

Review Paper

Digital Divide & Agricultural Sector in Indian Context— *An Overview*

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Received: 10-02-2024

Revised: 25-05-2024

Accepted: 02-03-2024

ABSTRACT

Agriculture Informatics is dedicated in development in Agricultural sector using technology. Like industrial revolution digital technologies are changing the systems and building an advanced, smarter as well as environmental friendly agricultural system. In regard to, technological, and tools related concern it is noted that there are huge disparities in Agricultural technological services due to Digital Divide. Effective farm management possible with Agriculture 4.0 systems. Various digitalization, automation systems like artificial intelligence, robotics, big data and analytics, Internet of Things, cloud computing and virtualization, augmented reality, HCI, usability engineering and so on are being used in many pre-production and post production of agricultural systems. Agriculture become an industry now, and transforming also day by day rapidly. This transformation in agriculture system is highly depends on state-of-art technology. Technological systems availability, support and systems are not same in all the countries and regions globally or nationally. This paper is a theoretical and conceptual work dedicated in finding about the Digital Divide with reference to its basics and features, to gather the gap of the digital systems in agricultural sectors in Indian context.

HIGHLIGHTS

- ① The Digital Divide refers to the disparity in access to technology, tools, services and the internet connectivity among different populations.
- ① The implementation of digital technology is responsible for Divide in Agricultural Systems.
- ① Digital agriculture is one of the emerging areas in agriculture and the uses of digital technology in agriculture is considered as digital agriculture.
- ① The government should invest to establish the proper infrastructure, so that divide can be reduced in Agricultural Systems.
- ① Digital divide in agriculture is the gap or limitation between the farmer, agriculture market, and the uses of digital technology.

Keywords: Agro Informatics, Digital Agriculture, Digital Agriculture, Smart Agriculture, Agricultural Systems

The significance and role of data is increasing day by day, and it is deemed as alternative of oil. In agricultural systems precision agriculture play a critical and important role and there are increased ways in collecting data through the sensors, and drones as well as internet of things (IoT) gadgets (Anjana *et al.* 2024; Paul *et al.* 2020; Rose, D.C. & Chilvers, J. 2018). In a country like

India real time data related to the soil moisture is really important and there technology plays a leading role. Data driven irrigation techniques play an important role

How to cite this article: Paul, P.K., Chatterjee, R., Das, N., Saavedra, R. and Jena, S.K. (2024). Digital Divide & Agricultural Sector in Indian Context— An Overview. *Int. J. Soc. Sci.*, 13(02): 71-80.

Source of Support: None; **Conflict of Interest:** None



in healthy agricultural informatics practice. Internet of Things, Data Analytics and other allied technologies can play an important role in developing and enhancing agricultural systems. It is a fact that different diseases are responsible in destroying about 20–30% of India's agricultural yield. And here agricultural products and tools are effective in reducing this destroy rate. As far as digital technologies are concerned, it is fact that more than fifty percent of global population are now using internet services. And regarding mobile phone digital connectivity more than ninety percentages are connected digitally. The development and growth of mobile phone is changing the use pattern of this device in agriculture and other sector (Araújo *et al.* 2021; Behera *et al.* 2015; Ozdogan *et al.* 2017). The growth of digital devices responsible in game changing fact and this increasing uses rate of electronic gadgets are dedicated in development in agricultural systems. The use of drones, GIS, GPS related mapping techniques are dedicated in healthy and effective fertilizer and pesticides management systems including water management, remote sensors, etc. Crop quality, growth can be seen and managed remotely. Further in several post production related matters, water management and sensor verification systems and management, claims related to the crop insurance, etc. are effectively possible with Agricultural ICT. However the issues of digital divide is a big concern in proper Agricultural Informatics practice. Drones, and other electronic gadgets are dedicated in proper digital agricultural practices but lack of availability of technology, tools, services and devices are leading the gap between 'have' and 'have not' in agricultural information systems practices. It is an alarming issue that, though there are huge potentiality of digital agricultural practice but in many developing and undeveloped countries the investment and technologies advances is still low in different context. The agricultural eco-system will be enhanced drastically if all the stakeholders are give effort in ICT and Computing practice. A full-fledged agricultural eco-system effectively possible with all stakeholder's support (Bowen, R. & Morris, W. 2019; Khanal *et al.* 2021; Zhang *et al.* 2016). Long term investment is highly essential for removing the digital divide in agricultural sector, and there are requirements

