

Sustainable E-Agriculture Knowledgebase for Information Dissemination to Develop Indian Agriculture Sector and Empower Rural Farmers

Rahul Singh Chowhan¹, Purva Dayya², Dr. U.N. Shukla³

Senior Research Fellow, Computer Science, Directorate of Extension Education, Agriculture University, Jodhpur, India¹

Ph.D. Scholar, Home Science, MPUAT, Udaipur, India²

Assistant Professor, Dept. of Agronomy, College of Agriculture, Mandor, Agriculture University Jodhpur, India³

Abstract: The goal of E-Agriculture is to enhance agricultural in addition to rural improvement by using various facts and verbal exchange techniques. The inspiration to use full-fledged potential of ICTs for agriculture capability building, and marketing has existed for a long time. It's far just most currently the dissemination of records started out harnessing ICTs extra efficaciously for better provider delivery to the farmers. ICT has increased sharing of knowledge from various sessions over radio talks and TV castings have stimulated agricultural improvements at some stage in the United States. We've got 29 States and seven Union Territories 644 District, 5,924 sub-districts, 6,50,244 villages and sixty eight.84% of the Indian populace is inhabited in rural areas as in step with the 15th Indian Census 2011. In this paper, we've got mentioned different factors of E-Agriculture within the Indian context.

Keywords: E-Agriculture; GDP; Communication Technologies.

I. INTRODUCTION

E-agriculture is the way by which aspired and expertise individuals impart insight of agricultural activities and understanding to various future strategies to another individuals and farmer communities, so that the updated knowledge can be used to execute farming operations using advanced methodologies [1]. Indian Agriculture contributes to 18.6 per cent of India's GDP, and approximately 59 per cent Indians derive their livelihood from the agricultural sector. Private sector initiatives like contract farming have commercialized the Indian agricultural sector. To enable Community members to exchange opinions, experiences, good practices and resources related to e-Agriculture, and to ensure that the knowledge created is effectively shared and used worldwide. But every technology possesses some features along with some loopholes. This paper gives some glimpse on the role & use of technologies in the area of agriculture. E-Agriculture involves the conceptualization, design, development, evaluation, implementation and application of innovative ways ICT in the rural domain, with a primary focus on agriculture. E-Agriculture is relatively a new term and it possesses the future scope to change and evolve as the understanding and opportunities related to this field grows. People around the Globe from few years from now will be carrying a handheld computer connected to the Web to get the information about the World at their fingertips [2]. E-Agriculture is becoming an evident stream targeting the improvement & development of rural agriculture through improved ICT processes. By encouraging the use of ICT and bringing it to the village can help farmers connect directly with agricultural scientists & researchers acting as advisors. Unlike urban laymen whose uptake of science is better with regular touch in media, but with farmers the invention and adoption of agro-scientific knowledge is highly dependent on daily productive activities, participation in Kisan-goshtis & melas and other socio-cultural interactions.

II. NEED OF E-AGRICULTURE

ICTs play a vital role in agricultural value chains as multifarious categories of ICT varies in strengths and weaknesses when applied to particular interventions [3]. The affects of ICT are diverse, and they influence market competitiveness in different ways. The few such ways are discussed as under:

- Reduced agric produce from lack of proper knowledge of storing & holding capacity
- E-agriculture can help reduce the insufficiency of customers to the rural farmers
- Share information related to seasonal crops, high yielding varieties & various crop planting technologies to the farmer
- Provide information on right time for plantation, appropriate spacing, crop rotation, water holding capacity of soil and other measure to the improve yield

- Provide the precise information on the herbicide tolerance, controlled use of pesticides and fertilizer supplements for better in order to preserve soil fertility, revamp crop development and crop quality [4]
- Provide market details like location, prices etc. to enable financial gain from selling to the farmer
- Know the suitable circumstances to grow crops to prevent floods, drought and other adversities

