analysis:

By the farmers, within the shopkeepers and other stakeholders of the business environment. A healthy comparison between the two farms, within the two states may help in selecting the best alternative by using all the sources of production in farming activities. Sharing of knowledge of the farming community at large. The Agricultural information has to be generated and applied, especially for small and marginal farmers, who require relevant and reliable information for improving, sustaining, and diversifying their farm enterprises. Agriculture also requires substantial knowledge has to be shared to and among farmers, including information about successful farming activities, latest technologies, pest control, disease outbreaks and new markets.

3 Employment creations⁴

i) Farming jobs are shrinking:

As countries are urbanizing and incomes are rising, food expenditures are declining as a share of total spending. To help produce these other goods and services, farmers have to take jobs off the farm. Yet the process can only be sustained if productivity of labour in farming increases, through innovation in production as well as better access to markets to sell the surplus.

ii) Market Access:

Information and communication technology also help in upgrading agronomic practices by facilitating extension, and importantly, it increases farmers' access to markets, and can hold their bargaining position, enabling them to get a better return on their produce. Greater market access and higher prices will in turn promote the adoption of productivity enhancing technologies to increase supplies. This opens up essential perspectives for rural youth to raise their income in agriculture.

iii) Higher yield:

The organic urban farms, use less water and land than conventional farming while producing 15 times higher yield, and encouraging urban population to get into agricultural investment.

4 Technological factors

i) Commercialization:⁵

Advancement in a new improved technology will help in more and high yield production of some of the leading exports from the country have like jute goods, tea, oil, cakes, tobacco, spices, coffee etc. By exporting them it will be possible to import in return the much required machinery and manufactured goods.

ii. Stabilizing the urban-rural gap:

The agriculture sector is mostly restricted to the rural areas, which eliminates the scope of participation of urban world. With the introduction of technology, the distance between the urban and rural shrinks, which gives more exposure toward the information technology which eventually benefits the agriculture sector.

5 Service Integration:⁶

Service integration is an approach to handle multiple suppliers of services and integrating them to provide a single facing front. It targets at rhythmic integration of services from various internal and external service providers into end-to-end services in order to meet the requirements. All the data can be integrated on a common cloud for easy accessibility. When all the services providers of the agricultural sector will be given a common front of reachability, it will benefit all the stakeholders of the sector. It will result in effortless information, support and benefits to the stakeholders,

Various Activities Executed By Farmers

Pre Harvesting Activities and Post Harvesting Activities as agricultural management and development –Managerial activities - Land preparation /Soil testing, Seed Management / Crop Planning, Fertilizers applications/ pest control mgt, Market rates /prices information, Rain and weather forecasting, Storage facilities Transport facilities, Info about Costing & Financial budget. Assistance in reducing manual efforts Information on Packaging / Processing and value added and financial assistance/ Insurance Facilities

⁴ (CHRISTIAENSEN, 2017)

⁵ (Jyoti Manjeet Yadav)

⁶ (Ritter, R. M., Oxford University Press)

Developmental Activities Include information on alternative source of income Information about demand and supply, Information about rain water harvesting, Organic farming practices, Information about Agriculture rights and Laws Information, Information about animal Farming Experiments in the farm while farming information about Government schemes and facilities Information about Exporting farm produce, information about contract farming Need of agricultural training. Information about successful farmers.

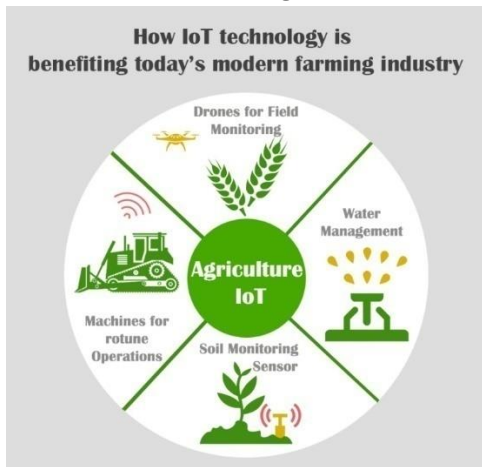
Current Scenario Of Technologies In Agriculture 4.0

The 4th revolution of agriculture has created two technologies, artificial intelligence which benefits in decision making ability and big data which helps in analysis of statistical data collected by different techniques. These technologies are used in agricultural activities for analysis of soil moisture, healthiness of crop, prediction of exact harvest time of crop, scheduling of pest control. System termed Internet of things (IoT) making possible to operate farm via remotely through mobile devices measures temperature, humidity, and amount of sunlight in production farms which increase the production with value added.