in proper policies, guidelines and initiatives for the better agricultural practices. Nationwide digital inclusion is the need of the hour for the smallholder farmers. Understanding technology, solving price issues, making technology zone for everyone is the need of the hour. In addition to these corporate organization and private players involvement is highly essential for a solid and advanced practice of agricultural systems. There are companies who engaged in technological practice and apps development including services such as '*Digital Saathi*' which is an AI supported online services. Like these initiatives and stakeholders, Smart and Digital Agricultural Systems is effectively possible with support of different agencies such as—

- ❖ Initiatives in Non-Government Organizations (NGOs).
- ❖ Mobile Network Operators (MNOs).
- ❖ Social Enterprise, etc.

Among the Agricultural ICT initiative and practices, important are *Digital Agricultural Innovations and Services Initiative (DAISI)* and *GSMA AgriTech Programme*.

Objective

The paper titled '*Digital Divide & Agricultural Sector in Indian Context— An Overview*' is focused on following aim and objective (but not limited to)—

- ❖ To know about the basic of Agricultural Informatics and Agricultural Information Technology related gap including features and characteristics in brief manner.
- ❖ To know about the Digital Divide in basics including its features, and nature in brief manner.
- ❖ To learn about the matter from the existing works completed related to the Digital Divide in the context of Agricultural Systems.
- ❖ To learn about the technological gap, issues and concern in developing proper Agriculture 4.0 and Agricultural Informatics practice.
- ❖ To find-out the solutions, issues and concern of Agricultural Digital Divide in Indian context.

METHODS

As far as 'Digital Divide & Agricultural Sector in Indian Context— *An Overview*' titled paper is concerned existing research works have been consulted, analyzed and reported in this paper. In addition to journal paper few doctoral thesis and newspaper reports also been studied related to the Digital Divide, Agricultural Systems, and Agricultural Informatics, and reported here in this work. Since Agricultural Informatics is offered by different companies therefore websites of various agro-tech companies also been analyzed in regard to conducting this work.

Digital Divide: An Overview

The Digital Divide refers to the disparity in access to technology, tools, services and the internet connectivity among different populations. It is observed that different parts of the world have varying levels of technology, and not everyone has equal access to digital tools and technologies. These concept is known as Digital Divide. Digital Divide is the unequal distribution of the opportunities among the people (Khanal *et al.* 2021; Paul *et al.* 2014; Revenko, L.S. & Revenko, N.S. 2019). It is the unequal access opportunities of digital technologies. It makes the bridge between socio cultural demographic economic infrastructural and awareness among the people. The main objective of Digital Divide is to gather and process the information according to need. It plays a vital role to find the gap between the Technological utilisation in different areas, sectors, organisations or maybe in countries. Digital Divide refers to the difference between the resource allocation and resource utilization. It is the competition between the use of information technology (IT) and Information and Communication Technology (ICT). It is noticed that developing countries are convenient to use the digital technology where is the developing and the under develop countries I am not familiar to use the digital technology in the proper field accordingly. It has the potentiality to enhance the productivity of any country. It has also been noticed that the digital resources has been unequally distributed among the rural and urban areas. The urban areas has getting more infrastructure support rather than rural areas. Urban peoples are

using more technological gadgets than rural areas (Da Silveira, *et al.* 2023; Daoliang, 2018; Zhou *et al.* 2021). The implementation of digital technology is also dependent on the willingness of the administration. The implementation of e-governance is completely dependent on the policies of the administration. The complete e-governance system is divided into local level, state level and national level. Different levels of administrative bodies have their own role to properly implement and execute the system. Digital Divide is noticed in different areas. It can be classified (may refer Fig. 1) as follows —