III. ECOSYSTEM OF E-AGRICULTURE

Use of E-Agriculture technology strengthen the conventional agricultural system and enhance the productivity in the agriculture value chain for everyone. Also, initiatives of E-Agriculture bring together a broad scope of indigenous and regional stakeholders to form a mutually beneficial value chain including addition of value to an article, production, promotion/marketing, and the providing after-sales service [5]. The role of E-Agriculture Value Chains is multidimensional and influencing the quality performance in various ways. The use of ICT in various agricultural activities at different stages is increasing in every components of the agricultural value chain with dissemination of information to farmers, particularly smart phones. The value chain concept of E-Agriculture Ecosystem has been stretched beyond identity of individual firms by connecting various distribution networks and adding up the following supporting factors in the growth of farmers:



Fig-1 Eco-system of E-agriculture

- Supports social businesses and small farmers providing grassroots agriculture domain and business support
- Provides Information and expertise consulting services
- Avail the technology and programs to reach rural and impoverished markets
- Connects with Governments and multilateral development agencies
- Supports to enable and increase rural outreach
- Create jobs, and helps develop partnerships with local businesses
- Easy handling of Bank related information for betterment of agriculture like crop insurance, subsidies etc. for entrepreneurs and farmers [6]
- Establishes communication with Universities and agriculture extension systems to strengthen advice and technical support related to farming
- Helps in taking online trainings and capacity-building for entrepreneurs

- Updates with new research and development projects designed to solve problems faced by farmers
- Use of Drones can provide more precise and periodic information on field crops at different landscapes
- Drones may also help farmers to get early warnings of problems anywhere in their fields providing sufficient time to respond
- Connects directly to markets suppliers, commodity markets, aggregators to sell best class products
- Also helps to access and evaluate new business models
- Allow subscriptions to various online communities, organizations, discussion forums, rural tele-centers, government and NGO-run agriculture service centers to help and promote entrepreneurship

IV. SIGNIFICANCE ROLE OF ICT FOR THE IMPROVEMENT AND STRENGTHENING OF AGRICULTURE SECTOR

ICT relates to the hardware and the software within IT but also broadens to telecommunications (telephone lines, wireless signals & devices), audio visuals and storage to store, transmit and retrieve information. ICT is now more used because computers technologies and telecommunication has integrated stressing on unified communication systems with the use of Skype, email and instant messaging [7]. Anything that helps people communicate and spread information like radio, newspaper, social media, internet, comes under the umbrella of ICT. The growth of smart phones and internet connectivity in remote rural areas has made ICT more popular.

The entire manual infrastructure has been digitized in field of agriculture. Integration of various hardware & software based tools has drastically reduced all paper and manual work into electronic form, for example like printing of passbook, paying using e-wallet, making e-salary bills, use of application software like MS Excel, SQL databases etc. This has also increased the IT opportunities within the agriculture field as IT people are required to handle various such related things within the firm. Advancement of communication technologies like Networking, Internet Technologies etc embedded with IT had made it possible to have stuffs like NEFT, Internet banking, Payment gateways, UPIs etc. for quick transfer of funds and access of mpassbooks from anywhere [8]. This also makes electronic technologies like Router, Server, Switches etc. to be its indispensable part.

The main concern of Agriculture and IT researchers is to improve value chains by including ICTs, connecting farmers to e-knowledge, online market information and various web based financial services. ICT helps in promotion of women entrepreneurs from distant places by commercializing their conventional agricultural products and techniques worldwide.

An effective use of ICTs for purpose of agriculture may ameliorate the food production and productivity in India. ICT plays an important role in improvising overall growth of farmer. Any system applied for getting information and knowledge for making decisions in any industry should deliver accurate, complete, concise information in time or on time. The information provided by the system must be in user-friendly form, easy to access, cost-effective and well protected from unauthorized accesses.