The Digital Transformation Technologies Are: -⁷

1. Internet Of Things (IoT):

The Internet of Things (IoT) technology opens a worldwide possibility of deploying IoT devices in agriculture with capability of sensing data remotely. The IoT is a sensor-based technology used to measure the data regarding Atmosphere, soil structure, intensity of fertilizers and its effects on the plants. The IoT minimizes the gap between virtual and real world. The IoT allows physical objects in world to become intelligent with online communications.



IoT



Agro Bots

2. Big Data Analytics:

“Big Data” denotes processing huge amount of data collected from ICT that leads to rapid decision-making data for improving productivity. This Artificial intelligence (AI), developed under industry 4.0, uses the previously stored data for decision making and requirement of agricultural sectors with preparation of schedule of these activities.

3. Drone technology:

⁷ (Shekhawat, Tejas G. Patil Sanjay P., 2019)

⁸ (DATAFLAIR TEAM, 2018)

Drone technology gives agriculture a high-end makeover. Drones can be useful throughout the crop cycle in Soil and Field analysis, Planting, Spraying, Crop monitoring, Irrigation and Health assessment. Drones use a variety of sensors for executing these activities, and the result is forwarded through orthomosaic maps for analysis.

4. Agro-bots:

The agro-bots operate in different fields of agriculture like production, processing and distribution. The robots specially designed under agriculture 4.0 are, the open-field robots that perform operations like irrigation and cultivation of crops, the facility robots that are used to monitor the yield of crops and controlling farming activities, and the livestock robots that are used to take care of animals. These robots enhance productivity through automation, unmanned farming and the ecofriendly farming promotion.

5. Blockchain Technology:

Block chain refers to system used to create everlasting, constant and clear record of exchange and processing. Block chain technology in agriculture involved smart contracts leads possible to stored data from its origin to the last customer end ensuring the legitimacy and origin of each transaction which helps to eliminate dishonesty in several actors in supply chain. Blockchain can reduce inefficiencies by improving traceability in supply chains.

6. Precision Farming:

The green revolution of 20th century was driven by blind use of fertilizers and pesticides. The new revolution will be driven by nanotechnology. The nutrients, fertilizers, pesticides and even water will be provided to the crops in a slow and sustained manner, resulting in a precise dosage to the crops. With the help of the sensors, AI and analytics, water requirement can be reduced to half. The wastage of fertilizers can be saved by 60%.

Solution – Interface With Recent Technology

Activities	Technologies that can provide assistance					
	Data Analytics	Agri-Bots	Drone Technology	Block Chains	IOT(Internet of Things)	Precision farming
Pre-Harvesting Activities	1.Seed management and crop planning 2.Rain and Weather forecasting 3.information about: i)Demand and Supply ii)Agricultural rights iii)Legal information iv)Government schemes and facilities v)Successful Farmers	1.Land preparation 2.Soil testing	1.Seed Management 2.Crop Planning		1.Land preparation 2.Soil testing	
Processes Activities	Information about: - i)Costing and Financial Budget	1.Fertilizer application 2.Pest	1.Fertilizer application 2.Pest control			1.Fertilizer Application

ies	ii)Financial Assistance iii)Insurance Facilities iv)Need for agricultural training v)information about exporting	control 3.Experim- entsin farm	3.Experiments in farm			o-n
Post-Harvesting Activities	Information about: - i)packaging, processing and value-added activities ii)Alternative source of income iii)Contract Farming	1.Assistan- cein reducing manual efforts 2.Assistance on animal Farming	1.Assistance in reducing manual efforts	1.Market rates 2.Price Informati on 3.Storag 4.Transp ort Facility	1.Storage Facility 2.Transpo rt Facility	

Initiatives By Government⁹

Government of India is actively taking serious steps to empower the farming sector with e-access. Various mobile applications as well as online portals are already created to help the farmers to gain the required information related to the agricultural knowledge. These portals provide farmers with a crucial information regarding various aspects of farming such as soil mechanics, market conditions, pre-harvesting as well as post harvesting procedures etc.