- ❖ Social
- ❖ Cultural
- ❖ Infrastructure
- ❖ Demography
- ❖ Economy
- ❖ Concern or awareness

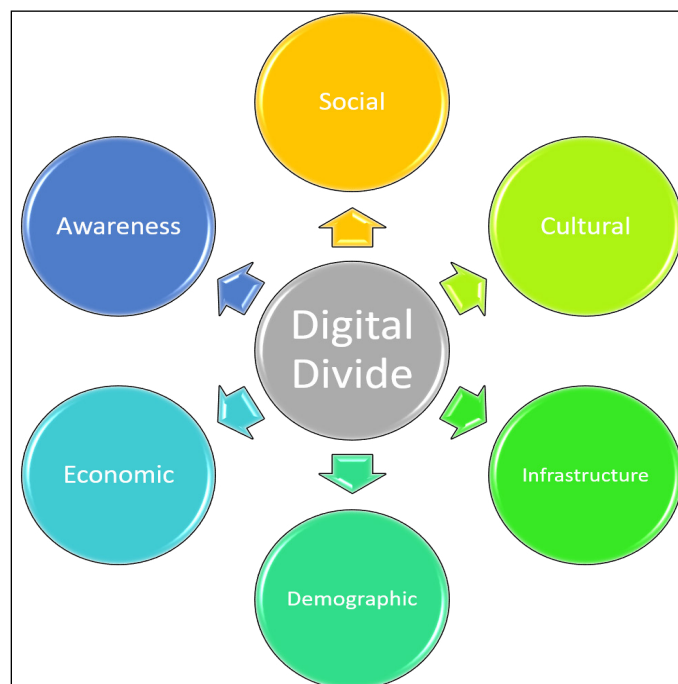


Fig. 1: Classification of Digital Divide

Agricultural Systems and Digital Divide: Few Aspects

Digital agriculture is one of the emerging areas in

agriculture. The use of digital technology in agriculture is considered as digital agriculture. The Digital Divide is noticed in digital agriculture. The development countries use digital technology in their agriculture production. Different types of electronic devices are used in agriculture production. Scientific use of digital technologies help to enhance the production (Kajol, R. & Akshay, K.K. 2018; Khan *et al.* 2023; Paul *et al.* 2014]. It is noticed that developed countries are following more scientific and methodical use of digital technology in their agricultural production. The Drone Technology, scientific monitoring of soil condition and need some nutrition in soil, requirement of water for the cultivation, use of pesticide, scientific monitoring of health of the plant and so on can be monitored by digital agriculture. It is seen that the underdeveloped countries are following the traditional cultivation methodology for the agricultural production. It is clearly noticed that there is an unequal use of technologies among the development countries and underdeveloped countries. It is necessary to adopt the scientific methodology of agriculture to get more production.

To reduce the gap of digital divide, it is necessary to increase the use of technology by the people. The administrative bodies and government should encourage the use of digital tools and technology. It is necessary to implement the e-governance system for the citizens. The government should invest to establish the proper infrastructure. It is necessary to build strong network connectivity for the high speed internet access. It also needs to invest a huge amount to build all the necessary infrastructure. It is necessary to build proper tools and to adopt different types of emerging Technology to reduce the gap and to make the bridges between different society, culture and peoples.