The various contribution of technology is pointed as under:

- Using laser technology based tractors for leveling farm fields/agriculture lands that can help in optimization of various inputs such as water, seeds, fertilizers etc
- Using power generation modes like solar energy panels for taking water out of well, generating electricity, regulated and optimized by ICT
- Collection of location based information can be carried out using GPS. GPS receivers help in mapping of farm fields, boundaries, roads, irrigation systems, and problem areas (such as weeds in fields, diseases) in crops. The accuracy of GPS allows farmers to create farm maps with precise acreage for field areas, road locations and distances between points of interest. GPS allows farmers to accurately navigate to specific locations in the field to collect time based data like tested soil samples, growth of crops, monitored climate changes [9].
- Timely information on weather forecasts and calamities using ICT based Kisan mobile messages while farmers using smart phones may use weather forecasting apps for on time & exact update of weather conditions.
- Better and spontaneous agricultural practices through community center at villages
- Plantation of seasonal crop based on researcher's advice keeping in touch with e-manual on mobile app
- Online subscription to various commodity sellers for better marketing exposure and pricing
- Useful data and collection of information from genuine databases and web portal for farmers
- Bridging the gap between farmers and markets by linking to the Internet
- Promotion of farming technologies using interactive multimedia
- Training of Field Assistants and Farmer from distance learning mode education
- Reduction of agricultural risks and enhanced incomes being aware and updated through media
- Automatic milking systems are also the part of ICT. They are computer controlled stand alone systems that milk the cattle without human labor. The complete process of the milking is automated and controlled by an agricultural robot, a complex herd management software, and specialized computers. The data & various

measures such as quality, quantity, availability etc for each animal is collected & stored, individual tracking of cow can be done to examine it, and an alert system can intimate farmers/ operators for any unusual changes like sickness, vaccination, injuries, etc [10].

- Improved networking and communication by using websites like facebook, whatsapp etc to improve the facility of online-trading, e-commerce
- Better representation at various forums, authorities and platform to acknowledgement of any good variety
- Use of Information Technology for agricultural administration, extension activities, research & development, marketing & quality management of farmer’s business
- Getting live assistance on water usage, disease and insect information