Kisan Suvidha App:

The main purpose of this omnibus mobile application is to provide farmers with the relevant information. The app is developed with such a user-friendly interface such that with the click of the button this application provides a farmer with the weather forecast of current day as well as up coming five days. This app also contains information regarding the dealers, market conditions, agro advisories, plant protection, IPM practices etc.

Mkisan Application:

The application is designed and developed by the inhouse IT team of DAC with the help of C-DAC Pune.It enables various stakeholders as well as farmers to obtain the advisory information sent by the exports and government officials.

Agri-Market:

This application allows user to get information regarding the crop prices within the 50km of device location. This application captures the location of the user by the use of GPS and fetch the market price of crop. This application also provides the user with the information of crop rates in nation as well as international market as well.

Crop Insurance Application:

⁹<http://mkisan.gov.in/downloadmobileapps.aspx>

This application is mainly used for the purpose of calculate the insurance premium for notified corps based on area. It also gives details on sum insured (normal and extended), premium calculation and payment details and subsidy information of any notified crop in any notified area.

Impacts And Threats Of Agriculture 4.0 *

I believe that this is just a start and absolutely this will replace the human job, but bringing autonomous robots beyond porotypes to actually working in the field has been an immense challenge. It is estimated that by 2050, the percentage of agricultural workers will drop from more than 50% to approximately 25.7% in India. An autonomous machine fills this void as it works more efficiently than a human worker and also reduces the requirement of manual workforce by 80% for conducting the fieldwork activities.¹⁰

The growing scarcity of the manpower in agricultural field is having negative impact on the growth of sector. However, the introduction of the modern and advanced methods of 4.0 will eventually be beneficial for the sector. However according to our calculation, full employment of these autonomous machines in 2050, will leave 30.23% of the total population of agricultural workers with no work. And the remaining will be engaged in supervising the machines, decision making and quality checks; no core farming will be done by the humans.

With the constant technological advancement and rapidly growing technology the world is adopting to the new trends agriculture 4.0 provides the new innovative way of doing agricultural processes in a much more efficient and fluent way

Cyber security is the most important mean while considering about the anything which involves internet or artificial intelligence. The agriculture sector is no exception to this as cybercrime is one of threats for agriculture sector.¹¹Data exploitation is always a major concern, Confidential data could be used against farmers on the commodity market, which for farmers is a zero-sum game.

Farming operations are inherently rural. Reliable rural broadband is a limiting factor for precision agriculture adoption, and loss of signal for any reason including net neutrality concerns is biggest threat for it.

Challenges In Adoption

Channel marketing strategies and viable value propositions for new technology are insufficient. This is significant challenge for the adoption of technology in agriculture sector as the promotion of such means is restricted.¹² The farming is all together restricted towards the traditional approach for several decades now to draw a drastic change in such a process and adopt the technical way of farming is a quite challenging task as farmers are prone to do farming process traditionally.

Indian farming is restricted to the rural area as about 82% of total farming is done in rural areas in order to develop the digital literacy for these farmers to acquire the required skill set for running the digital machines is big task which eventually take lot of time. The ability of the farmers to adapt to new

¹⁰ (Sushruth Sunder, 2018)

¹¹ (David Christian Rose Jason Chilvers, 2018)

¹² (Savan Patel, 2018)

technology from financial aspect is also a challenge. A farmer with large size of farm is interested in deploying new technologies instead of farmer possess small size farm denied because of more investment as compared to yield of farming. The current internet penetration in India is just 30%, compared to developed countries like China having 50% penetration and USA that tops the charts with 85% of penetration.

In India, different languages are used from one state to another. A total number of 750 languages are spoken in India currently. Due to this, implementing mass communication activities in our country becomes difficult, but in countries like USA for example, where 80% of population speak a single language -English or in China, where 70% of the population speak Mandarin, makes it whole lot easier compared to that in India.¹³

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¹³ (Rishi Nair, 2015)