Agricultural Sector and Digital Divide: Indian Context

Digital Divide is seen in different sectors in India. It has been noticed that the unequal distribution of the resources has been present in India. It also has unequal use of digital technology by the different sectors. Unequal usage of digital technology is observed in the different states of India. Some States have strong

digital infrastructure than other states. Digital Divide is clearly noticed in the urban area and rural areas. Digital infrastructure is better in urban areas rather than rural areas. Economic conditions of the citizen create concern to use the digital devices. Some people have faced difficulties to purchase digital devices and they have some difficulties to recharge for their internet uses. Recharge facilities are unavailable in some remote areas. Digital infrastructure creates Digital Divide in India. The urban areas have comparatively good digital infrastructure and network connectivity whereas the rural areas have lack of digital infrastructure (Chisita, C.T. 2010; Javaid *et al.* 2022; Liu *et al.* 2020). Networking infrastructure is important to getting a high speed internet connectivity. It has been seen that some areas have 5th generation (5G) of internet connectivity but in some places very less internet facility. Some places have poor internet connectivity. The speed of the internet also varies between the places.

As India is a developing country, it is trying to adopt the emerging Technologies for the different sectors. India is trying to move towards the green governance. It implements e-governance system to facilitate the easy and smooth operation of Administrative operations for the citizens. Different levels of administrative bodies have used different e-governance. Each state government has different schemes for the citizens (Kaniki, A.M. 1988; Kovács, I. & Husti, I. 2018; Zhai *et al.* 2020). To manage different schemes different kinds of e-governance systems are available throughout the India. Each state is using their own e-governance mechanism to give the facility to the citizens. The central government also has their own e-governance system. The users of the e-governance system are spread across the entire nation. It also has different levels of users including citizens, local level, state level and national level. The digital India is a national level campaign by the government of India to encourage the citizen to increase the use of digital technologies digital Services. The aim of the Digital India campaign is to increase the use of electronic devices, enhance the internet connectivity & speed and improve the digital infrastructure in the nation. The digital India initiative is trying to reduce the digital divide among the different parts of the country.

that includes urban areas, rural areas, hill areas, forest areas and so on.

India is trying to implement the digital technology in different sectors. It encourages the use of digital technology by the citizen of India. Digital Divide is seen in different sectors where the digital technology is implemented. Digital device is noticed in the implementation of education 4.0, industry 4.0, digital agriculture, digital waste management, digital Health Care, entertainment industry and so on (Klerkx, L. & Rose, D. 2020; Madaswamy, M. 2020; Rotz *et al.* 2019). In each of the fields it is observe that there is an unequal number of user who have use more technology based task rather than others. There is a lack of awareness among the people to use the digital technology to perform some task.

Lack of Technological awareness limits potentiality of the user of the system. A Technologically skilled person is able to operate the digital devices efficiently. It gives the benefit to the user to use any system more effectively. To reduce the Digital Divide in all sector it is necessary to give proper education and training to the user of the system. Lack of awareness and lack of education and training deviate the objective using of utilisation of digital technology. Is also notice that Technology availability also create Digital Divide. It is necessary to update any system to get the maximum benefit. In real scenario it has been notice that there is a lack of technology of the system. It is also very challenging to select the proper tools for any system. For a single task many tools are available (Gómez-Chabla *et al.* 2019; Paul *et al.* 2019; Samadder *et al.* 2023). Different to have different facilities. It is very difficult

to select the appropriate tools to perform any particular task. Unequal access of different tools and Technology creates the Digital Divide.

Table 1: As on 31st March, 2024, the Telephone Subscribers in Million

	Urban	Rural	Total Subscriber
Wireless	634.47	531.02	1165.49
Wireline	30.91	2.88	33.79
Total	665.38	533.9	1199.28

Source: Official website of TRAI.

Table 2: As on 31st March, 2024, Tele-density in percentage

	Urban (%)	Rural (%)
Wireless	127.51%	58.87%
Wireline	6.21%	0.32%
Total	133.72%	59.19%

Source: Official website of TRAI.