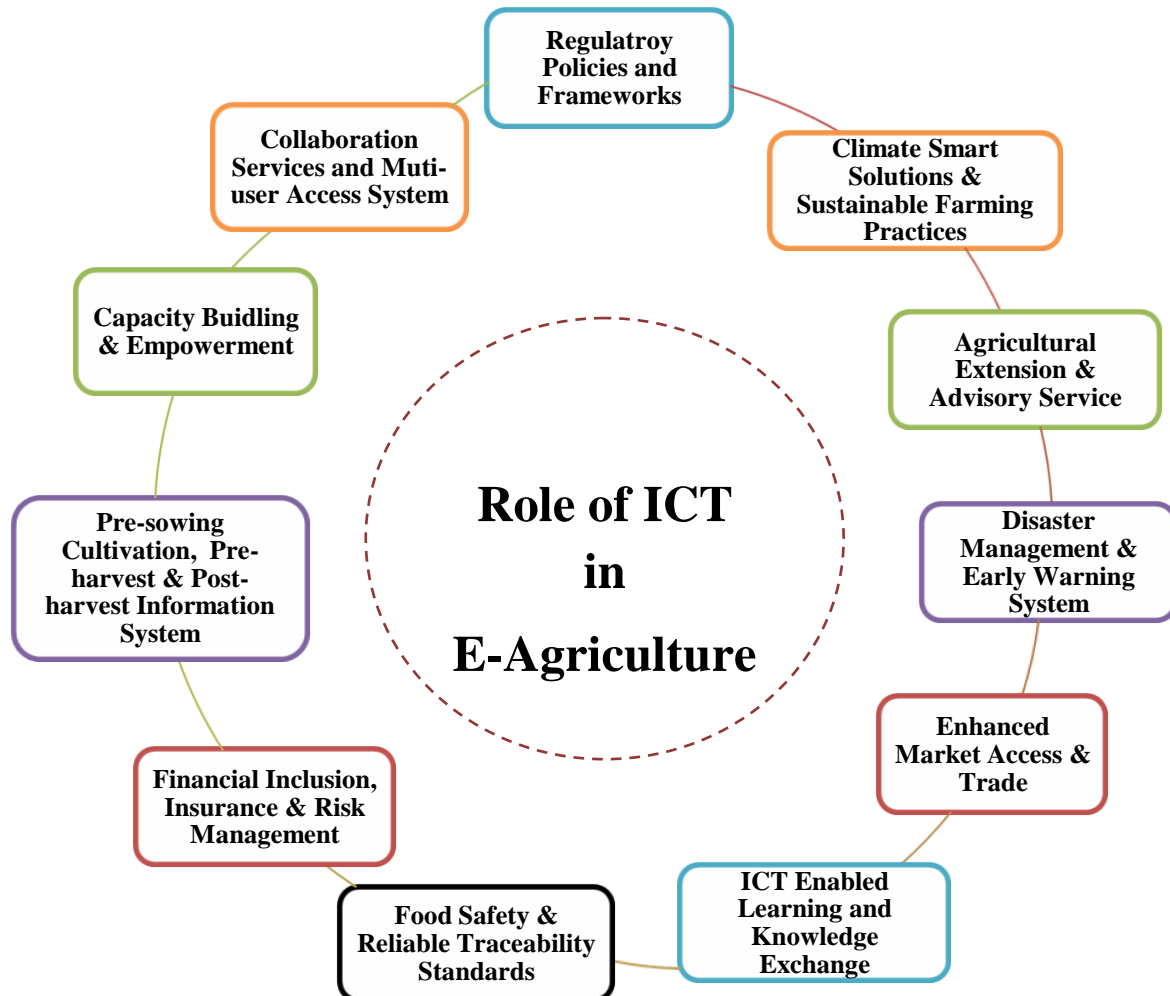


Fig-2 Role of ICT in E-Agriculture

V. FACILITIES BY ICT FOR TECHNOLOGICAL EMPOWERMENT OF FARMING COMMUNITIES

- ICT can be used as a strategic tool to support agricultural development at each stage of the farming life cycle
- ICT can serve as a catalyst for individuals to share knowledge, learn from others, and improve decision [11]
- ICT can empower rural communities, improve rural livelihoods, and build sustainable agriculture and food security
- ICT can help in early warning of pests and disease outbreaks, and providing information on cropping calendars and providing information of food stocks
- Capacity-building for extension workers in utilizing the ICT in agriculture is needed
- Direct connection to a trusted supplier of seeds, fertilizers and irrigation equipments
- Access to best practices of sowing, irrigation, land preparation, soil testing, compost making etc. [12]
- Online instruction on regulated use of fertilizer, pesticide, labor, and other cost cutting factors