Table 1 shows as on 31st March, 2024, the Telephone Subscribers in Million, Table 2 shows as on 31st March, 2024, Tele-density in percentage, Table 3 compare year wise Total Telephone Subscribers in Million and compare year wise Tele-density in percentage. Fig. 2 shows as on 31st March, 2024, the Telephone Subscribers in Million, Fig. 3 shows as on 31st March, 2024, Tele-density in percentage, Fig. 4 shows year wise comparison of Total Telephone Subscribers in Million and Fig. 5 shows year wise comparison of Tele-density in percentage. By analysing the Data and Chart it is clearly visible that Digital Divide is present in Urban and Rural Areas in India (Klerkx *et al.* 2019; Paul, 2015; Tewathia *et al.* 2020).

Table 3: Comparison of year wise Total Telephone Subscribers in Million and comparison of year wise Tele-density in percentage

Category	As on 31 st March - 2017	As on 31 st March - 2018	As on 31 st March - 2019	As on 31 st March - 2020	As on 31 st March - 2021	As on 31 st December- 2023	As on 31 st March- 2024
Mobile Telephone Connections (in million)	1170.59	1188.99	1161.71	1157.67	1180.64	1190.33	1199.28
Mobile Teledensity (in %)	91.11%	91.51%	88.45%	87.22%	86.66%	85.23%	85.69%

Source: <https://www.trai.gov.in>.

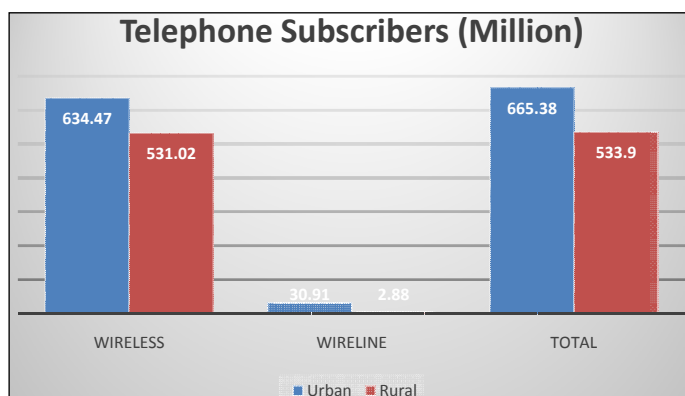


Fig. 2: As on 31st March, 2024, the Telephone Subscribers in Million

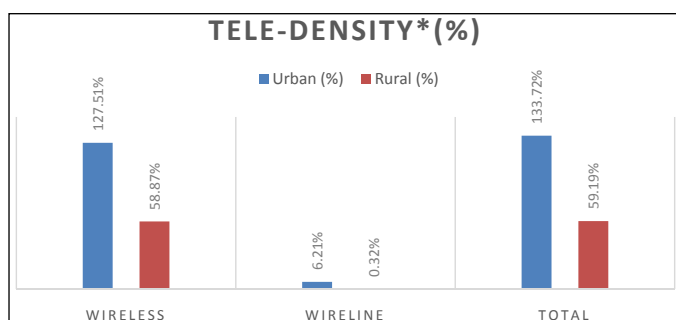


Fig. 3: As on 31st March, 2024, Tele-density in percentage

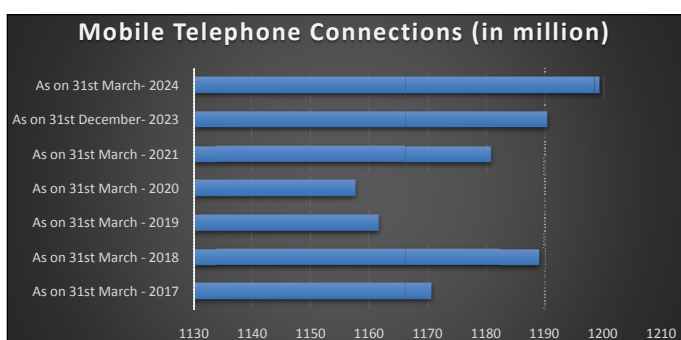


Fig. 4: Year wise comparison of Total Telephone Subscribers in Million

there are huge disparities in tools, technology and systems in Indian Agricultural Systems. Nowadays, technology and digitalization are the crucial in progress of the society, economy, and overall growth of the country. As the technology growing very fast, adaptation and implementation of the technologies become difficult. There are various barriers to impose

the digital technology in development of the agriculture sector. Agriculture is the significant sector to develop a society, state, nation, and economy.

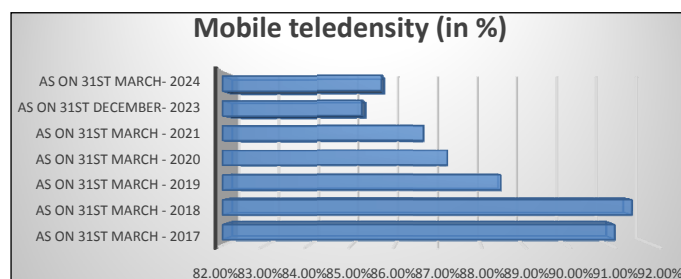


Fig. 5: Year wise comparison of Tele-density in percentage

Thus, Digital technology is highly in demand to enhance the quality, productivity, and sustainability in agriculture sector (Kumar *et al.* 2020; Upadhyaya *et al.* 2019). Digital divide in agriculture is the gap or limitation between the farmer, agriculture market, and the uses of digital technology. There are various factors effects in digital divide in India such as—

Data privacy and security

Digital agricultural system gathers information regarding the farming, weather forecasting report, food supply chain, and agriculture market. Security and privacy issues effect in digital agriculture system.

Poor Internet Access and connectivity

Pure internet connectivity is the major issues in application of digital agriculture system in rural areas. Various issues impact on the internet connectivity and accessibility such as financial constraints, social constraints, high implementation cost, and lack of interest. Therefore, implementation of high-speed internet connectivity in rural areas to impose the digitalization in agriculture sector is very difficult tasks.

Lack of Skills and Knowledge

As most of the farmer are living in the village areas, there is lack of literacy regarding digitalization and technology applications in agriculture fields. Farmer have no sufficient knowledge and skills of farming in association with advance digital technology. As the

technology changing rapidly, it is challenging tasks to enhance skills and knowledge of the farmers (Klerkx, L. & Rose, D. 2020; Zambon *et al.* 2019).

High Cost and Affordability

High cost is the factor to impose the advance technology and digital agriculture in the rural areas. The growth of agriculture impedes due to the economic imbalance and insufficient fund in agriculture. Therefore, sufficient required to develop growth of agriculture with the support of digital technology.

Lack in Technology Adoption

Nowadays, digital technology enhancement and transformation shifted rapidly and potentialities of technologies are growing continuously. Agricultural sector facing challenges in adaptation of advance digital technologies.

Age Limitation and Language Barrier

Age limitation is another factor to impede the application of digitalization in agriculture sector. The maximum age of the farmers is high that is the limitation in development of the digital agriculture. Language barrier is the limitation in progress of digital agriculture. Most of the farmers have lack in literacy. Here Fig. depicts the digitalization in agriculture sector with technology involvement (*Source: agmatix*).



Fig. 6: A concept on Digitalization in Agriculture Sector

Therefore, The barriers in digitalization of agriculture sector solved with the solutions including implementation of high speed internet connectivity

in agriculture, enhance digital technology skills and knowledge of farmers, Supply sufficient funds and build strong public- private partnership model in agriculture to generate funds in agriculture sectors, advance technology adoption, encourage and provides skills among young generation to involve in Agri -markets of agriculture sector.