VI. OPPORTUNITIES AND BENEFITS OF E-AGRICULTURE TO IMPROVE AND STRENGTHEN AGRICULTURE SECTOR

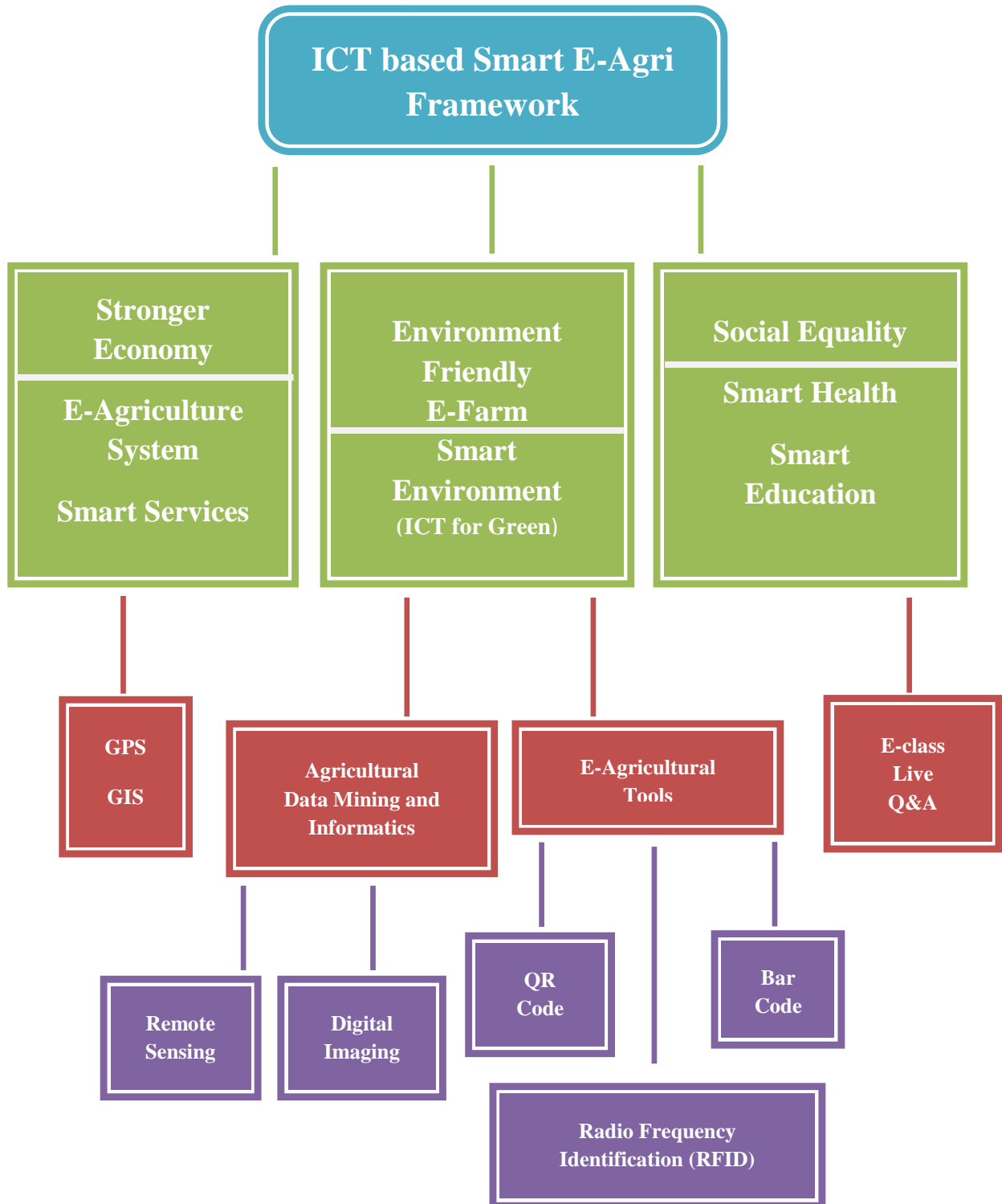


Fig-3 Smart E-agriculture Framework

The Global Digital Divide, a digital gap in terms of access to and use of ICT, is impeding the capability, efficiency and productive capacity of agricultural activities carried out by the rural farmers in India.

The involvement of ICT in agriculture has revolutionized the traditional agricultural techniques by bringing in digital imaging, digitized farm records, real time communication etc to farmers for daily purpose use at affordable prices [13]. ICT has benefits like more involved learning, personalized learning set based on interest, progress level etc., greater

community involvement, enhanced teamwork, upgraded global collaboration, increased transparency, reduced corruption, lower prices, socio-economic development, knowledge based society, decentralization of governance i.e. e-health, e-learning, e-commerce, e-healthcare etc., Electronic record for better crop information and many more.