Scenario of Digital Divide in Agriculture

Digital divide is the major issue in agriculture sector of India. There are various barriers in the growth of agriculture in India. Digitalization in agriculture is essential to minimize the issues of agriculture and accelerate the progress of the agriculture in India. According to the National Remote Sensing Center (NRSC) report, 182 million hectares are the planted fields in India. Therefore, digitalization helps to minimize the requirement of resources for farming which save water resources, minimize expenses, save agriculture fields. The Indian Council of Agriculture Research reveal experiment report in the 2021 that 20% to 30% crops are damaged by the pests and diseases (Javaid *et al.* 2022; Paul, 2016; Warren, M. 2002). Therefore, analysis of real-time data required to save the yields from destruction by pests and diseases. Internet and Mobile Association of India (IAMAI) discover that 60% of Indians access Internet and only 29% people out of 60% belongs from rural areas. According to this result large population of farmers not access internet. According to the World Bank report 23.4% people are from rural areas those have not proper skills and digital literacy. Therefore, all the factors impact on the progress of digital agriculture in India. 80% Indian farmers are belonging to poor and marginal family and have no sufficient funds to expense for implementing digitalization in agricultural fields in India.

Suggestive Measure for Removing Digital Divide in India

The digital divide is a global issue and there are variety of forms. Digital divide can be seen in diverse areas like education systems, healthcare, governance and business, etc. As far as Agriculture is concern some of the possible solutions in this regard as under —

Developing less cost technologies

As far as technologies are concerned it is observed that most of the available technologies are costly and difficult to bear by the rural farmers or the farmers who are from poor or backward economic status.

Less internet accessed Mobile apps

Many a time farmers may be unable to send and receive internet access and that may lead to the unavailability of the services. Therefore it is a need of the hour where less internet based mobile applications can also run effectively.

Technological integration

In Agricultural Informatics different kind of technological tools and applications are being used, and all these apps and its forms/ standards are changing depending upon its need (Kaniki, A.M. 1988; Zhou *et al.* 2021). Therefore a proper integration of such technologies and apps are highly essential.

Information kiosk and rural support

Information is the power and it is needed in rural and urban all types of farmers and agriculture associated professionals. Though, in rural areas more information support is essential in order to remove the digital divide.

Training and Skill development environment

A proper skill development and training environment is highly essential in order to avail and use of different agricultural technologies, applications and services and it may be workshop, training program or short term courses leading to Certificate and Diploma.

Language based Technological products and supports

In a country there are different languages, and farmers or agriculture associated professionals are used different languages depending upon their need, and requirements. Thus while developing the products, apps and web-portal customized language services may play a leading role in developing Digital Divide (Levkina *et al.* 2019; Paul, 2014; Zhang *et al.* 2016).

Knowledge Sharing among the Agro Professionals

A proper communication with farmers are highly essential, and in this regard new age apps and portal can be wonderful in regard to removing digital divide.

CONCLUDING REMARKS

Modern and advanced agricultural systems are truly associating with various technologies and tools viz. Database Systems, Networking Technologies, Web Systems and Management, Multimedia Systems. In addition to these few such as artificial intelligence, robotics, big data and analytics, cloud computing, augmented reality, etc. are impactful in precision agriculture more effective, efficient, safe, and environmentally friendly. As far as Indian agricultural systems are concern it is the need of the hour to introduce more data-driven methods for the enhancement of agricultural capacity, industrial agricultural systems, water utilizations, soil management, etc. Thus removing digital divide can lead such development. New finance strategies, digital literacy training, cheap rated agricultural apps are important and need of the hour and bringing such matters may lead the minimizing Digital Divide. A futuristic agricultural system with removing Digital Divide further possible with following initiatives—

- ❖ More women need to connect for better and advanced agricultural information systems development.
- ❖ More fund in technologies, systems and apps are highly essential and need to bring in agro-tech sector.
- ❖ ICT policies need to modify and rectify as per the requirement of the time and agro industrial are essential.

Digital Agricultural system is essential to bring based on rural and urban areas. As per data of IAMAI out of sixty percentage adult online users only twenty nine percentage are lives in rural areas. Thus it directs that a majority of the people have not utilized internet services. A World bank survey reveals that 23.4% of Indian adults are living in rural areas and having lack

of knowledge in digital literacy. Therefore farmers from rural areas are having problem in uses of digital tools, devices and technologies. Thus proper measures can be taken in order to avoid such issues and problem.

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