The set of circumstances for small and marginal farmers of rural India can ameliorate the following capacity & efficiency development initiatives with introduction of E-Agriculture and use of ICT in their practices:

- Farmer friendly regulatory measures and opportunities to achieve agro-business and social benefits by constant technology based access to agricultural universities and extension offices [14].
- Governance & institutional reforms defining and directing the economic growth
- Self-analysis and management of native issues and possible solutions
- Reassuring banking services for Rural Farmers and user-friendly online support system
- Strategic follow-through of accountability of persons or Institutions dealing with small and marginal farmers
- Conducive legal & regulatory framework for the support of farmer
- Online report presentation of factors affecting the Farmers in various fields
- Implementation of comprehensive policies and strategies reforms
- Use of ICT for banking and financing purposes
- Revamp managerial obligations (planning, organizing etc) and functional structures by use of ICT [15]
- Enhancement of technological learning through agriculture hands-on projects providing direct exposure to the students within the universities and school
- Transparency in multilateral deals, agreements & supply chain
- Benefits to a wide range of stakeholders, from small farmers to businesses and governments
- Potential job opportunities for people with knowledge of ICT cum agriculture and adoption of new agri-business opportunities based on a proven & well-formed business model that reinforces technological assistance for farmers
- Offering technology based services to farmers like soil testing, compost testing, financing, logistics, farm machinery, better forecasting and others services for increased efficiency and reduced losses [16]
- Direct query solving sessions with the progressive farmers, researchers & entrepreneurs regarding crops grown, presence of nutrients in, water holding capacity of soil, and access to irrigation methods and inputs
- Training and explaining the way to improvise the productivity & income at lower costs
- Using ICT based devices like GPS, GIS etc for better risk mitigation against risks of pests, crop diseases, weather forecasting etc.
- ICT provides access to expert information, online services, and best practices worldwide along with inexpensive access to progressive communities of farmers
- ICT promises the economic growth and creates job opportunities in rural areas
- Avails the facility of greater food security along with potential to cost-efficiently source produce in bulk [17]
- Foster the connections with various rural communities, aggregated groups of farmers and government based organizations creating opportunities to address & sort out practical problems and sharing of best agricultural practices
- Builds up the ability to regulate market efficiency and finance by directly connecting buyers and sellers at single platform
- Easy access to information on credit-worthiness i.e. spending in financially responsible way and various risk management techniques to farmers
- Serving new customers who has no formal access even to reasonable priced products and forming stronger relationships with companies providing agriculture technology based tools reaching out to new customer base
- Satisfactory understanding of unfulfilled financial requirements which may help in creation of innovative financial products such as agri-business loans and insurance contractor [18]
- ICT also helps agriculture researchers to check and validate academic research based on various real-world matrices and applications

VII. MAJOR CHALLENGES WITH FARMERS AND FARMING TECHNOLOGIES

According to 2011 Agricultural Census of India, an estimated 61.5% of the 1300 million Indian populations are rural and dependent on agriculture. The number of farming households is 159.6 million. The % of marginal households with less than 1 ha of farm land has come down from 62.9% in 2000–01 to 22.5% in 2010–11. This indicates that marginal farmers have sold their land and moved out of agriculture, probably gone to cities in search of better jobs or better livelihoods. At constant 2011–12 prices, the share of agricultural GDP has gone down from 18.4% in 2011–12 to 16.1% in 2014–15 [19], [20]. Pre globalization era, 65% of our gdp contribution was from agriculture. Now it has come down to 35%, 15% manufacturing, 45% services and 5% other. The challenges faced by farmers lacking the use of technology are as follows:

1. Lack of Knowledge of Market Demand: In general, farmers/ producer are isolated from the majority of end consumers, particularly from the larger, more sophisticated, consumers (e.g. hotels, large restaurants etc.) and their

associated demand preferences (with regard to quality, size, quantities etc.). Also, they have little control over input costs or prices received for their goods [21].

2. **No proper channel of commodity selling:** Direct links to the customer can only be present where farmers sell & produce in local markets. Production quantities are highly dependent on the demand and capacity in the local market.
3. **Ineffective Price Strategies:** No proper price strategy for the value products which leads for a compromise at lower prices than the market price. Also, lack of organized retail and competing markets curbs the capability of Indian Farmers to sell the surplus and profit-oriented crops. The rural Indian farmer (or farmers from most of the developing countries) receives only 8% to 20% of the price paid by the consumers, the difference goes either to losses, lack of productivity, improper use of time & resources or to middlemen (dealers, wholesalers, distributors etc.). Whereas farmers from developed economies approximately receive 64% to 81% because of direct platform of interaction among farmer communities (commodity holders) and consumers [22], [23].
4. **Lack of wider scope of business:** Another factor that effects the low production is socio-economic backwardness caused due to illiteracy in rural workforce and inadequate finance and marketing support services for farm produce. Economical and financial deals for B2B or B2C strategies are inclined to be the lack knowledge of what is happening in the wider value chain.
5. **Inadequate Facilities:** There are inadequate processing and storage facilities which may lead to more waste of production. Developing economies like India do lack cold storage systems, packaging & delivering techniques and well-organized rural transport system [24]. The slow travel and ineffective hierarchy of traders delay in the delivery of goods to the end user which reduces the final accrual of the production resulting in low contribution in terms of pre-realized value of the product. Government must ensure various policies and services for safeguarding of produced outcome.
6. **Technological drawback:** There are GPS systems for better monitoring of farm fields. But GPS devices come with less battery life which may lead to loss of monitored data. Also there are high costs for integration of automation especially for novice farmers with less or no financial backup. Automated devices also need post-installation maintenance making more financial toll [25].
7. **Need of Skilled Labor:** The farmers have to hire skilled employees or he himself will require training program to interact with the automated system which may consume more efforts, extra-time and financial support [26]. Also, conventional techniques of cattle to plough lead to one of the lowest per-capita productivities and farmer incomes. This requires traditional mix technological farming and equivalently trained personnel.
8. **Insufficient agricultural infrastructure and support facilities:** Farmers are hesitant to adopt technology along with the traditional farming techniques. This is due to lack of awareness regarding beneficial agricultural methodologies among the farmers. This may also include lack of knowledge of ICT to harness its qualities for various agricultural purposes. India has bad rural roads connections that affect on time supply of appropriate inputs and transport of outputs. Also, improper irrigation technique leads to crop failure and regional floods, poor seed quality etc are other causes for 30% of wastage of production [27], [28].
9. **No Common ground of communication:** Inadequate use of Public-Private Partnerships because of no ubiquitous platform of interaction for the farmers is developed. Also due to lack of knowledge of ICT many farmers are unable to connect and participate in various online activities.
10. **Small Farm Holding:** On an average, the land holding capacity per farmer is less than 2.5 hectares and is also prone to fragmentation because of family disputes, etc. Again, over manning of such small land holdings results in camouflaged unemployment with little productivity of labor. Also, acquisition and promotion of modern technology based agricultural practices on small farm holdings is non-pragmatic and consumes high costs [29]. Disguised unemployment causes more people employed than what is required this causes a challenging problem to turn down the Per Capita productivity in farm sector.

CONCLUSION

In India, E-Agriculture can put use of ICT on the higher scope of Go-Green Go-Digital Resolution making India self-sufficient and independent in field of food, technology and their connection. This paper reviews diverse dimensions of the E-Agriculture and related use of technology in traditional agricultural practices. The speculation of ICT in the agricultural sector defines the economical growth and promises to spawn new openings and opportunities for trained person. ICTs can play vital role at all stages of lifecycle of a crop, whether it is pre-cultivation or harvesting and post-harvest use of technologies. The aim of E-Agriculture is to bridge the gap between various inventions and farming methodologies by using improved policies and supportive processes to spread contribution of ICT for rural and agricultural development, in order to achieve positive influence on rural livelihoods and production. Every system rides drawback with it. But It seen that technology gives much better advantages in most of the cases. The technological difference can be reduced by implementing better Platform of Practice (PoP) for farmers where farmers can be trained and taught about various solutions and functional and productive way of farming.

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